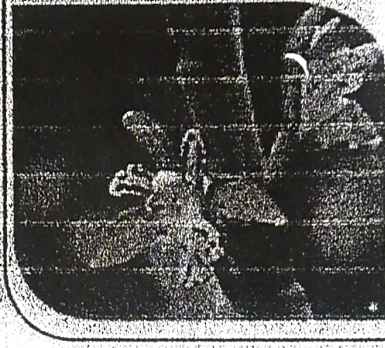


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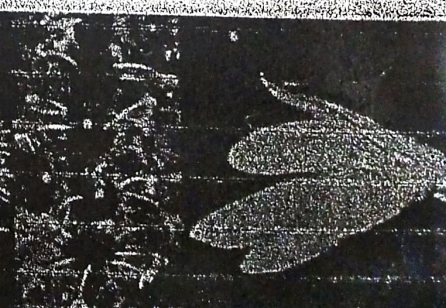
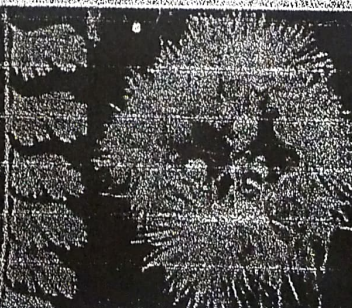
Edited by:

Lal Ji Singh

Vinay Ranjan

Sahma Babbar

Vol. I



"New Vistas in Indian Flora" is an attempt to amalgamate recent researches in interdisciplinary branches of botany carried out in India. The book is divided in two volumes (1 & 2) and contains 45 articles covering a wide range of topics related to all the major plant groups like algae, fungi, lichen, bryophyta, pteridophyta, gymnosperms, angiosperms and on molecular taxonomy.

Articles on diversity of algae to angiosperm, medicinal plants, endemic plants, rare plants, alien flora, taxonomic review of genus & family, plants used in natural dye, Vedic plants, and DNA bar coding, are included in the two volumes; these articles would provide baseline information on plant diversity for framing effective conservation strategies. Each article is very comprehensive in approach and will provide recent researches outcomes in the respective fields.

The book will enhance our knowledge on various aspects of plants including conservation and sustainable management of biological diversity. The present volumes will be an ineluctable reference book and beneficial to student, teacher & researcher in the field of Botany and would surely inspire the researchers, policymakers, plants lovers and the public at large and will help us in scientific awareness, conservation and sustainable management of biological diversity.

ABOUT THE EDITORS



Lal Ji Singh, Joint Director (Scientist-'E') & Head of Office, Botanical Survey of India, ANRC has been working in revisionary, exploratory, and conservation studies on flora of India especially of Andaman and Nicobar Islands, plant morphology, anatomy especially aerial roots in dicots; he obtained D. Phil. in Botany under the supervision of Prof. D. R. Misra from the University of Allahabad, Allahabad; he has described more than 12 taxa new to science, various new additions to Indian Flora. The occurrence of aerial roots in 13 taxa, phloem wedges in roots of some Bignoniaceous Genera and vessels in some pteridophyte for the first time, an invention of eco-friendly reusable drinking Straw; made taxonomic revisions and systematic studies on the taxa belonging to the families Cycadaceae, Loranthaceae, Musaceae, and Zingiberaceae, phenology of 73 tree species of Andaman and Nicobar Islands for the first time; he has published over 118 research papers in leading national and international journals; he is member of various societies/committees; Coordinator of various research/training programme. Fellow of the Linnean Society of London (FLS), Indian Botanical Society (IBS), Association of Plant Taxonomy (APT), Andaman Science Association (ASA). Life member of Indian Botanical Society, International Society of Plant Morphologists, Palaeobotanical Society, Andaman Science Association and Plant Taxonomy; recipient of NET, award of honor by ASA (The Andaman Science Association), ASIAME (South Asia Thematic School), TOSI (The Orchid Society of India).



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CHAPTER

DNA Barcoding of Medicinal Plants

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ABSTRACT

Medicinal plants form a numerically large group of economically important plants, which are of high commercial value. During the last three decades, there has been a substantial increase in demand of herbal products worldwide. Most of the herbs in their dried, fragmented or powdered form are not identifiable by appearance, taste or smell and hence can easily be adulterated or substituted with some other herbs. Addition of adulterants and misidentified ingredients to the herbal formulations sold in the markets can pose a serious threat to the life of the consumer. Moreover, many medicinal plants in India are at risk of extinction mainly due to their indiscriminate collection to meet their increasing demand. Statutory provisions to check such practices cannot be strictly adhered to because of the limitations of current methods of identification. The correct botanical identification of these herbs is utmost important to prevent adulteration and/or substitution by other plants which could be ineffective, less effective or sometimes even harmful. Likewise, unambiguous identification and authentication of the plants is important and a very critical step for the management of endangered species and for the characterization of genetic diversity. Traditional methods of authentication by morphological, microscopic and chemical based tests cannot be relied upon for unambiguous identification of herbals. DNA barcoding, which is a robust, rapid and cost effective technique, offers a practical solution for the authentication of highly processed plant materials. The present chapter provides an overview of DNA barcoding, compares it with the traditional taxonomic methods, summarizes the progress made in development of DNA barcodes of medicinal plants and their use in authentication of therapeutic herbs sold in markets, and highlights the present limitations of the technology for its extensive application.

Keywords: Adulteration/substitution, DNA barcoding, Medicinal plants, Traditional taxonomic methods.

INTRODUCTION

According to the World Health Organization (WHO) a medicinal plant can be defined as "a plant which has been used for medical purposes at one or another time."

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CHAPTER 8

IoT-Based Smart Agriculture in India

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ABSTRACT

Proliferation of technologies can strengthen agriculture field for assessment of agriculture-related information such as water level, productivity of crops, soil quality, and proper fertilizers as per soil type. In fact, farmers can remotely access, receive updates of weather forecasts, and monitor their land through mobiles and computers. Furthermore, there is also a need to enhance skills and knowledge of farmers in harvesting so that excessive use of pesticides and fertilizers should not affect natural ecosystems and quality of food products as well. Thus, proper awareness of important information in agriculture, such as soil forecasting and weather forecasting, is one of few common problems for nationwide Indian farmers. For transformation of traditional agriculture to smart agriculture, the Internet of things (IoT) plays a crucial role in providing information to farmers about their agriculture fields. Monitoring of environmental factors can be done with the help of IoT-based devices and related environment. This chapter initially critically analyzes, assesses, and addresses the existing problems related to agriculture, and then, integration of sensor technology and its integration with the IoT have been studied and reviewed based on real-life existing problems. Furthermore, this attempt presents a solution for sustaining soil quality in varying weather conditions so that issues related to sufficient knowledge about the soil can be optimized.

8.1 INTRODUCTION

Agriculture is the back bone of India as it provides employment to over 60% of the population. In addition to this, food products such as pulses, rice, spices, wheat, etc., are also outsourced from India to worldwide. Therefore, agriculture plays a vital role in the economic development of the nation and contributes to making a country from developing to a developed nation. Furthermore, India is well known for its diversity in culture, religions, caste, traditions, and beliefs with a mixed compound of 28 states, nine union territories, geographical location $8^{\circ} 4'$ and $37^{\circ} 6'$ North and longitudes $68^{\circ} 7'$ and $97^{\circ} 25'$ East within an area of 3,287,263 km², where approximately 1,210,569,573 people are living. Due to different weather conditions (temperature, humidity, rain, etc.) and soil conditions (moisture, pH level, and nutrition level), Indian farmers are facing many problems, which is a very important and serious concern in today's scenario [1–3].

In the past few decades, numerous technological transformations have been observed in the area of farming, which are based on a technology-driven approach as compared to the old manual techniques. This scenario has led to smart farming—an emerging concept of integrating technology with agriculture in order to increase output with minimum efforts.

With the help of this new emerging concept, information such as soil, temperature, humidity level, rail fall status, fertilizers, storage capacity of water tanks, etc., can be easily obtained. In addition to this, farmers have control over livestock monitoring and growing crops performance. However, in traditional agriculture, extensive farming, use of indigenous tools, cattle raising, lack in harvest production, and use of the slash and burn method are important characteristics. Due to the use of the slash and burn method in the traditional approach, the organic matter from soil is reduced very rapidly.

There is a need to motivate small farmers and provide ways to boost crop productivity such as rice. Table 8.1 shows the current rice productivity in various states of India.

Most of the farmers here possess less than 2 hectares of land. Therefore, there is need of employing more technological tools to improve the crop productivity within limited resources, knowledge, and awareness.

8.2 LITERATURE SURVEY

For agriculture, soil, light, and water are important sources of productivity of crops. However, soil erosion continues to be a major environmental problem

with regard to land use in India. In fact, soil erosion is a big problem in India. Zaines et al. [13] have discussed about soil conversation issues in India. The authors have focused on soil degradation in Himalaya region, Indo-Gangetic plains, dry and arid regions, and coastal lands in India.

TABLE 8.1 Top 10 Rice-Producing States in India (2016)

Sr. No.	State	Rice Productivity (in million tons)
1.	West Bengal	15.75
2.	Uttar Pradesh	12.5
3.	Punjab	11.82
4.	Tamil Nadu	7.98
5.	Andhra Pradesh	7.49
6.	Bihar	6.5
7.	Chhattisgarh	6.09
8.	Odisha	5.87
9.	Assam	5.14
10.	Karnataka	3.95

Soil erosion on hill slopes, shifting cultivation, sheet erosion, ravine lands and floods, shifting sand dunes, wind erosion, and improper land management are major challenges in various agroclimatic areas of India. Thus, there is a requirement for various reclamation programs for efficient learning and training [14] and land use planning to improve productivity in limited lands. In 2016, India's total geographical area was 328.73 million hectares (mha), reporting area was 304.89 mha, and area used for agriculture purpose was 264.5 mha. The authors discussed that important combination of factors for soil degradation depends on various factors and equals 147 million hectares of land (94 mha from water erosion, 16 mha from acidification, 14 mha from flooding, 9 mha from wind erosion, and 6 mha from salinity). To enhance the production capacity of the ecosystem, there is a need to monitor the domain to restore vibrancy. For this, farmers require thorough information of farming cycle, market price, and current production level statistics along with available basic knowledge of each crop for in depth understanding. Mohanraj et al. [15] have discussed the benefits of information and communication technology (ICT) in agriculture sector and have presented the path of rural farmers to replace traditional techniques. In this chapter, comparative analysis between the developed system and the existing systems is discussed. Gubbi et al. [16] have focused on various Internet of things (IoT) devices, which will enable farmers to enhance food production by 70% by 2050.

An automated soil erosion monitoring system that works on the principle of measuring the soil erosion on the surface as well as the factors that affect the erosion process has been proposed in [15]. It works by measuring the ground-level changes, rainfall patterns, air quality, weather temperature, soil temperature, and soil moisture through remote communication (using ultrasound waves) and then analyzes the data for measuring the soil erosion. The authors have presented this automated system in Thasos Island, Northern Greece, where they have studied the impacted areas for erosion and collected data for environmental quantities to study soil erosion. They have used solar power supply, a special-purpose data logger and a remote communication unit to collect data. Such a system can highly benefit by incorporating the IoT system and practices. IoT devices such as sensors and microcontrollers can sense the surrounding data and communicate it over a network to the cloud. Thereon, the collected data can be analyzed easily for environmental factors and the soil erosion process. The IoT can provide a more robust and automated system to study the erosion factors. Such a system, if used in India, could prove to be an asset in increasing the productivity of agriculture to a large extent.

8.3 CURRENT PROBLEMS FACED BY FARMERS

In India, agriculture is the major source of income for about 47% of the population, contributing 16% to the national GDP. The economy of the country is highly dependent on the agricultural yield. In addition, it is also responsible for fulfilling the basic needs of food, raw materials, nourishment, and strengthened environment for the people. Even though agriculture is the main source of income for a vast majority of people in our country, there are many problems that are faced by the farmers on a daily basis leading to bad crop and eventually bad turnover for these people. A few of these problems can be observed in Figure 8.1.

A major reason for failure to produce a crop good in quality and quantity is soil erosion. Either the soil selected is not according to the expected output or the good soil gets eroded by climactic conditions such as rain or winds. Bad soil often leads to a low yield. Seeds are also the most essential input for attaining a high yield, but uneven distribution of good seeds in the market and lack of high quality seeds due to their cost often leads to poor input and hence equally poor yield for the farmer. In the current conditions, the change in climate over the years has led to an unstable and nonstatic environment for the agricultural field. Extreme heat across the world has led to a large fall

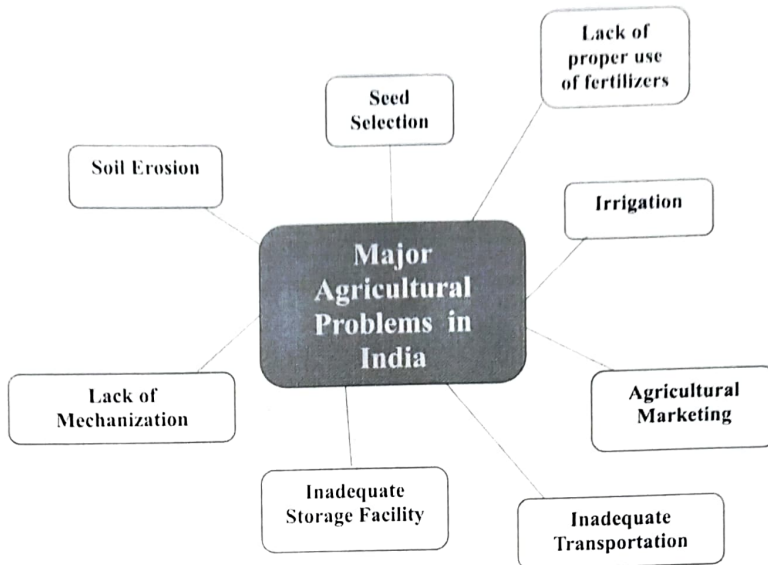


FIGURE 8.1 Major agricultural problems in India.

in the yield of the farmers. Erratic rainfall also causes major losses and crop damage. Irrigation is another most important aspect of farming, but despite the fact that India is the second largest irrigated country of the world after China, the irrigation facilities are not up to the mark, and only a small amount of the total cropped area is covered. Due to varied climate conditions and uncertain rainfall, irrigation becomes more important and should be taken care of more prominently if we want to reach high standards of farming and agriculture in our country. Most of the work in farming such as irrigation, crop sowing, soil monitoring, weeding, and transportation of crops is still done manually in most parts of India. Carrying out such tasks manually, using tools such as wooden ploughs, leads to a more time-consuming and difficult-to-implement process. There is also the added lack of precision, which leads to low yields for the farmers and wastage of human resources as well. Hence, there is a requirement to automate basic tasks in agriculture for maximizing output and minimizing human efforts. Employing machinery and related tools can highly benefit to help in avoiding wasting of labor force and add convenience and efficiency to farming methods to facilitate increased production. There is also a lack of storage facilities available to the farmers in India, which often leads to selling of the crops immediately after

harvesting and mostly at lower than expected prices. The income of a farmer could be highly increased if adequate storage is made available to them so that there is no rush to sell the crops fearing damage. The Parse Committee estimated the postharvest losses at 9.3% of which nearly 6.6% occurred due to poor storage conditions alone [10]. Transportation of crops is also a major concern due to the lack of good connectivity of cities to the village areas in the country. The existent roads are also not durable enough in changing weather conditions and hence are unusable many times, leading to failure of transporting of the crops on time without spoilage. In conclusion, we can say that the agricultural sector in our country suffers from a large number of basic problems, which should be rectified and dealt with on an immediate basis. One of the best solutions to counter these problems would be to deploy IoT methods in smart farming.

8.4 INCORPORATION OF IOT IN AGRICULTURE

In India, agricultural practices are generally carried out manually by the farmers, which have often led to low yield of crops. To resolve this, we are going to introduce the IoT in the field of agriculture to automate the process of crop monitoring and prediction.

The IoT is an enabling technology that interconnects various devices, sensors, and objects to transfer data within each other over a network with minimum human interference. It is used to build up a smart environment such as smart agriculture or smart transport or smart health, by utilizing physical devices such as sensors, microprocessor, controls, and various communication protocols. These physical devices are not enabled to interact with the Internet directly but can do so by using an IoT gateway. An IoT system, hence, is considered to be a network system by interfacing its environment with the Internet by using sensors, global positioning system (GPS), lasers, scanners, and other information sensing devices available.

Smart solutions to agriculture issues have been deployed in farming at various levels, and the IoT has already brought revolutionary changes in agriculture. Intelligent agriculture systems that deploy IoT practices can be depicted in Figure 8.2

An intelligent agriculture system first deploys a platform where the production of crops is maximized, along with an expert service providing platform for integrating IoT with farming practices. Finally, an online trading platform is used to advertise market and sell the yield at adequate prices leading to high profits.

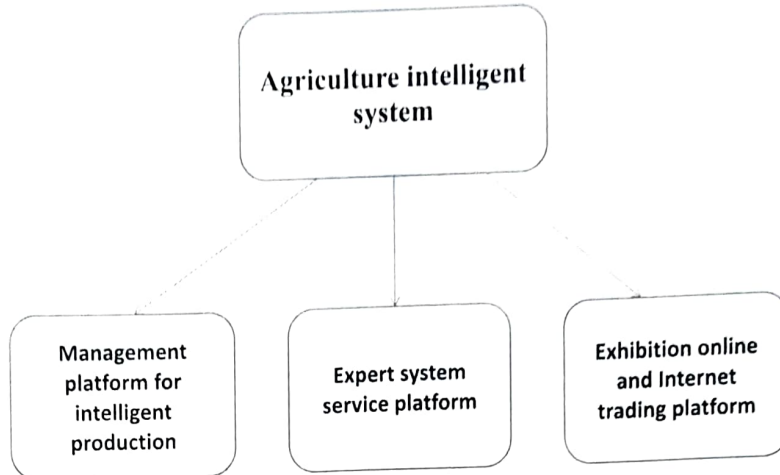


FIGURE 8.2 The modules of an agriculture intelligent system.

Agricultural sector is plagued by a variety of problems such as investment costs, lack of lands, limited knowledge regarding best practices, improper use of fertilizers, lack of good quality seeds and soil, limited storage facilities, etc. The IoT, if deployed in conjunction, can highly help the farmers tackle these issues to a large extent. The innovative methods of farming with the IoT can address the issues of irrigation, soil monitoring, climate change, etc., and increase the output, food safety, storage, and sustainability of the production. To accommodate a larger population, the demand for food will increase, and new techniques need to be designed to create more efficient agricultural production methods. Moreover, global climate is changing, and the growing conditions of the agricultural goods are being affected as well, so there is a need to create new agricultural production models with the focus on productivity and rational usage of environmental resources. In order to overcome variability, one of the biggest challenges to agricultural productivity, farmers need a broader understanding about the characteristics of the field and the development of the crops. Crop investigation and prediction is a time-consuming process, which, if implemented using IoT and data analytics, can be carried out in a much effective and precise manner. This shall lead to optimized yield, minimum costs, and reduction of environmental effect on crops.

Important parameters needed for such a system, such as soil moisture, pH values, weather conditions, etc., can be easily collected using IoT, and

an effective strenuous system is created for a better crop monitoring system that maximizes crop yield on the basis of the farm field. The main objective of the system is to improve the quality of life for farm workers by reducing high-labor tasks. Replacing human labor with help of IoT is an emerging trend across the world.

8.5 SMART FARMING SOLUTIONS

As we have already discussed, integrating the IoT with agriculture leads to a better crop production and lesser human intervention in the process, leading to an efficient and highly profitable area for the farmers of the country. Precision agriculture deploys IoT practices in the field of farming in order to ensure optimum growth, health, and sustainability (as shown in Figure 8.3). There are many ways in which IoT could be deployed in this field, some of which we discuss in the following.

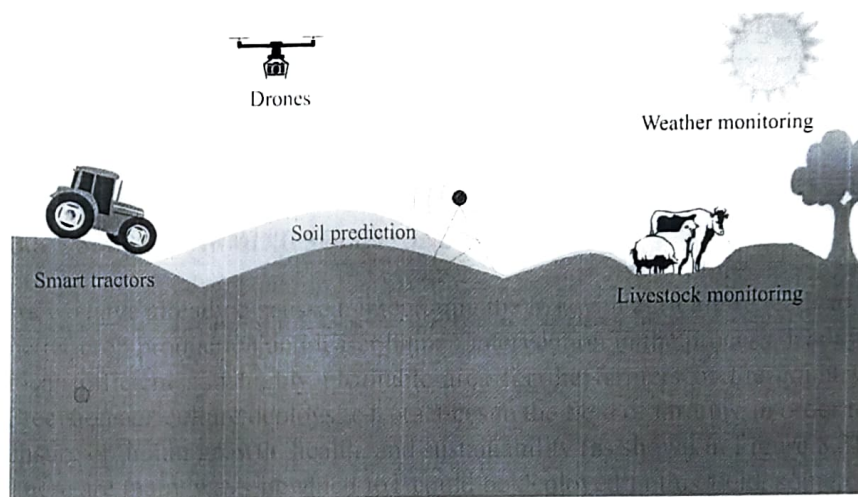


FIGURE 8.3 Applications of precision farming.

8.5.1 SOIL PREDICTION

Soil is the most important part of any agricultural practice, and proper use of soil for specific crop growth is a critical process that determines the actual yield of crops for a farmer. In the older farming methods, soil was planted

following the traditional approach of selection and sowing. Not choosing the appropriate soil for the intended crops and the actual weather conditions leads to bad crop growth and losses in the turnover eventually. The IoT can greatly help in predicting the soil by studying the climate of growth and the kind of crops required on the field. Data collected over a period of time can be accessed from over the cloud and used to predict what kind of soil would lead to maximum crop growth in the region. Precise soil prediction is an essential part of precision farming and smart agriculture.

8.5.2 WEATHER MONITORING

Climate is a crucial aspect for agricultural crop growth, and therefore, there is a need to keep track of the surrounding weather conditions, according to which the soil, water level, and crop types can be updated without relying on the imprecise meteorology predictions or manually checking the field for rains. Smart agriculture deploys various sensors across the farmer's field to collect data from the environment and stores it over a cloud. This data can then be used to study the weather conditions and select appropriate crops, soil, and irrigation needs of the farm.

8.5.3 GREENHOUSE MONITORING

Since greenhouse monitoring requires manual intervention for keeping track of the irrigation process, temperature, light, and humidity, IoT technology could be deployed for automating majority of this process [2]. Such a system can monitor the greenhouse atmosphere and alter the surrounding conditions accordingly to form an automated greenhouse environment for the crops. The greenhouse can be segregated into multiple areas that are managed through a base station. Sensor nodes are placed in these measurement areas to collect relevant information, which is then passed onto the controlling sensors to control or change the in-house environment parameters. This arrangement leads to an effective and precisely controlled greenhouse system.

8.5.4 LIVESTOCK MONITORING

Monitoring the hundreds of livestock on a farm can be a tedious process with keeping track of their location as well as looking out for any health

issues. This process is an important function to be taken care of, in order to carry out the proper management and growth of farming itself. Sensors can be attached to the livestock to track their location, grazing patterns, bodily functions, etc., which are then sent over to the cloud, from where the farmers can monitor and take appropriate steps to maintain their animals.

8.5.5 SMART TRACTORS

Smart farming is evolving to use more artificial intelligent hardware for agricultural purposes. The tractors on a farm are important for carrying out various tasks on the field based on the kind of equipment used. Artificial-intelligence-powered tractors can highly reduce the manual labor involved with farming by introducing driverless tractors involving minimum human intervention. Inclusion of technologies such as GPS, camera, and IoT connectivity would enable these machines to be autonomous to a large extent and diminish active human control required.

8.5.6 DRONES

Surveillance of the farm field is one of the most valuable pieces of information for precision program. Any kind of problems can be detected early and taken care of, before they lead to more serious issues. However, the traditional approach using helicopters, etc., does not guarantee accurate data collection across very large fields, and hence, smart farming uses drones—unmanned aerial devices—with sensors and built-in digital cameras, giving farmers a better view and more accurate representation of their fields. These drones can be used at on-demand basis and are easy to use and deploy providing real-time data with low investment. They are also a safe and reliable solution to farm management.

8.6 SOLUTION FOR SUSTAINING SOIL QUALITY IN VARYING WEATHER CONDITIONS

In varying weather conditions, soil can be protected by adding organic matter and careful management of fertilizers and appropriate pesticides [4–6]. Table 8.2 lists products that fulfill the criteria of soil protection.

TABLE 8.2 Products Fulfilling Soil Protection

Ref	Product Name	Product Feature	Product Solution	Facilities
[17]	Yuktix Products ColdSense	Monitoring Weather conditions & Asset, managing Pesticides	It conserves resources and enhanced yield and quality	Email Notification Text Message Maintains Dash Board. Live Display and sensor nodes are connected with Yuktix cloud through gateway via Ethernet
[18]	Weeding Robot	It uses the concept of digital image processing to extract the images from databases of related crops so that similar crops can be pesticides timely with robot arms	It reduces the cost of spraying pesticides in the cops.	Autonomous electric robot Dino with precision guidance(GPS and camera)

8.7 LIMITATIONS OF SMART AGRICULTURE

Although the IoT in agriculture would accomplish a great deal of comfort and increase in productivity on a whole, but there are several challenges that arise in implementing technologies in the field [7,8]. First, the lack of knowledge in this field would cause major apprehension in deploying such a system by a farmer on his land. The initial cost of implementation would also be a concern for them. If the system does work, the devices used in smart agriculture will have to be exposed to the harsh environmental conditions on a daily basis, leading to wear and tear and also needing high source of power to keep them in use all through the time. These devices will have to be programmed in a way that they can work on low power for long amounts of time without needing a reset or battery change, since such frequent changes would require shut downs of the stations entirely leading to loss of data. Most often than not, the farmers do not have access to a good-quality network in order for the interconnectivity to work as intended. Even if there is, the link quality at the networking level has also to be maintained in order to assure seamless transfers to and from the cloud storage for the sensors. The security, authenticity, and privacy of the involved have also to be maintained from any kind of internal or external attacks. The hardware for a secure system could cost even more to the meagerly earning farmers. Another consideration to develop IoT solutions in smart farming is to make the farmers aware of and

comfortable with using new technologies without any fear or apprehension. Due to lack of education and access to technology, this could be a major hindrance in implementing precision agriculture. In addition, all agricultural fields are different in nature and environmental conditions around them. Since our country is vast in geographical area, similar digitization of things is not feasible. Methodology and development would differ for different fields of study.

8.8 FUTURE SCOPE

Smart farming is the future of all agricultural practices, which would result in maximum yield and minimum effort. Farmers would be in better control over the process of growing crops, livestock management, irrigation, and soil monitoring. Although India has not yet implemented smart solutions in the agricultural sector extensively, many countries have already developed IoT-based solutions in the field of farming which India can also benefit from by incorporating such practices. The Kaa IoT platform, built in Miami, is an enterprise-grade IoT enablement technology that allows walking safely into the agriculture IoT field [9]. It works on the principle of tying different sensors and devices together and provides a variety of IoT-based services such as remote crop monitoring, predictive analytics for crops and livestock, climate monitoring, livestock tracking, and many other facilities. Dashboard is another agricultural monitoring tool using which a farmer can operate satellite imagery and weather data for a better visualization of his practices. LoRa is another Australian revolutionary technical advancement used for real-world smart agriculture deployment such as smart cattle ranching, ingestible cattle health tracker, soil moisture monitoring, cattle health monitoring, autonomous irrigation, and others. ThingsBoard, Inc., is a US corporation founded in 2016 with RnDcentre in Kyiv, Ukraine, that delivers robust and affordable IoT platform with out-of-the-box components and application programming interfaces for smart solutions. They have devised an interactive dashboard that can represent smart farming IoT data visualization embedded in the agricultural project as a smart farm solution. Other interesting IoT agriculture applications are also being used in various countries, such as CROPX's soil monitoring system to indicate the level of irrigation required by measuring moisture, temperature, and electrical conductivity in the soil, TempuTech's wireless sensors to ascertain safety in agriculture storage, CLASS's smart equipment for crop flow management, PRECISIONHAWK's drone for data collection, surveying and imaging in

the field, JMB's monitoring solution, in North America, to monitor pregnant cows, and many more. We can take inspiration from these smart solution applications in the future in order to effectively incorporate smart agriculture in our country.

8.9 CONCLUSION

The importance of agriculture in a developing nation, such as India, is high, and incorporating the concepts of IoT in this field can result in increase of agricultural yield to a large extent. Smart farming solutions such as drones, automated tractors, and soil moisture monitoring can ease the problems faced by farmers in the current manual setup [11,12]. We have also seen how the IoT is being used extensively for precision farming in various countries other than India and their applications in implementing solutions for precision agriculture. Although there are limitations of cost, resources, knowledge, and technicalities in putting up these concepts in practice, the overall benefits and ease of work for the farmers shall result in high yields, and hence, deployment of IoT in farming should be done in the majority of regions in our country. Such a scenario shall have a positive impact on the growth of the nation and economy as a whole.

KEYWORDS

- Internet of things (IoT)
- precision farming
- smart agriculture
- weather monitoring
- smart irrigation
- soil erosion.

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Lecture Notes on Data Engineering
and Communications Technologies 54

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Detection of Cache Pollution Attacks in a Secure Information-Centric Network



Akanksha Gupta and Priyank Nahar

Abstract The future of Internet architectures is information-centric networking structure, to solve the problems of content spoofing attacks in the current Internet structure, making it more useful for IoT-based applications. The ICN is structured with the Internet forwarding state technology which is an advanced technology with a comparative structure. In this paper, we are concentrating on the Internet forwarding strategy which uses data forwarding in NDN-based networking. It understands content priority and prefixes the content parameter and passes through the named data network to deliver the packet based on the demands. Also, future Internet router cache could face the problem of overflowing with non-popular content due to cache pollution attack (CPA); i.e., the router keeps receiving requests for vulnerable content. The detection and defense against such spoofing attacks are especially difficult due to cache pollution attack's similarities with every other consumer request. Based on the hobby content priority, named records networking accelerates the process and decreases the traffic to reach the request with low latency site visitors. We thereby address the present-day measures, arrangements and endeavors of the apparatus's applied clustering approach to discover and defend against CPAs. Finally, we recommend the improved decision tree method where once any attack is detected an assault table will be updated to report any abnormal requests. While such requests are nevertheless forwarded, the corresponding content chunks are not cached. We carry out the above technique simulations with the aid of ndnSIM.

Keywords Information-centric networking (ICN) · Content pollution attack · Clustering · False locality attack · Location distribution attack · Internet of Things · Smart agriculture · Attack detection

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1 Introduction

In recent years, several projects have been designed in promising architectures for investigating new network architectures based on named data networking. These futuristic approaches of architecture design integrate with information-centric networking (ICN). In general, these structures are designed to overcome the traditional IP-based networking issues which cause poor mobility, scalability and low-efficient content distribution. Additionally, the proposed structure has been the ideal solution for replacing the traditional TCP/IP-based Internet model. Moreover, it does support content-based Internet services. Content-centric networking (CCN) is one of the best examples for named data network architecture which carries out the communication via content rather than TCP/IP-based hosting [1]. Instead of host-centric architecture, the Internet future architecture has more features such as high dissemination power and traffic management as well. The future Internet architecture shall fulfill the lack of new content-based IoT agriculture applications. The main feature of the NDN is network caching in multipath communication with secure data retrieval in content-oriented IoT agriculture applications. Named data networking routers distribute large scale of content based on incoming packet. In order to fulfill NDN consumer request, the router forwards the subsequent content against flow of retrieval. These are the processes which improve the NDN in various sequences; efficient multipath communication, quick content retrieval, network traffic control and fault tolerance, though dense caching causes security problems against various spoofing attacks and cache pollution. Finally, network caches register malicious activities in terms of violating the content locality. Further, it will affect cache misses and latency of content response throughout the consumers. One of the main security features of NDN content-centric network is interested about what kind of content is stored in the network structure, where is the IP layer structured, and where to store the content. The process of current Internet structure faces security-related issues with respect to content storing. There are two types of cache pollution attacks: false locality attack and location distribution attack. Location distribution attack starts the request of distinct unpopular content through which the transmission path occupies unpopular content and pushes out the popular content. Finally, the user does not fulfill the requirement. With continuation of LDA attack, the network follows up an FLA attack where the malicious user frequently sends requests for unpopular content due to which the router keeps unpopular content in the cache and it does affect the original users.

To design an advanced detection system for cache pollution attack, understanding the impacts of attacks throughout the network is more important. The current detection symptoms are not efficient to detect the pollution attack with respect to indistinguishable unpopular content from router cache. The router content is difficult to distinguish, and it also increases the computation time to respond to legitimate requests. On the other hand, the network does receive frequent requests from attackers without interval which may cause large memory usage and computation time. Cache pollution attack scales routing topologies without knowing network servers which

will restrict large number of NDN application deployments. [2–4] The proactive countermeasures will protect the NDN network from adversarial attack moments. The existing system does not maintain protective circumstances detection approach and mitigates pollution attack.

Our proposed solution shall consider mentioned aspects and contribute the better computation and response to users. The clustering mechanism is one of the prominent methods to overcome the difficulties. Named data network security mechanism would have been the solution for discussed challenges than in current host-centric method. The host-centric authentication security mechanism should not provide security for content, but it does secure the hosting part. The host-centric model basically describes how to open the communication channel to start the host basic Interest approach and through that way it makes security for hosts, channel security and end-to-end device security possible. The proposed solution should consider the quality of the content since it provided well enough security mechanism. Due to the security aspect the network channel restricts some quality features in terms of memory and interest traffic. Unexpected arrivals of data packets in NDN router queue which does not have capacity to handle the interest traffic will affect the response quality. Also, attack detection system should analyze the interest queue because when the legitimate user sends the interest request to the NDN data structure, the system immediately responds back via router content store. Since CS is utilized for content, cache sends it through via NDN router. The existing DoS/DDOs and cache pollution attacks describe the unpopular cache content requests which might reduce the intensity of content quality.

Further, in the advanced NDN infrastructure, the proposal needs to be flexible, application adaptable and auto learning system, which can play a prominent role in future real time IoT applications. The system takes care and provides sufficient security against various content-based attacks. Achieving high response of content, private cache availability and identifying unknown spoofing attacks with mitigation, are the areas that need enhancement, to provide NDN quality measurements.

In this paper, we investigate through various research references on NDN and present the algorithm we rely on in our proposal design. We present short overview of unknown threat detection and mitigation design and evaluate content quality measurements with NDN simulation results.

2 NDN Overview

Named data networking is a future Internet architecture which has been designed with pull model and inserts the content into the router based on the consumer's request. Even then, the consumer request has been fulfilled through interests and content objects. The content object basically constructs binary data together combined with its name, bits of confirmation and data signature [5, 6]. In hierarchical structure, NDN content has more than one component. High volume content is spited with frame fragments, and it is easily identifiable via its name. The optional control information provides the filter facility to send desired content by the same name which is stored

in the router. The NDN router forwards consumer requested interest name toward the network content producer since the content is stored in the producer with its name using prefix where as in host-centric IP prefix utilizes for requesting the content [7, 8].

Every step of data process will hold your forwarding information base (FIB). It is called lookup table, and it supports multipath delivery towards frequent forwarding incoming entries in the same prefix name. The NDN router maintains the pending interest table (PIT), and it stacks outstanding consumer interest. The final step of data process is to retrieve the content from content producer and traverse the same path to reach the consumer. The above architecture clearly describes about content cache in router content store. The refined structure maintains a cache of a copy of content in each router content store. Every consumer request does not need to be responded to from content producer and further then request will get the response from nearest content availability.

3 Literature Review

Li proposed architecture-based encryption concept for ICN control [9], where the subject and content will be shared to all clients who are authorized in the system and all the authorized clients will maintain a symmetric key. The symmetric key will encrypt the content name and subject. The publisher creates the AC policy which can be third-party accessible. Whenever the publisher sends the content and the subject to the client, the third party will encrypt the data and send to the client and the symmetric key encrypts the details and shares it to the client. AC policy does the encryption on the process and indicates the details to the clients. The process of the ICN architecture will maintain the system. The information-centric networking would be working under Internet scenarios of users, but normally the host and IP-based architecture would be in place. Here usage scenario will accommodate the data which is information-centric networking. Consider the case when a popular Internet page has been saved at different locations and is accessed by a bunch of users, would reduce the traffic and load significantly and the users will be able to access the data regularly. Based on users request, the routers shall reduce the traffic overall in the network. NDN content-centric network based on information and data to UDP/TCP to implement ideal features of caching and naming reduces the congestion through this method and will get to optimize the resources [10]. Reza Tourani, Travis Mick proposed that security protocols integrated with client and significant mitigation might be investigated [7]. Every investigation's suspicious interface is identified and prefixed with the attacks. By following the content cache, the privacy-analyzed schemes affect the clients significantly [11]. The propositional way network load will be increased, and there is increased download latency in traffic. The network will maintain privacy mechanism which is routed to wide network approach and not fulfilled in cache scheme. Zhang proposed a content encryption method, the process of the encryption is notified with public key and random key, every client communication will pass through the

random key k_1 , and request has reached to random key k_2 , which is located at another communication end of the process [8]. Now each communication will end at an edge router which encrypts the random key content name and publisher identity. The publisher key has decrypted the content and identity and finally encrypts the name and identity of the communication. These processes will take 10 s time for small content. The large content of the request will flow through the edge routers for multimedia IoT agriculture applications. Marica Amadeo, Claudia Campolo proposed priority-based data delivery in the interest vehicles via named data networking. The content of named data networking communication performs caching and accurate movements on the time based on the request from the other vehicles or RSUs. The selection and forwarding will decide the interest's low-priority and high-priority contents with the prefix names of Low and High. The consumers will send the request at the same time it will deliver the packets and simultaneously forwards both the requests. This will analyze the latency and reliability of the data and secure the sensitive data. Tan proposed the protected content into two portions; one is a large cacheable portion, and the second is small cacheable. Every client retrieves the smaller portion from publisher which is used to reconstruct the content and check the verified clients. The malicious user passes the smaller content to illegal user who wants to check the authorized clients, meaning the system will not allow passing of the details. Also, the process needs online connectivity until it completes the entire process.

4 Novel Based K-Means Clustering Technique

We present the attack detection system usually target to content-based locality in named data network caches. Clustering is the most easily available option to detect the attack through hierarchical or partitioning methodology. We would like to exploit the novel based k-means clustering technique and then present our scheme in details:

Overview

- Compute interest metrics.
- If interest is received, the router will update the popularity table for this interest.
- All the interests are classified into different clusters by using novel-based k-means clustering technique.
- Based on the clustering result, we can determine whether the router is under LDA or FLA by using an 'improved decision tree'.
- Once location-disruption attack (LDA) or false-locality attack (FLA) is detected, an attack table will be generated to record those suspicious interests and broadcasted to the neighbors hop by hop. All the routers receiving the attack table will not cache the content chunks in the corresponding data packets.

Detection Contribution

- Interests clustering is performed by the proposed novel k-means clustering technique.
- To detect whether it is LDA or FLA, use proposed improved decision tree method.

Proposed Flow

Compute Interest metrics:

- First, we compute total number of all interests, total count of the interests for the same content and time interval of two consecutive interests for the same content.
- Each and every router computes interest probability and time interval for same content.
- The router will update the popularity table for corresponding interest.

Clustering:

- All interests are classified into different clusters by using NBAC.
- In existing method like k-means, a structure that is more informative than the unstructured set of flat clusters. But, our method is basically hierarchical, and it provides hierarchical output.
- However, hierarchical clustering method is very sensitive to initial value.
- In our method, the initial cluster and number of clusters are computed by mean-shift clustering.

Detection:

- After clustering based on the clustering result, we can determine whether the router is under LDA or FLA by using IDT method.
- Normally decision tree method, without proper pruning or limiting tree growth, tends to over fit the training data, making them somewhat poor predictors.
- To avoid this issue, in our proposed method, the tree growth is computed by butterfly optimization algorithm (BOA).

The proposed flow chart describes the flow of interest with content store in pending interest table. Based on the table, the interest gets discarded or moved forward to forward interest table. The core step of the proposed flow in the clustering technique further then makes the detection part involved in decision tree process. The detection part will check the attack table with respect to the response of the cache content or forward will carry over the process. The simulation process executes the attack detection with dropped packets. In order to execute the process, the total number of packets, total received packets, duration of simulation and transmitted bits are examined. The pseudocode steps mention the clear execution step of entire interest forward details, pending interest table, forwarding information base and further then will send interest and discard the collapsed interest (Fig. 1).

Algorithm 1 Interest Process

1. start

- Interests clustering is performed by the proposed novel k-means clustering technique.
- To detect whether it is LDA or FLA, use proposed improved decision tree method.

Proposed Flow

Compute Interest metrics:

- First, we compute total number of all interests, total count of the interests for the same content and time interval of two consecutive interests for the same content.
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Algorithm 1 Interest Process

1. start

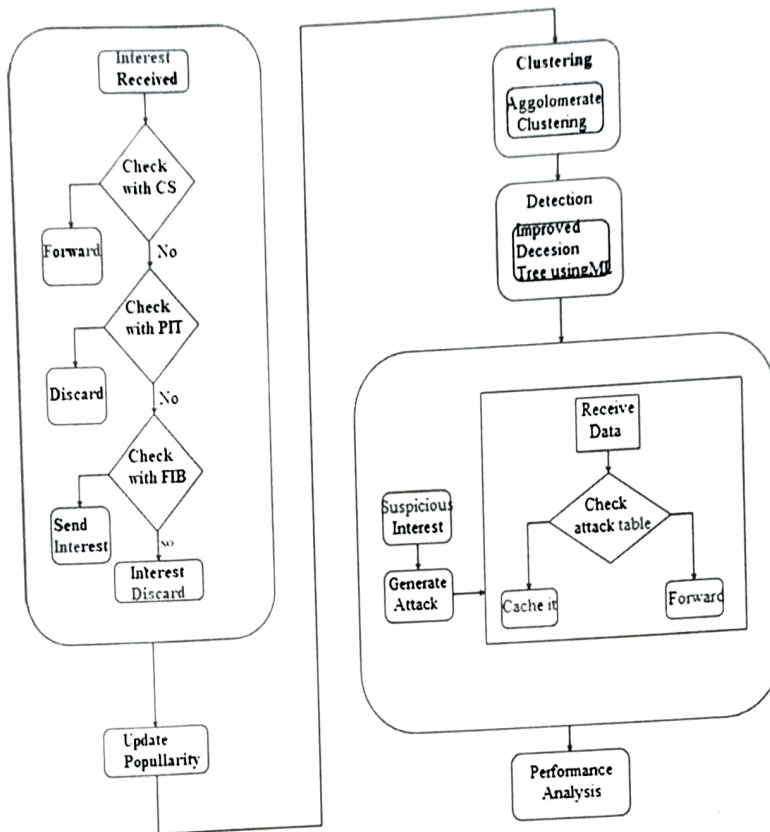


Fig. 1 Smart agriculture attack detection flow chart

2. Interest Received//I
3. If (I ==CS)
4. {
5. Forward data to interface
6. }
7. else if(I ==PIT)
8. {
9. Interest discarded
10. }
11. else if(I ==FIB)
12. {
13. Send Interest
14. }
15. else
16. {
17. Interest discarded

18. }

Algorithm 2 Popularity Table Process

1. Update Popularity Table
2. clustering by Novel based K-Means technique
3. Detection of decision tree growth by Butterfly Optimization algorithm (BOA)
4. if (Data Received ==Attack)
5. {
6. Cache the Data
7. Send the suspicious interest
8. Generate Attack Table
9. }
10. else
11. {
12. forward the data
13. }
14. End

The above algorithms follow described interest process and popularity table updates.

Algorithm 3 Attack Detection

1. Start
2. for(i = 0; i < nm; i ++)
3. {
4. for(j = 0; j < nm; j ++)
5. {
6. if(nm[i].packets.equals(drop))
7. {
8. Blockedlist[i] = nm[i];
9. message("Attack Detected !! Packetdropped")
10. }
11. else
12. {
13. message("Packet Sent")
14. }
15. }}
16. End

Table 1 Simulation parameters

Parameters	Values
Network size	600 * 600
Maximum speed of nodes	16 m/s
Transmission smooth factor	0.5
Content store	500 packets
Data rate	6 Mbps
Node size	2.00
Speed	1.000
Zoom	2.000
Nodes	11
Simulation time (s)	600 s
String value	1024
X axis proposal	50
Y axis proposal	20

When implementing the proposed flow in ndnSIM simulator [12] the transmission smoothness is 0.5, node size is 2.00 and string value 1024. The total number of nodes utilized for this scenario is 11, and total simulation time is 600 s. The data rate is 6 Mbps, and content store capability is 500 packets. The maximum speed of the node is 16 m/s (Table 1).

Fig. 2 ndnSIM python viewer window

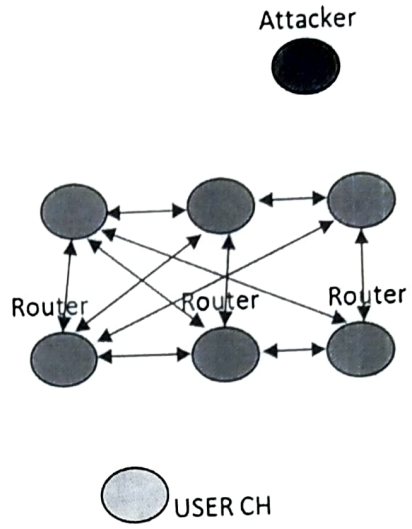


Figure 2 shows the simulation of the attack in python viewer.

Fig. 3 Packet transmission to cluster head

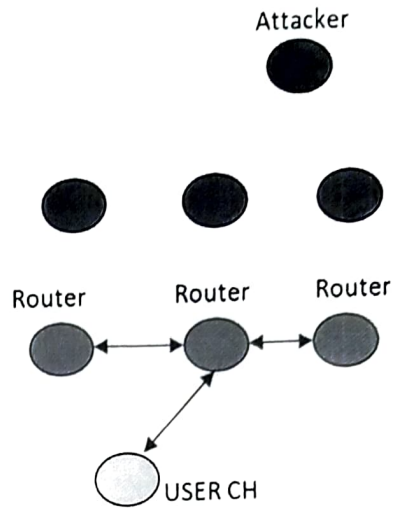


Figure 3 depicts the simulation in the net animator. The position of the network nodes and characters is classified with different colors. Red-colored node is an attacker node. The cluster head forms and the nodes sent packet to the CH.

Fig. 4 Node location analyzed

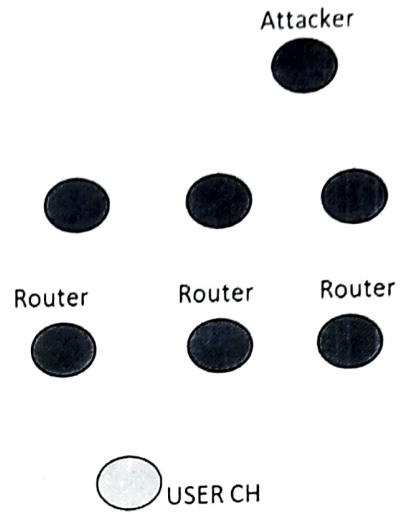


Figure 4 depicts the scenario with router, user and the attacker. The figure clearly shows that there is one attacker, nine routers and one user. We have given the node numbers and simulation time for this ndnSIM to get the parameters.

Fig. 5 Router-to-router transmission

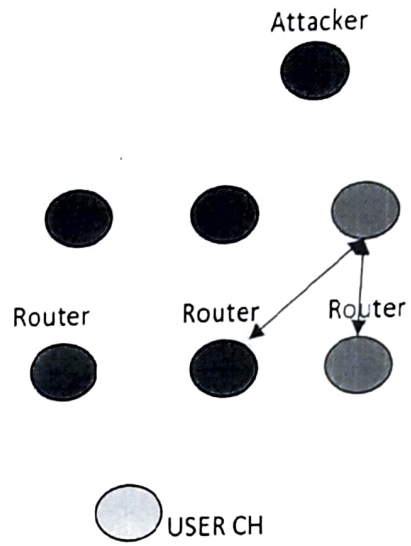


Figure 5 depicts the simulation in the net animator. The cluster head forms and the nodes send packet to the CH.

Fig. 6 Packet dropped position

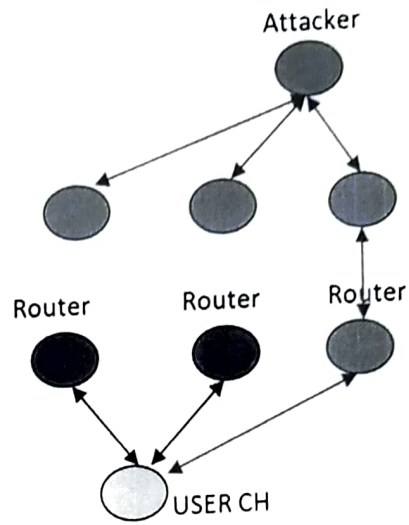


Figure 6 depicts the simulation in the net animator. The cluster head forms and the nodes send packet to the CH. The attacker node sends the packet and the packet drops. The above scenario describes the packet dropped.

Fig. 7 Packet dropped position

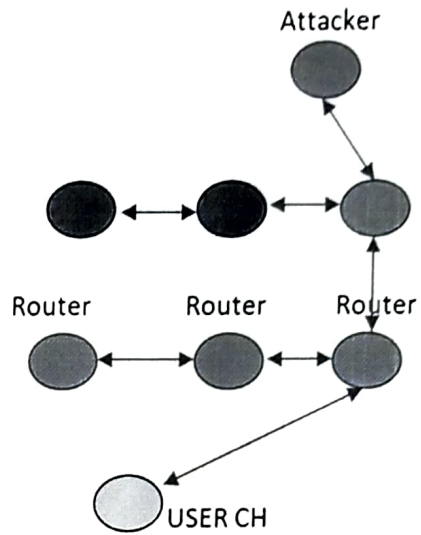


Figure 7 depicts the simulation in the net animator. The cluster head forms and the nodes send packet to the CH. The overall process is clearly seen in above image, and it connects the user to the router and attacker.

```

18 15.2795 1024
19 15.2959 1024
20 15.3123 1024
attack Detected!! Packet dropped!!!
22 15.3448 1024
23 15.3612 1024
24 15.3776 1024
25 15.394 1024
attack Detected!! Packet dropped!!!
27 15.4267 1024
28 15.4431 1024
29 15.4595 1024
30 15.4759 1024
31 15.492 1024
32 15.5084 1024
33 15.5248 1024
attack Detected!! Packet dropped!!!
35 15.5576 1024
36 15.5739 1024
attack Detected!! Packet dropped!!!
38 15.6067 1024
39 15.6231 1024
40 15.6395 1024
41 15.6559 1024
42 15.6721 1024
43 15.6885 1024
44 15.7049 1024
45 15.7213 1024
46 15.7377 1024
47 15.754 1024
48 15.7704 1024
49 15.7868 1024
50 15.8032 1024
.....
Total Sent Packet=50
.....
Total Received Packet=45
.....
Duration : 15.8032seconds
.....
transmitted bits : 802816bits

```

Fig. 8 Packet dropped position

Figure 8 shows the output of the simulation. The output describes total packet sent and received and the duration for the packets. The total sent packets are shown against total duration. The entire simulation time is mentioned, and attack detection is visualized with packet dropped. Finally, the visualization ends with transmitted bits.

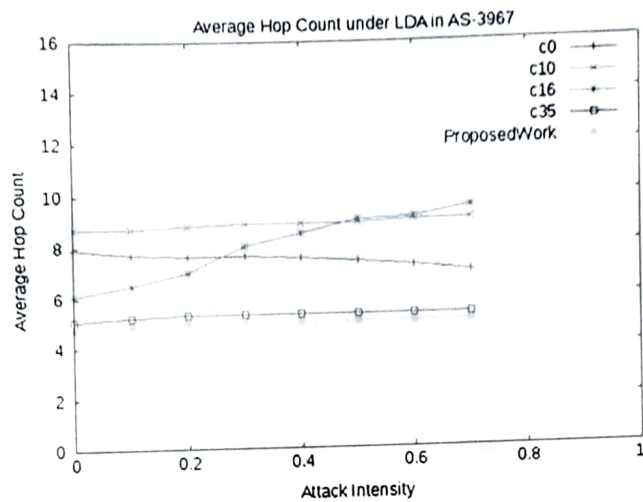


Fig. 9 Attack intensity

Figure 9 depicts the comparison of hop count of the node to reach the user and proposed system in existing system. The proposed work impact is clearly visible in above figure.

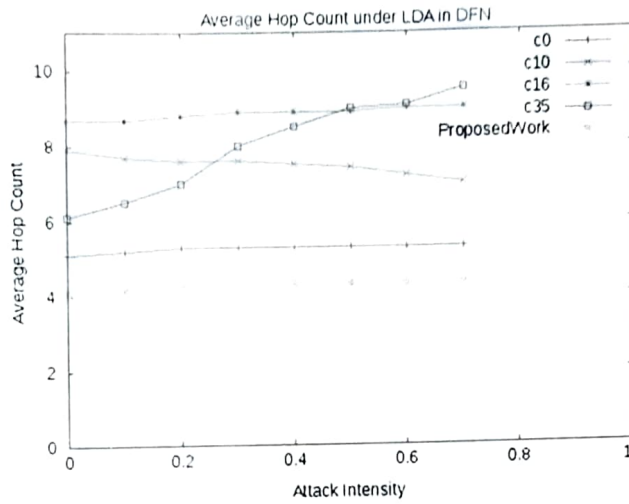


Fig. 10 Attack intensity in LDA

The average hop count is decreased in the proposed work which means the attack intensity downgraded in proposed method. The image has taken average hop count against attack intensity.

Figure 10 depicts the comparison of hop count of the node to reach the user and proposed system in existing system (by comparing in LDA DFN). The location distribution attack is taken, and the values of average hop count against attack intensity.

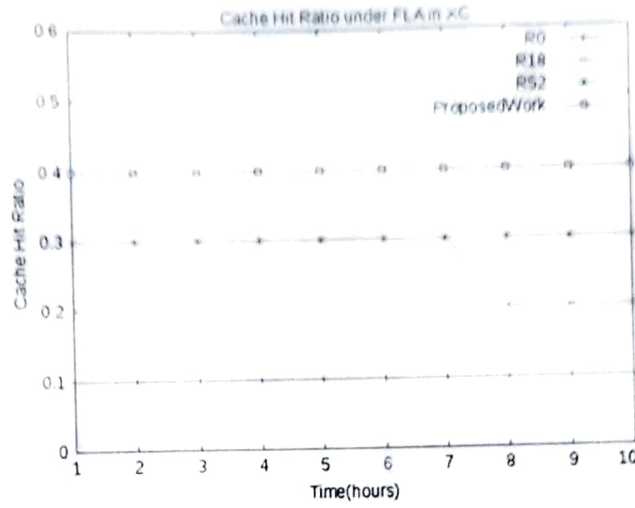


Fig. 11 Cache hit in FLA

Figure 11 depicts the comparison of cache hit ratio of and proposed system and in existing system. The false locality attack has taken cache hit ratio against time of the process.

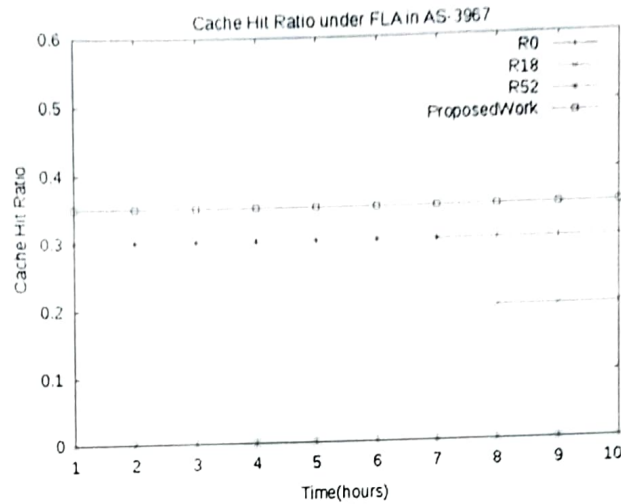


Fig. 12 Cache hit ratio in AS

Figure 12 depicts the comparison of cache hit ratio of the node to reach the user in the proposed system and in existing system.

5 Conclusion

Data retrieving is important task of Internet of Things in agriculture using NDN, and this helps in networking of the various popular contents. So, cache memory is more vulnerable from the different kinds of spoofing attacks. This attack is called cache pollution attack, and this attack is overcome in our proposed system. In this work, we have proposed an algorithm which is more efficient in defense and deduction of attacks in the system. In this system, we have differentiated various requests which help us to differentiate malicious and regular requests. We have proposed k-means clustering technique a cluster-based technique to find the abnormal requests. We have used named data network (NDN) for simulating the entire scenario. In our system, the cache hit ratio is increased up to 60%, detection of attack ratio increased up to 25% when compared to previous algorithms. Also, we have increased the memory level, CPU utilization when compared to the previous system.

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Energy

Crises, Challenges and Solutions

**Edited by
Pardeep Singh
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WILEY Blackwell



3

Recent Advances in Alternative Sources of Energy*Pradeep Pratap Singh¹, Ambika², and Maya Verma³*¹ Department of Chemistry, Swami Shradhdhanand College, University of Delhi, New Delhi, India² Department of Chemistry, Hansraj College, University of Delhi, New Delhi, India³ Department of Physics, Hansraj College, University of Delhi, New Delhi, India**3.1 Introduction**


Energy has occupied a predominant space in the existence and development of mankind. However, humans seek more and more sources of energy from the time immemorial. The demand of energy has drastically increased with the growth in population. To meet the energy requirements, there is a constant search for the alternate sources of energy. In the quest of meeting energy requirements, one should also be considerate towards its effects on the environment. At present, most of the energy requirements are fulfilled by non-renewable resources. However, these resources suffer from several disadvantages like limited availability, long time duration for their formation and non-sustainable, greenhouse gas emissions. The emission of carbon dioxide, methane and other harmful gases that are the main cause of global warming may result change in the weather patterns which in turns affect the ecosystems (Wang et al. 2020a). Apart from the air pollution, excessive usage of fossil fuels results in water pollution, land pollution, climate change etc. All these pollutants severely affect the human health and environment. Burning of coal emits mercury, which on inhalation by the human beings and other animals may lead to neurological disorders (Munawer 2018). Many pollutants emitted due to burning of fossil fuels may enter the water cycle and cause acidic rain. This acidic rain when mixes with the water bodies can severely harm the aquatic animals and plants. Acidic rain may also cause corrosion to machineries and monuments (Munawer 2018).

Thus, there is an urgent need of technology which can replace these resources with sustainable energy sources. Renewable energy resources are the potential candidates that could produce energy much greater than the actual energy requirements. These are the sources which can be continuously replenished by nature such as sunlight, wind, water etc. Our ancestors had realized the importance of these resources very long back and described them as powerful energy sources in Vedas. In the twenty-first century, huge investment and

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Shadpour Mallakpour
Chaudhery Mustansar Hussain

Handbook of Consumer Nanoproducts

 Springer



Ambika and Pradeep Pratap Singh

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Abstract

Cosmetics are substances used to enhance the “appearance” of the human body. Globally millions of consumers use cosmetic products on daily basis. Cosmetic products can be used to treat conditions such as photoaging, hyperpigmentation, wrinkles, and hair damage. Due to the daily application of cosmetic products, they are required to ensure quality, safety, and performance at high level.

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Natural Polymers–Based Green Adsorbents for Water Treatment

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**Susheel
Kalia**



Natural polymer-based hydrogels for adsorption applications

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11.1 Introduction

Water is an essential requirement for the sustenance and continuation of life. Today, the world is facing multiple challenges in sustainable supply of water and its magnitude is rapidly increasing (Ambika, 2016, 2018). With the increasing population, the demand for fresh water is also increasing. Furthermore, the water scarcity situation is worsening due to the overexploitation of surface and subsurface water resources. Also, most of the water resources are getting polluted due to industrial revolution and various other anthropogenic activities, including waste disposal, agricultural run offs, mining, oil spills, and so on (Ambika, 2016, 2018). These activities may result in the introduction of various contaminants like, toxic dyes, heavy metals, polycyclic aromatic hydrocarbons (PAHs), antibiotics, pesticides, and so on into water bodies. These harmful and toxic contaminants may lead to various life-threatening diseases. Therefore there is an urgent need to develop the technology that can effectively control water pollution.

There are many methods used for the treatment of polluted water, including flotation, adsorption, photocatalytic degradation, chemical precipitation, membrane separation, and electro dialysis (Kyzas and Matis, 2018; Puget et al., 2000; Wan and Zhuang, 2017; Konstas et al., 2019; Oncel et al., 2013; Yang et al., 2019; Oztekin and Altin, 2016). However, adsorption is the most common method employed for the remediation of water pollution (Bian et al., 2018). Generally, most of the available adsorption materials can effectively adsorb only a single pollutant from the complex wastewater. Therefore the demand for development of new economical, efficient, and recyclable adsorption materials is continuously increasing for the wastewater treatment.

Hydrogels are three-dimensional, polymeric networks which can absorb large volume of hydrofluids as compared to its own mass (Fennell and Huyghe, 2019). Various properties of hydrogels such as mechanical properties, water-absorption capacity, and so on depends on their three-dimensional network structure (Ahmed, 2015; Haque and Mondal, 2016).

Green Energy and Technology

Mohammad Jawaid
Akil Ahmad
Norli Ismail
Mohd Rafatullah *Editors*

Environmental Remediation Through Carbon Based Nano Composites

 Springer

Carbon-Based Nanocomposites: Preparation and Application in Environmental Pollutants Removal



Ambika and Pradeep Pratap Singh

Abstract Environmental pollution is a problem of enormous public concern worldwide. With the increasing population, the demand for fresh water is also increasing while per capita annual availability of water has reduced. Due to the rapid industrial growth, the water is getting polluted. Various pollutants, such as heavy metals, dyes, pesticides, insecticides, herbicides, antibiotics, oil spills, plant nutrients, bacteria, viruses, etc., pose serious risks to the environment. Thus, there is an urgent need to develop new methodologies and materials for the removal of pollutants from the environment. Carbon-based nanocomposites have drawn the attention of scientists because of their unique chemical and physical properties. These nanocomposites pose a great potential for application in various environmental fields including, air pollution biotechnologies, monitoring, wastewater treatment, etc. The present article describes the preparation of carbon-based nanocomposites and their application in environmental pollutants removal.

Keywords Carbon-based nanocomposites · Pollutants · Carbon nanotubes · Graphene

1 Introduction

One of the major global concerns in the twenty-first century is problems related to the environment. Environmental pollutants can comfortably spread into the surroundings via different pathways [95]. Anthropogenic activities are treated as an imperative part which could contaminate the different ecosystems [93]. Various types of pollutants, such as heavy metals [59, 69, 91], organic dyes [15, 52, 60, 79, 82], bacteria/viruses [125, 140], can pollute the different ecosystems. The polluted environment not only

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Ecological Approaches to Pest Management

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Ecological Approaches to Pest Management

ABOUT THE BOOK

This book presents the most comprehensive guide to biological control agents ever made available to practitioners. The book helps you identify and understand the biology of predators, parasites, pathogens, competitors, and antagonists that help control specific insect, pathogen, nematode, or weed pests. This book helps you to combine cultural, physical and chemical methods with biological control, minimize pesticide impacts on natural enemies, release natural enemies and enhance their activity, identify and use natural enemies to control pests in almost every agricultural crop, garden, and landscape. Growers, pest control consultants, landscape professionals, gardeners, students and instructors of pest management or biological control will find this book an essential reference tool.

Topics: Pesticides, Insecticides and Herbicides, Crop and Plant Production.

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Recent Trends in Biodiversity and Environmental Science

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Strategies and Trends

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Algorithms for Intelligent Systems

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Srikanta Patnaik

Xin-She Yang

Ishwar K. Sethi *Editors*

Advances in Machine Learning and Computational Intelligence

Proceedings of ICMLCI 2019



Springer

Srikanta Patnaik · Xin-She Yang ·
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Editors

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Bug Priority Assessment in Cross-Project Context Using Entropy-Based Measure



Meera Sharma, Madhu Kumari, and V. B. Singh

1 Introduction

A large number of bugs are reported on bug tracking systems by different users, developers, and staff members located at different geographical locations. Bug priority (P1, the most important, to P5, the least important) is an important attribute which determines the importance and the order of fixing of the bugs in the presence of other bugs. To automate the bug priority prediction, we need historical data to train the classifiers. In reality, this data is not available easily in all software projects, especially in new projects. Cross-project priority prediction works well in such situation where we train the classifiers with historical data of projects other than the testing projects [1, 2].

The bug reports are reported by users having different levels of knowledge about the software which results in uncertainty and noise in bug reports data. "Without proper handling of these uncertainties and noise, the performance of learning strategies can be significantly reduced" [22]. The entropy-based measure has been used to calculate the uncertainty in bug summary reported by different users. In literature, researchers [1, 2] have made attempts for cross-project bug summary-based priority prediction. No attempt has been made to handle uncertainty in bug summary in cross-project context for bug priority prediction. We have proposed summary entropy-based cross-project priority prediction models using Support Vector Machine (SVM), k-Nearest Neighbors (k-NN), Naïve Bayes (NB), and Neural Network (NNET). In addition to the summary entropy, we have also considered bug severity and the derived bug summary weight attribute. Results show improvement in performance over summary-based cross-project priority prediction models [2].

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The rest of the paper is organized as follows: Sect. 2 deals with related work. Section 3 describes the data description, bug attributes, and model building required to perform the analysis. Results have been discussed in Sect. 4. Finally, the paper is concluded in Sect. 5.

2 Related Work

Bug priority assessment helps in correct resource allocation and bug fix scheduling. A bug priority recommender has been proposed by Kanwal and Maqbool [3] by using SVM classification technique. The study was further extended for comparison of SVM and NB performance with different feature sets by Kanwal and Maqbool [4]. An attempt for bug priority prediction has been made by Alenezi and Banitaan [5] using NB, Decision Tree (DT), and Random Forest (RF) for Firefox and Eclipse datasets. Lian Yu et al. [6] proposed defect priority prediction using Artificial Neural Network (ANN) technique. Results show that ANN performs better than Bayes algorithm. Tian et al. [7] proposed a new framework called DRONE (PreDicting PRiority via Multi-Faceted FactOr ANalysEs) for Eclipse projects and compared it with Severis^{Prio} and Severis^{Prio+} [8].

In literature, several studies have been conducted in cross-project context [9–16].

Bug summary-based cross-project priority prediction models have been proposed by [1, 2] using SVM, NB, k-NN, and NNET. Results show that cross-project bug priority prediction works well. Another attempt has been made by authors to propose bug summary-based cross-project severity prediction models [17].

Software are evolved through source code changes done in it to fix different issues, namely bugs, new features, and feature improvements reported by different users. These source code changes result in uncertainty and randomness in the system. In literature, researchers have used entropy-based measures to quantify the code change process for defects prediction [18]. Researchers have used entropy-based measures to predict the potential code change complexity [19]. A software reliability uncertainty analysis method has been proposed by Mierswa et al. [20].

To our knowledge, no work has been done for measuring trustworthiness of bug summary data in bug repositories. The uncertainty/noise present in bug summary data can affect the performance of prediction models. In this paper, we have measured the uncertainty in bug summary by using entropy-based measures. In addition to summary entropy, bug severity and summary weight for bug priority prediction in cross-project context have been considered. We have compared our proposed summary entropy-based bug priority prediction models with Sharma et al. [2] and found improvement in performance of the classifiers.

Table 1 Priority-wise number of bug reports of different projects

Project	Product	Priority-wise number of bug reports					
		P1	P2	P3	P4	P5	Total
Eclipse	V2	923	1416	8609	370	229	11,547
Eclipse	V3	361	963	26,667	320	136	28,447
OpenOffice	DB	76	472	2834	243	38	3663
OpenOffice	SST	82	518	4210	316	114	5240
OpenOffice	PPT	62	553	2688	90	37	3430

3 Description of Datasets, Bug Attributes, and Model Building

In this section, description of datasets and bug attributes used for validation and the model building have been discussed.

3.1 Description of Datasets

We have taken different products, namely Platform Version 2 (V2), Platform Version 3 (V3) of Eclipse project (<http://bugs.eclipse.org/bugs/>) and Database Access (DB), Spreadsheet (SST), Presentation (PPT) of OpenOffice project (<http://bz.apache.org/000/>). We have considered the bug report for status “verified,” “resolved,” and “closed.” Table 1 shows the distribution of bug reports of different priority levels.

3.2 Bug Attributes

To predict bug priority in cross-project context, we considered three attributes, namely severity, summary weight, and entropy of summary. Severity is a nominal attribute, whereas summary weight and entropy are continuous attributes. Bug severity gives the impact of bug on the functionality of software or its components. It is divided into seven levels, namely “Blocker, Critical, Major, Normal, Minor, Trivial, and Enhancement.” Blocker is the highest level, and Enhancement is lowest level. Bug priority determines the importance of a bug in the presence of others. Bugs are prioritized by P1 level, i.e., the most important, to P5 level, i.e., the least important. The bug summary gives the textual description of the bug. Summary weight is extracted from the bug summary attribute, entered by the users.

The bug summary has been preprocessed with the RapidMiner tool [21] to calculate the summary weight of a reported bug [2].

Different users are reported bug on bug tracking system. The size of software repositories is also increasing by an enormous rate that enhances the noise and uncertainty in the bug priority prediction. If these uncertainties are not handled properly, the performance of the learning strategy can be significantly reduced [22]. We have proposed entropy-based measure to build the classifier for bug priority prediction to handle uncertainties in cross-project context. We have used Shannon entropy to build the classifier model.

Shannon entropy, S is defined as

$$S = -p_i \log_2 p_i$$

where $p_i = \frac{\text{Total number of occurrences of terms in } i\text{th bug report}}{\text{Total number of terms}}$.

The top 200 terms have been taken from all terms based on their weight. To rationalize the effect of the priority, we multiplied the entropy by 10 for P1 and P2 priority level bugs, 3 for the P3 priority level bug, and 1 for P4 and P5 priority level bugs [23].

3.3 Model Building

We have proposed summary entropy-based classifiers based on SVM, k-NN, NNET, and NB for bug priority prediction in cross-project context by taking bug attributes severity and summary weight. We have taken the bug reports of two products of Eclipse and three products of OpenOffice projects. To get the significant amount of performance, we have used the appropriate parameters values. "For SVM, we have taken polynomial kernel with degree 3, the value of k as 5 in case of k-NN and for NNET the training cycle as 100" [2]. Number of validations is taken as 10 and sampling types as stratified sampling for different classification techniques. The performance of the proposed models has been validated using different performance measures, namely Accuracy, Precision, Recall, and F-measure.

Figure 1 shows the main process of cross-project priority prediction.

4 Results and Discussion

We have validated the entropy-based classifier of different machine learning techniques, namely SVM, k-Nearest Neighbors, Naive Bayes, and Neural Network using 10 fold cross-validations for predicting the bug priority. We have compared the proposed entropy-based approach to Sharma et al. [2]. We have taken the same datasets and techniques as taken by Sharma et al. [2] to predict the bug priority in cross-project

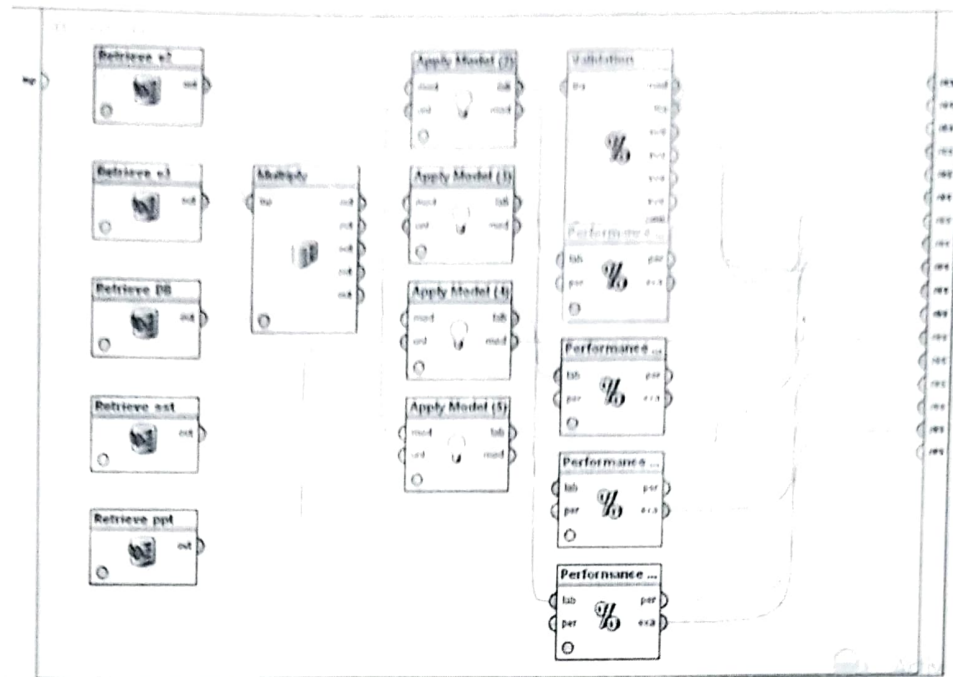


Fig. 1 RapidMiner process for bug priority prediction in cross-project context

context. Table 2 shows the Accuracy of different machine learning techniques to predict the priority of cross-validated projects.

Accuracy for Training Dataset V2

For testing dataset V3, our entropy-based approach improves the Accuracy by 3.46% and 91.93% for SVM and NB, respectively. Our entropy-based approach improves the Accuracy by 7.86%, 10.21%, 2.81%, and 82.85% for SVM, k-NN, NNET, and NB, respectively, for testing dataset DB. For testing dataset SST, our approach improves the Accuracy by 6.66%, 8.42%, 2.96%, and 82.08% for SVM, k-NN, NNET, and NB, respectively. Our entropy-based approach improves the Accuracy by 11.69%, 10.99%, 13.00%, and 85.19% for SVM, k-NN, NNET, and NB, respectively, for testing dataset PPT.

Accuracy for Training Dataset V3

Our entropy-based approach improves the Accuracy by 6.34%, 6.57%, 6.40%, and 82.10% for SVM, k-NN, NNET, and NB, respectively, for testing dataset DB. For testing dataset SST, our approach improves the Accuracy by 3.46% and 91.93% for SVM and NB, respectively. Our entropy-based approach improves the Accuracy by 9.39%, 8.16%, 7.41%, and 76.44% for SVM, k-NN, NNET, and NB, respectively, for testing dataset PPT.

Accuracy for Training Dataset DB

For testing dataset V2, our entropy-based approach improves the Accuracy by

Table 2 Accuracy (%) of cross-validated projects

Training versus testing dataset	Accuracy (%)			
	SVM	k-NN	NNET	NB
V2 versus V3	95.51	89.26	91.13	95.59
V2 versus DB	84.93	86.24	80.04	86.40
V2 versus SST	86.43	87.69	83.19	87.02
V2 versus PPT	89.53	88.13	91.02	89.48
V3 versus DB	86.13	86.27	86.21	86.32
V3 versus SST	86.66	86.89	86.74	86.95
V3 versus PPT	87.67	86.50	87.64	81.95
DB versus V2	77.73	83.29	83.14	68.21
DB versus V3	94.48	91.05	96.07	85.55
DB versus SST	85.10	92.18	96.53	86.34
DB versus PPT	86.73	83.97	86.82	69.30
SST versus V2	77.61	74.00	50.40	58.68
SST versus V3	94.47	88.15	81.09	80.72
SST versus DB	84.93	88.15	81.33	82.25
SST versus PPT	86.85	83.76	82.30	61.25
PPT versus V2	78.58	79.13	83.02	79.02
PPT versus V3	94.87	93.34	93.94	92.06
PPT versus DB	86.24	82.72	73.87	86.35
PPT versus SST	86.98	77.96	75.82	86.97

3.43%, 10.29%, 9.09%, and 60.21% for SVM, k-NN, NNET, and NB, respectively. Our entropy-based approach improves the Accuracy by 1.04%, 0.11%, 2.70%, and 79.27% for SVM, k-NN, NNET, and NB, respectively, for testing dataset V3. For testing dataset SST, our approach improves the Accuracy by 5.46%, 13.35%, 16.66%, and 76.19% for SVM, k-NN, NNET, and NB, respectively. Our entropy-based approach improves the Accuracy by 8.77%, 5.66%, 11.59%, and 60.12% for SVM, k-NN, NNET, and NB, respectively, for testing dataset PPT.

Accuracy for Training Dataset SST

For testing dataset V2, our entropy-based approach improves the Accuracy by 3.14%, 1.08%, and 49.11% for SVM, k-NN, and NB, respectively. Our entropy-based approach improves the Accuracy by 0.92% and 75.93% for SVM and NB, respectively, for testing dataset V3. For testing dataset DB, our approach improves the Accuracy by 7.89%, 11.11%, 4.18%, and 75.83% for SVM, k-NN, NNET, and NB, respectively. Our entropy-based approach improves the Accuracy by 8.89%, 5.25%, 4.02%, and 52.07% for SVM, k-NN, NNET, and NB, respectively, for testing dataset PPT.

Accuracy for Training Dataset PPT

For testing dataset V2, our entropy-based approach improves the Accuracy by 4.33%, 5.85%, 8.59%, and 70.95% for SVM, k-NN, NNET, and NB, respectively. Our entropy-based approach improves the Accuracy by 1.42%, 1.64%, 0.38%, and 84.93% for SVM, k-NN, NNET, and NB, respectively, for testing dataset V3. For testing dataset DB, our approach improves the Accuracy by 9.23%, 5.62%, and 72.92% for SVM, k-NN, and NB, respectively. Our entropy-based approach improves the Accuracy by 7.46% and 75.73% for SVM and NB, respectively, for testing dataset SST.

Out of 19 combination cases, SVM, k-NN, NNET, and NB outperform in 19, 16, 14, and 19 cases, respectively, in comparison with Sharma et al. [2]. Our approach improves the Accuracy 0.92–11.69% for SVM, 0.11–13.35% for k-NN, 0.38–16.66% for NNET, and 49.11–91.93% for NB across all the 19 combinations for bug priority prediction in cross-project context. SVM and NB outperforms for bug priority prediction across all the 19 combinations.

Table 3 shows the best training dataset with highest Accuracy for different machine learning techniques. Across all the machine learning techniques, on the basis of Accuracy, DB is the best training dataset for V2 testing dataset, DB is the best training dataset for V3 testing dataset, SST is best training dataset for DB testing dataset, DB is the best training dataset for SST testing dataset, and V2 is the best training dataset for PPT testing dataset.

Avg. F-Measure for Training Dataset V2

From Table 4, we observed that the value of F-measure (avg.) lies between 34.32%–48.49%, 30.69%–40.52%, 31.63%–40.04%, and 35.13%–39.44% for training candidates V3, DB, SST, and PPT, respectively, across all the machine learning techniques.

Avg. F-Measure for Training Dataset V3

We obtained the value of F-measure (avg.) that lies between 33.94%–35.22%,

Table 3 Classifier-wise best training candidate with highest accuracy

Best training dataset (Accuracy %)				
Testing datasets	SVM	k-NN	NNET	NB
V2	PPT (78.58)	DB (83.29)	DB (83.14)	PPT (79.02)
V3	V2 (95.51)	DB (91.05)	DB (96.07)	V2 (95.59)
DB	PPT (86.24)	SST (88.15)	V3 (86.21)	V2 (86.40)
SST	PPT (86.98)	DB (92.18)	DB (96.53)	PPT (86.97)
PPT	V2 (89.53)	V2 (88.13)	V2 (91.02)	V2 (89.48)

Table 4 Average precision (P), recall (R), and F-measure (F) for training dataset (V2 product)

Testing datasets	SVM			k-NN			NNET			NB		
	P (%)	R (%)	F (%)	P (%)	R (%)	F (%)	P (%)	R (%)	F (%)	P (%)	R (%)	F (%)
V3	40.75	33.47	36.19	52.29	53.91	48.49	31.53	41.44	34.32	76.83	40.15	42.58
DB	32.28	34.46	33.30	45.61	37.99	40.52	28.05	34.71	30.69	48.87	35.78	35.83
SST	33.94	33.53	33.52	48.91	36.81	40.04	28.78	35.84	31.63	54.93	34.10	34.76
PPT	39.90	34.14	35.13	65.55	35.33	38.56	36.27	35.72	35.88	45.58	37.45	39.44

33.53%–35.98%, and 32.04%–35.96% for training candidates DB, SST, and PPT, respectively, across all the machine learning techniques as given in Table 5.

Avg. F-Measure for Training Dataset DB

Table 6 shows the value of F-measure (avg.) that lies between of 25.23%–41.53%, 26.33%–38.09%, 30.93%–51.12, and 32.30%–42.75% for training candidates V2, V3, SST, and PPT, respectively, across all the machine learning techniques for bug priority prediction.

Avg. F-Measure for Training Dataset SST

From Table 7, we observed that the value of F-measure (avg.) lies between 25.00%–39.50%, 26.27%–38.80%, 32.46%–51.34%, and 31.84%–46.00% for training candidates V2, V3, DB, and PPT, respectively, across all the machine learning techniques.

Avg. F-Measure for Training Dataset PPT

Table 8 shows the value of F-measure (avg.) that lies between 26.71%–40.29%, 29.10%–39.88%, 27.88%–40.53%, and 27.64%–37.54% for training candidates V2, V3, DB, and SST, respectively, across all the machine learning techniques.

Table 9 shows the best training dataset with highest F-measure (avg.) for different machine learning techniques. Across all the machine learning techniques, on the basis of F-measure, DB is the best training candidate for V2 testing dataset, V2 is the best training candidate for V3 testing dataset, SST is best training candidate for DB testing dataset, DB is the best training candidate for SST testing dataset, and SST is the best training candidate for PPT testing dataset.

Figure 2 shows the Accuracy comparison using SVM machine learning technique for cross-project bug priority prediction.

Figure 3 shows the Accuracy comparison using k-NN machine learning technique for cross-project priority prediction.

Figure 4 shows the Accuracy comparison using NNET machine learning technique for cross-project priority prediction.

Figure 5 shows the Accuracy comparison using NB machine learning technique for cross-project priority prediction.

5 Conclusion

In the absence of data for building a classifier, cross-project study provides a solution. In this paper, we have proposed an approach for cross-project bug priority prediction using three attributes, bug severity, summary weight, and summary entropy. By considering learning from the uncertainty, we have derived an attribute termed as summary entropy using Shannon entropy. To build the classifier, we have used machine learning techniques, namely Support Vector Machine (SVM), k-Nearest Neighbors (k-NN), Naïve Bayes (NB), and Neural Network (NNET). The built-in classifiers

Table 5 Average precision (P), recall (R), and F-measure (F) for training dataset (V3 product)

Testing datasets	SVM			k-NN			NNET			NB		
	P (%)	R (%)	F (%)	P (%)	R (%)	F (%)	P (%)	R (%)	F (%)	P (%)	R (%)	F (%)
DB	34.96	33.67	33.94	52.33	34.55	35.22	34.92	33.87	34.06	33.82	34.99	34.31
SST	35.41	32.78	33.53	49.80	33.91	35.98	35.45	32.93	33.66	35.14	33.73	34.11
PPT	35.64	31.54	32.76	45.24	30.38	32.04	35.67	31.50	32.74	33.30	41.22	35.96

Table 6 Average precision (P), recall (R), and F-measure (F) for training dataset (DB product)

Testing datasets	SVM			k-NN			NNET			NB		
	P (%)	R (%)	F (%)	P (%)	R (%)	F (%)	P (%)	R (%)	F (%)	P (%)	R (%)	F (%)
V2	30.67	25.18	25.23	43.13	43.52	41.53	33.65	34.75	32.78	34.92	39.27	35.58
V3	35.26	24.36	26.33	40.30	43.85	38.09	38.57	34.30	34.36	29.05	42.27	31.58
SST	35.13	29.61	30.93	51.29	51.14	51.12	35.10	32.68	33.39	69.66	33.61	34.78
PPT	45.27	30.67	32.30	43.24	44.59	42.75	37.22	34.36	34.91	43.69	38.23	36.63

Table 7 Average precision (P), recall (R), and F-measure (F) for training dataset (SST product)

Testing datasets	SVM			k-NN			NNET			NB		
	P (%)	R (%)	F (%)	P (%)	R (%)	F (%)	P (%)	R (%)	F (%)	P (%)	R (%)	F (%)
V2	30.75	24.99	25.00	39.67	43.93	39.50	29.76	33.31	27.32	33.61	39.94	32.89
V3	35.17	24.32	26.27	41.63	42.40	38.80	34.33	35.96	32.87	31.54	42.31	31.46
DB	34.67	31.74	32.46	50.63	53.05	51.34	40.63	44.39	41.20	38.63	36.04	34.85
PPT	35.32	30.52	31.84	48.30	51.56	46.00	40.10	48.67	39.34	40.85	40.76	32.92

Table 8 Average precision (P), recall (R), and F-measure (F) for training dataset (PPT product)

Testing datasets	SVM			k-NN			NNET			NB		
	P (%)	R (%)	F (%)	P (%)	R (%)	F (%)	P (%)	R (%)	F (%)	P (%)	R (%)	F (%)
V2	30.45	26.57	26.71	49.55	32.43	35.41	29.40	34.77	31.84	41.53	39.68	40.29
V3	35.18	26.83	29.10	44.82	29.06	32.71	28.20	34.07	30.43	38.98	43.41	39.88
DB	34.13	34.65	34.24	47.71	41.70	40.53	25.48	33.72	27.88	33.76	35.04	34.30
SST	35.27	33.61	34.06	42.69	41.41	37.54	25.00	34.35	27.64	54.88	33.92	34.30

Table 9 Classifier-wise best training candidate with highest F-measure (average)

Best training dataset (average F-measure)				
Testing datasets	SVM	k-NN	NNET	NB
V2	PPT (26.71)	DB (41.53)	DB (32.78)	PPT (40.29)
V3	V2 (36.191)	V2(48.49)	DB (34.36)	V2 (42.58)
DB	PPT (34.24)	SST (51.34)	SST(41.20)	V2 (35.83)
SST	PPT (34.06)	DB (51.12)	V3 (33.36)	DB (34.78)
PPT	V2 (35.13)	SST (46.00)	SST (39.34)	V2 (39.44)

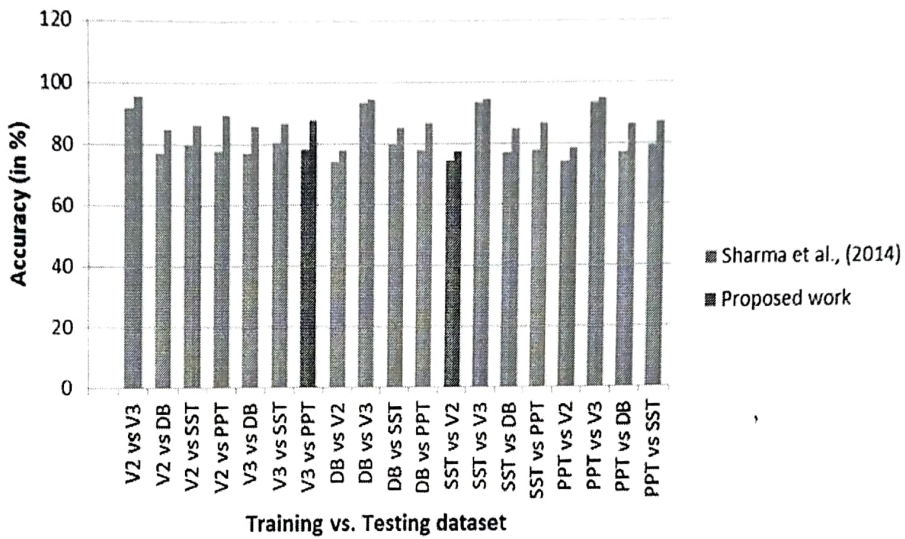


Fig. 2 SVM accuracy comparison (proposed work vs. Sharma et al., 2014 [2])

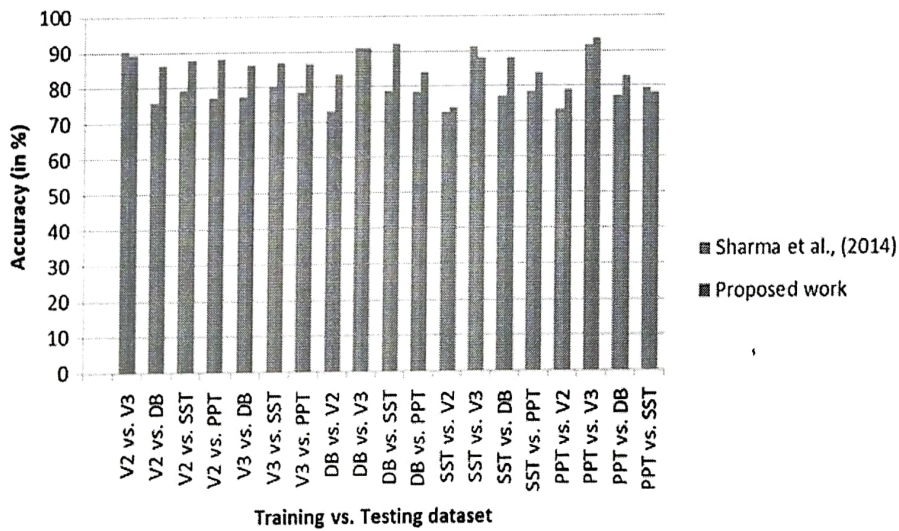


Fig. 3 k-NN accuracy comparison (proposed work vs. Sharma et al., 2014 [2])

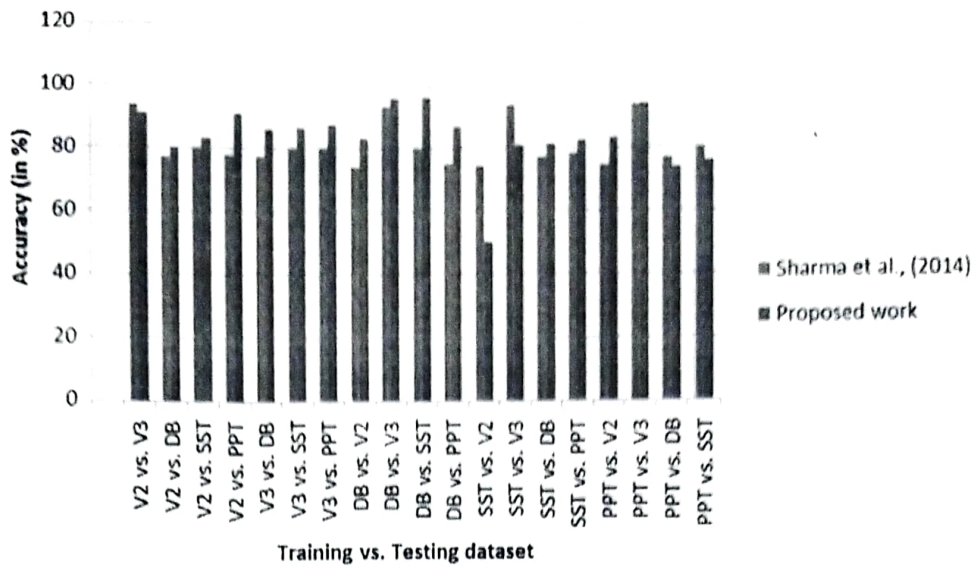


Fig. 4 NNET accuracy comparison (proposed work vs. Sharma et al., 2014 [2])

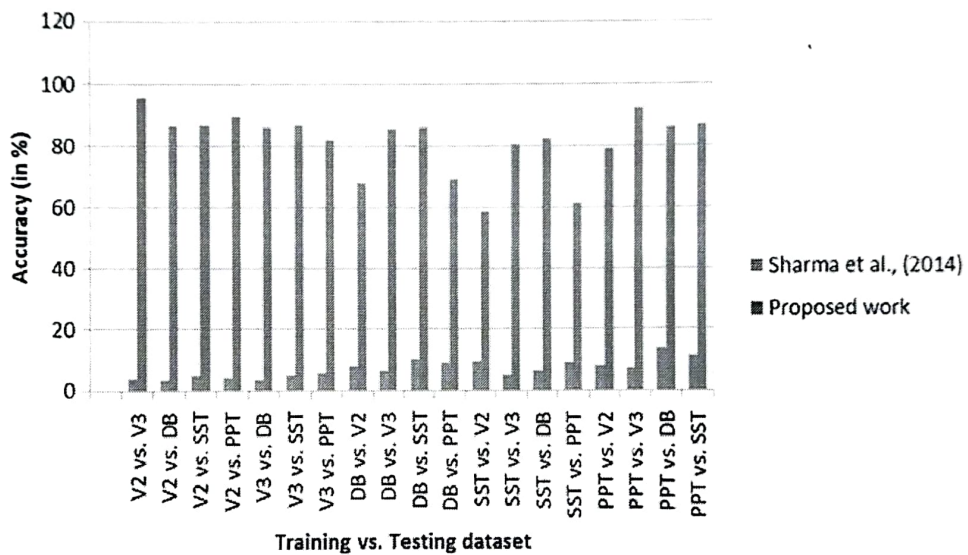


Fig. 5 NB accuracy comparison (proposed work vs. Sharma et al., 2014 [2])

based on these techniques predict the priority of a reported bug in cross-project context very accurately and outperform with the work available in the literature.

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Bug Report Classification into Orthogonal Defect Classification Defect Type using Long Short Term Memory

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Abstract— Software systems are being used in many businesses for performing critical operations such as financial operations. A bug in these systems can lead to financial losses. By identifying the type of such bugs, developers can easily take an action to fix a bug. Orthogonal defect classification model is a popular model for classifying bug reports in various attributes. In this paper, we proposed a bug report classification method that classify into their type as defined by ODC based on long short term memory, a RNN which is used in many classification task. The proposed method outperforms the classical approach such as bag of words and TF-IDF based classification models.

Keywords— Orthogonal Defect Classification, Long Short Term Memory, Classification

I. INTRODUCTION

Software systems have become an important part of businesses. They support many operations from keeping record of their product to the financial operations. The complexity and size of these systems have increased over the years. The presence of a bug in these systems can cause serious problems and affect the operations. The users report these bugs. The bug reports helps in improving software development process. Researchers and software developers analyze the bug reports to improve the software systems. In the context, to know the type of bug is very important and hence classification of bug reports. This study classifies the bug reports into orthogonal defect classification (ODC) defect type.

Orthogonal defect classification [1] is a method for analyzing and classifying the defects based on various attributes. ODC is based on cause and effect model. It classifies the defects based on the semantics of a defect. An in-process measurement paradigm extracts important properties from the defects [2]. The ODC defect type refers to the nature of change to fix the defect.

The main contribution of this study is,

- Bug report classification from unstructured text provided in the description field of bug reports based on LSTM

- Compare the performance of LSTM and TF IDF based approach in terms of accuracy, precision and recall

The rest of the paper is organized into various sections. Section II overview the related work based on ODC. Section III presents the proposed framework and LSTM. Section IV discusses the results. Threats to validity are discussed in section V. Section VI concludes the study with future work.

II. RELATED WORK

The section overview the recent approaches that try to automate the process of bug classification based on orthogonal defect classification attributes. L. Huang et al., [3] presented an AutoODC approach to automate the defect classification process according to ODC as a supervised text classification problem. In this approach, they integrates ODC experience with domain knowledge and introduces a relevance annotation framework according to which an annotator not only assign defect category but also specify the reason why a given defect should be assigned this defect category. They were able to achieve an accuracy of 82.9% and 80.7% using the naïve bayes and support vector machine algorithms on 1653 defect reports.

F. Thung et al., [4] propose an automatic defect classification method based on support vector machine. This classifies defects into three categories control and dataflow, structural and non-functional by aggregating ODC defect type attributes. In the proposed scheme, they extract the useful information from the bug reports by applying text mining techniques to classify defects. To empirically validate the results, they collected 500 defect reports and manually classified them in three categories before automatically classify the defect reports using support vector machine. They were able to achieve an accuracy of 77.8%.

F. Thung et al., [5] propose an active learning and semi supervised classification approach that minimizes the efforts of manually labelling of the defect reports. The approach uses both labelled and unlabelled defect reports to train the machine learning algorithms. Author labels only 50 defects out of 500

defect reports and were able to achieve a weighted precision of 65.1%. The main aim of the proposed approach is to decrease the time spent in classifying the defects.

Hernández-González et al. [6] proposed a method based on ODC defect impact attribute. In the proposed method they use the labelling from a set of crowd and used most voted label as true label and train the machine learning algorithms. They named this approach as learning from crowd. A set of five annotators were asked to assign label according to ODC defect impact. Total 1444 defect reports were collected from two projects, compendium and Mozilla.

F. Lopes et al., [7] presented an automatic defect classification method which evaluated the use of machine learning algorithms such as k-Nearest Neighbors, Support Vector Machines, Naïve Bayes, Nearest Centroid, Random Forest and Recurrent Neural Networks to classify the software defects using ODC attributes activity, trigger, impact, target, qualifier, age and source. To validate the method, 4096 defect reports were collected from three projects.

The previous studies have used the one or more ODC defect attributes to automate the process of defect classification. In this work, we used the eight categories defined in ODC defect type namely Interface, Function, Build/Package/Merge, Assignment, Documentation, Checking, Algorithm, and Timing/Serialization. These categories can be applied to any software project.

III. PROPOSED FRAMEWORK

The proposed framework is depicted in Figure 1. First, we preprocess the text in the description of the bug reports by removing punctuation, special symbols and stop words. The text is tokenized to get the vectors for each of the word in the cleaned description. Vectors for each

word is generated using the word embedding. Word embedding represents the words into low dimension space. It allows similar representation for the words having similar meaning. A word embedding matrix is formed from these vectors. The word embedding matrix has a fixed dimension for each of the word. For this study, dimension of the matrix is 100 and vocabulary size is 5000. It serves as an input to LSTM.

A. Long Short Term Memory

Long Short Term Memory (LSTM) is a recurrent neural network. It is capable of capturing the sequence of words. Recurrent neural networks (RNN) are neural networks where different layers are connected a one layer acts as a input to the next layer in the network. The parameters remain same for each layer in RNN and thus help to reduce the complexity of the network. It is also used to learn the past information but at the time of training, RNN loses some important information by partially using the past information. This problem is known as gradient vanishing problem. To overcome the problem of vanishing gradient descent, LSTM uses a cell state as a memory of the network. It can handle the long term dependencies. There are four steps of LSTM network. First, the irrelevant information from the current cell is removed, referred as forget gate. The second step determines how much information is to be added to the cell state, referred as input

gate. In step 3, information from previous state and the current state is combined to update the current memory cell and finally the output is determined.

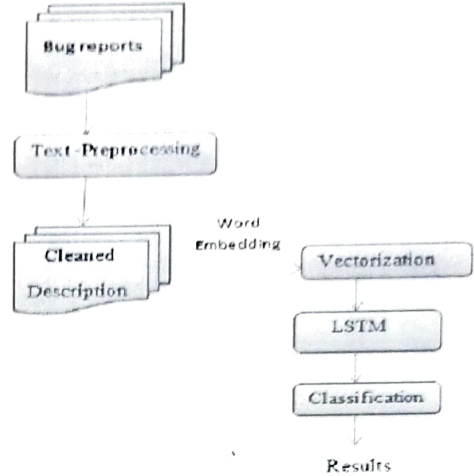


Figure 1 Proposed Framework

B. Dataset

For the experimental work, we collected the datasets from F.lopes et. al.[7]. The dataset contains 1618, 1095 and 1383 bugs for MongoDB, Cassandra, and Hbase respectively. The bug reports are composed of title, description and comments that helped in manually classification of these bug reports into orthogonal defect classification attributes.

TABLE I DETAILS OF DATASETS

Defect Type	#Reports
Algorith/Method	2365
Function/Class/Object	543
Assignment/Initialization	169
Interface O-O Messages	312
Checking	407
Relationships	8
Timing / Serialization	158

In this study we used the defect type attribute. Defect type attribute is further categorized into various types. The dataset is classified into seven types but for the experiment we have used only 4 classes as for the rest of the types, dataset does not have sufficient number of bug reports. The details of three datasets are shown in table I. It shows the Defect type and the number of reports in each type.

C. Evaluation Metric

In this study, we used accuracy, precision and recall to evaluate the performance of the kNN, NB, RF and SVM classifiers. The metrics accuracy, precision and recall are calculated based on the confusion matrix. It is a tabular presentation of the performance of the model prediction. Confusion matrix compares the values of the predictive class to the actual class values. Consider a given class the following measurements can be taken:

True Positive (TP): refers to the number of instances correctly classified as class C.

False positives (FP): refers to the number of instances classified incorrectly as to another class.

True negatives (TN): refers to the number of instances not classified as C.

False negatives (FN): refers to the number of instances assigned to other classes but they actually belong to class C.

The evaluation metrics accuracy (Acc), Precision (Pre) and Recall (Rec) now can be defined as :

$$acc = \frac{TP+TN}{TP+FP+FN+TN} \quad (1)$$

$$pre = \frac{TP}{TP+FP} \quad (2)$$

$$rec = \frac{TP}{TP+FN} \quad (3)$$

IV. RESULTS

We implement LSTM based method with pre-trained word embedding generated for each word in the cleaned corpus of the bug reports. We also compare our LSTM based bug report classification method with existing TF-IDF based method [7]. We used the same dataset as of [7]. To compare with our method, we took the highest result in terms of accuracy, precision and recall from TF-IDF based method. Table 2 show the accuracy, precision and recall score of two different methods based on TF-IDF and LSTM with pre-trained word embedding.

Table II. RESULTS

Methods	Acc	Prec	Rec
TF-IDF[8]	34.7	34.7	34.8
LSTM	68.7	59.4	57.2

Figure II shows the result comparison between two approaches In terms of accuracy, precision and recall.

The proposed approach based on LSTM is able to outperform the TF-IDF based approach by 34%, 24.7% and 22.4% for accuracy, precision and recall respectively.

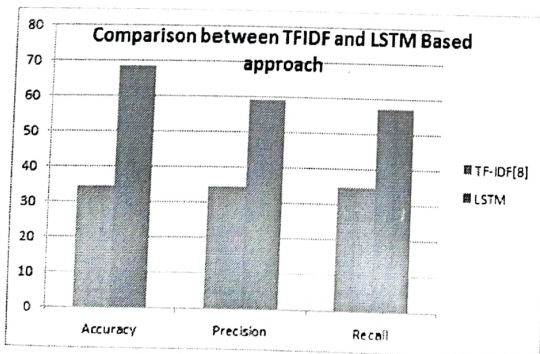


Figure 2. Comparison between two approaches

V. THREATS TO VALIDITY

The section discusses the construct, internal and external threats to validity of our work.

A threat to construct validity refers to the selection of measures. For the evaluating the performance of proposed methodology we used accuracy, precision and recall which are the well-established measures in classification problem. So there are minimum threat to construct validity. There are other issues that can be addressed such as redundancy in the bug reports, class imbalance etc. we have used under sampling technique for the imbalance issue.

Internal threats to validity refer to the experiment biasness. We have compared our method with the existing method to prove the effectiveness of our method. But most of the studies do not provide their experimental script. We have taken the same datasets and compared our results to the original work.

External threat to validity is concerned with the generalization of results. We have taken the dataset from [7] which has a 4096 bug reports from three NoSQL databases Cassandra, Hbase and MongoDB. The size of the dataset is small. The dataset does not have sufficient bug reports for some classes.

VI. CONCLUSIONS AND FUTURE WORK

The study proposes an automatic classification of bug report into defect types as defined by orthogonal defect classification model. We evaluate the performance of Long Short Term Memory in terms of accuracy, precision and recalls. We compare the proposed method to TF-IDF approach. The results show that the LSTM based classification model outperforms TF-IDF approach. In future, we plan to develop a tool based on neural networks model to help developers to automate the process of bug report classification.

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DHAROHAR: THE GLORY OF THE NORTH-EAST

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Gender and Feminism

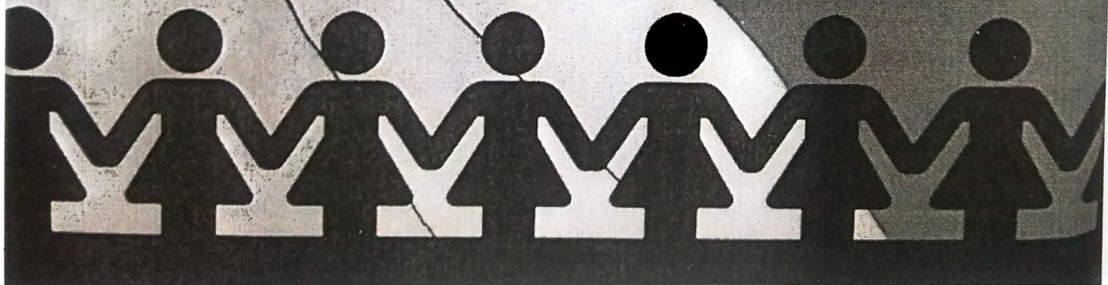
UNDERSTANDING AND EMPOWERING WOMEN

Editors

Dr. Yogesh Kumar Sharma

Dr. Susheela B.

Dr. Anupama Rawat





Gender and Feminism

UNDERSTANDING AND EMPOWERING WOMEN

Prof. Yogesh Kumar Sharma is a poet, story writer, essayist, blogger and an author. Prof Yogesh Kumar Sharma (M.A., MPhil, PhD.) is presently working as Professor in Swami Shraddhanand College, (University of Delhi), Alipur, Delhi-110036. He was also Associate NCC Officer (ANO) in his college. His early education was held at Khurja and higher education, (M.A., M.Phil., Ph.D.) at Institute of Advanced Studies, Meerut University Meerut, U. P., INDIA. His research work "Influence of *The Bhagavad Gita*" on Matthew Arnold is considered as outstanding scholarly work in literary circles. He has published several articles and his poems on different topics have found place in a number of newspapers, magazines and journals. He has written many poems (more than 700), short stories (around 50), articles and essays (200) on different aspects of society concerning day to day life of the people. As a poet he has authored a book *Voices. Dharohar: The Glory of the North-East* is another book written by him, based on travelogue

About the Book

The definition of 'Feminism' is not about strengthening gender diversity by standing on the side of a woman; it is a common struggle for human freedom marred by gender inequality.

This book is a noble attempt by the academic scholars to unlearn and dismantle the normative structures and identify the difference. Multiple social, religious, caste and ethnic identities have tried to negotiate themselves through uprisings, protests, movements to fight against oppression espousing their cause as marginalised and the less privileged. To universalise but to contextualise the difference and to bring into forefront diverse grievances, needs and expectations and make each and every campaign more inclusive is the need of the hour. This book creates a bench mark by focusing on differences and not on similarities. It is a trail marked for inclusivity.



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AUTHORS P R E S S

Introduction

“O it is excellent
To have a giant’s strength, but it is tyrannous
To use it like a giant”

(Shakespeare, *Measure for Measure* II.ii.107-109)

All the battles, wars, and struggles in the entire world among human beings, animals, birds and other species are mostly fought for survival, existence, power, control and excellence. The above-cited lines very clearly state that it is the goal of every human being and it is very natural and instinctive human nature to attain power. However, it should be used judiciously because even a minor action may hurt others. Now, all claim benefits and rights but do not think about their duties and the rights of others. The majority of human beings forget about the rights of others. All try to crush, exploit, disgrace and persecute others. This mentality and behaviour are universal.

“The weak die out and the strong will survive, and will live on forever.”
(Anne Frank, *The Diary of Anne Frank*)

Most of the time this struggle for survival and power was for selfish motives and benefits. Human beings became so callous and treacherous that they started using these tools of oppression for a materialistic chase, powers and positions. This defamed these movements. This is a very real thing that all know these tendencies and vested interests but they are inclined to ignore them. Everyone in this universe has a lust for power and identity. These new concepts of feminism and marginalisation are used for such aims.

Most people want something “Extra” in their life. So, for this extra, they try to misuse their power and resources. This tendency creates imbalances in society and gives birth to the reaction of oppression and such forces try to exploit others. They may be workers, farmers, masters, men, women, upper caste people, lower caste people, rich, poor minorities, majorities and so on. Nobody is

2022, do a mid-page analysis. Similar styles of violent killing can be seen in two Hindi and Malayalam movies. The researcher also aims to improve comparisons with bilingual movies. The female characters come up with the idea of how a woman's power can be expressed through movies to achieve self-improvement.

Divya Bharathi. N has carefully pinpointed the various notions of feminism in the masterpiece *Ahalya*. Her paper, "Facets of Feminism in Kavita Kane's *Ahalya*" has described how different kinds of feminism take up priorities throughout the novel.

The final paper "Semiotic Construction of Masculinity in 'Things Fall Apart'" by Chinua Achebe written by *Manisha Rao* is an inspection of how language has constructed a masculine aspect in the very famous novel *Things Fall Apart*.

In this way, this edited book has seen the radiance of the day after the unrestricted support, cooperation and proper and judicious help and guidance of several scholarly people to whom we would like to express our thanks and gratitude. We would like to thank all the valued contributors who demonstrated their remarkable and receptive concerns to write scholarly critical essays on the theme selected by us keeping in view their area of interest. It was a big challenge for them. We are very grateful to all the contributors, professors, research scholars and faculty members for adhering to the time frame and taking pains for doing all major and minor corrections and reshaping their papers at the advice of the editors.

We are also thankful for the affection, love, blessings and support of our family members. We could not understand how we managed and completed this difficult task.

We are also extremely grateful to the Managing Director and the publisher for accepting the manuscript and giving valuable suggestions. We are also thankful to the team of publishers. It was a great honour to all the scholarly contributors for their faith. We also appreciate the whole editorial, production and publishing team to publish this edited book of outstanding quality.

Prof Yogesh Kumar Sharma
 Deptt of English,
 Swami Shraddhanad College
 (University of Delhi)

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HOW BLUE IS MY SAPPHIRE

Dr. Yogesh Sharma

Associate Professor, Deptt of English,
S.S.N. College, (University of Delhi)
ALIPUR- Delhi - 110036, INDIA

I am a true Indian and a Harijan. So are all my relatives, friends and contacts. One happy day I gave good news to all, "I am going to Varansi." All were happy but worried too. With congratulations, I was showered with advices.

"Varanasi-Holy Ganga!how lucky you are! Great?"

"No, no, you would have tried to America."

"It's the same thing. Varansi or America...Makes no difference. Success is more important...This time Varansi...next ...America! Who knows?"

Really, a big name! A big city, a lonely planet and a glamorous playground of dark-superstitious-Hindu world.

"But beware of Pundas, Brahman, Sadhus and cheats."

"Don't go out alone on banks of river Ganga. It is full of rowdy Sadhus, pundas and cheats. "

I was surprised that why everybody was so scared of Hindu Sadhus and pundits but love Muslim mazars and dargahas.

In India too, I have been hearing this since I was a child. Indian model of secularism has made Muslims as the most important

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The Romantic Breeze

Editor-in-Chief

Kanwar Dinesh Singh

Associate Editors

Parul Mishra

Rajashree Mohapatra





Dr. Kanwar Dinesh Singh is a distinguished Indian poet, storyteller, critic, and translator based in Shimla, where he works as Associate Professor of English at a Government College affiliated to Himachal Pradesh University. Winner of *Himachal Pradesh State Sahitya Akademi Award*, he has published several volumes of poetry, haiku and short fiction written in both English and Hindi, as well as books in literary criticism. His recent publications include a volume of poems and ghazals – *The Frosted Glass*, a collection of very short stories – *Within Minutes*, and translations of Hindi short fiction into English under the title – *Beyond Semblances* and edited books – *The Poetry of Walt Whitman: New Critical Perspectives*, *Explorations in Australian Poetry* and *Hues of Life: An Anthology of Short Stories*. His poems, haiku, short stories, reviews, interviews, and essays have appeared in many reputed journals, newspapers, magazines, and anthologies in India and abroad. He edits *Hyphen*—a journal of literature, art, and culture, and sits on the editorial and advisory boards of several literary journals. Some of his books have been included on the list of recommended readings in the syllabi of universities across the country.



Dr. Parul Mishra is currently working as Faculty of English at GD Goenka University, Gurugram, Haryana, India. She has published several articles related to *Existential Concerns, Folklore, Mythology, and Gender Studies*. Recently, she has edited the books on *Gender, Sexuality and Literature* (ISBN:978-81-946799-0-5), *Disaster, Holocaust, and Dystopian Literature: Concepts and Perspectives* (ISBN: 978-81-946799-3-6), and *Indian Folklore: Contemplation on Arts, Aesthetics and Culture* (ISBN: 978-81-949267-4-0).



Ms. Rajashree Mohapatra: Born in Odisha in India received her MA degrees in History, Journalism and Mass Communication from Utkal University, Odisha. She is a teacher by profession. Being a post-graduate in Environmental Education and Industrial Waste Management from Sambalpur University, Odisha, she has devoted herself as a social activist for the cause of social justice, environmental issues, and human rights in remote areas through non-governmental organization. Poetry, painting, and journalism are her passion.

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YOGESH SHARMA

Dr. Yogesh Sharma is a poet, short story writer, essayist and blogger. He is presently working as Associate Professor in Swami Shraddhanand College, (University of Delhi), Alipur, Delhi. He was also Associate NCC Officer (ANO) in his college.

Dream

Here and there, to and fro;
 Enjoying dreams, as in a little ferry, go
 Seafaring far transversely in the sea,
 But in realism all alone, just little bee.
 And the dreams are huge and strong;
 And the voyage very long.
 Here and there, to and fro;
 Enjoying dreams as in a little ferry, go

Earth, the deep and sky,
 Calmly on the couch I lie,
 Having just a tiny rest.
 I have really through my best,
 Some time in an appalling brigand fight,
 But I confine them all right.
 Earth, the deep and sky,
 Calmly on the couch I lie,

Then I awake, "O Mother dear."
 And I rouse and sat upright,
 I found myself in a worldly gear,
 And my mother's arms around me—tight.

Sl. No- 173
Chapter

CENTERING THE MARGINS
ESSAYS ON
DALIT LITERATURE

Edited by
Dr Bijender Singh
Dr S. Chelliah

CENTERING THE MARGINS ESSAYS ON DALIT LITERATURE

Any intelligent survey of present literary scenario brings home the fact that the voice of protest, Dalit consciousness or subaltern voice is found to be out and out an indispensable theme solely with an avowed social purpose, thereby touching upon some sweeping revolt against economic exploitation, subjugation of women, suppression of the underprivileged and the oppression of the downtrodden and the Dalits. Not only lovers of literature but also literary critics and social scientists are really very anxious and even curious to study these literary insights and perceptions related to Dalit or protest literature. This anthology does neatly acknowledge the aspirations of marginalised people in their pursuit of equal rights, freedom of expression, liberty and fraternity, oppression of women and the marginalised and the exploitation of the lowborn and the neglected, all of which get projected in this volume which includes insightful essays on such themes as caste, deprivations, hunger, traumatic realism, improbable imbalance, subalternity, untouchability, Dalit discrimination, marginalisation, Dalit feminism, Dalit exploitation, caste discrimination, voice of assertion, gender politics, multi-axial intersectionality, violence, repression, resistance, Dalit subjugation, patriarchal voice, resistance, identity crisis, humiliation, heartbreak and post-partition trauma. This anthology entitled *Centering the Margins: Essays on Dalit Literature*, consisting of thirty critical essays on diverse aspects of Dalit Literature, will be of immense current literary use and value to both scholars and teachers and will no doubt be well received by the social critics, intellectuals, writers and thinkers of both India and abroad.

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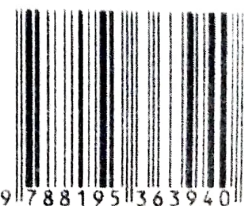
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A Fine Balance: A Story of Improbable Imbalances

Dr Yogesh Kumar Sharma

A Fine Balance by Rohinton Mistry is a very famous novel. It shows more about the intellect and genius of the author who has created a very impressive but imagery story in a very brilliant manner. Characters appear alive from the black and white events of life and performed excellent drama which is strong enough to grip the readers. After reading the novel one cannot stop thinking whether all the miseries, misfortunes and tortures that chop down Ishvar and Om were true or imagery.

Rohinton Mistry has masterly control and approach towards life, death and oppression. Readers are disgusted with the brutal description and creation of division and oppression in society. Mistry became a symbol and writer of paradoxes, a writer who delved deep into the society and oppression, all wish to avoid, as it is difficult to tolerate and digest such things. In the present novel *A Fine Balance*, the author Mistry is very open and rather blunt. At places, it is almost very difficult to believe. It is the clear flight of fancy or personal prejudices. The title *A Fine Balance* is highly contradictory sans all the balances in life and society.

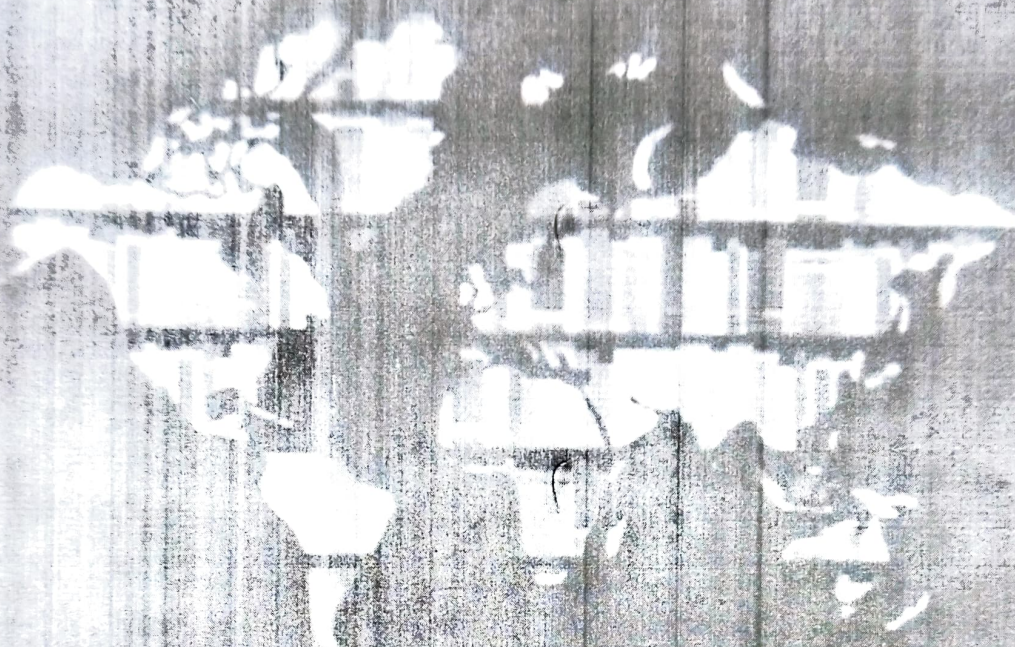
Moving on a tight rope, Rohinton Mistry tries to maintain a fine balance between life and death, joy and miseries, laughable buffoonery and ugly ribaldry, oppression and kindness. In the novel, it is a great presentation by one of the most deeply

Sl. No - 174
Chapter



IN TRANSLATION

Literature Across The World



Editor

Dr. Rajshree Roselean Kapoor

The creative power and literary aspect of an artistic work is transformed via translation which will lead to greater exposure and new vistas for language readers. The relevance of world literature as well as the exploration of manifold cultural experience and representation creates a sense of shared values through engaging literary translations. The edited book *In Translation: Literature Across the World*, the chapters imbibe various aspects of translations under one larger term. With the translated book, revitalizing literature and language while drawing attention to the absorption of one language and culture to another is fostered. Literary translation opens the vast arena of literature creating a specific niche to unknown and unexplored languages and communities. The book has launched thirty-two skillfully written chapters on the art of translation and serves as a reference book for new researchers across the world interested in translation.

IN TRANSLATION

Literature Across The World



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CHAPTER 3

Lost and Found in Translation

Dr. Yogesh Kumar Sharma

The practice of translation is very old in India. Many Hindu and ancient Indian scriptures and books have been translated into many languages and they enriched the intellectuals and eminent literacy figures in all parts of the world. Translators help the literary world to channel forward in a new way that no amount of promotion and discussion in the innovative language can do for a new learner. The translation is an outbreak and a new window of literature in the world.

Translators open the knowledge and literature and breaking the barriers of languages: both written and orally form. It is just like a hidden force of knowledge. Thoughtful philosophical and psychological issues are dealt with very deeply, in Indian scriptures and works of literature. These topics in translations could enrich the good study material in any of the world universities. A wide-ranging theory of translation between languages that can anticipate and solve the intricacies of linguistic, cultural and philosophical transfer without changing the meaning, set the standard of 'understanding and evaluation' although appears a near unfeasibility, giving the multiplicity of variables the procedure of translation has to meet and contend with.

Translation technique is very important and very necessary to understand for all the writers and the books. But good translators are needed to translate correctly so that sense and meaning are not changed and distorted. Now, Translating Indian literature is beginning to be taken seriously. Without the translations, the Renaissance would never have ever happened. They are the cultural breakers of history, throwers of voices and the new creators.

The popular and multifaceted issues of the society – poverty, religion, region, violence, caste, gender, and language are very soundly

Sl. No- 176 - Chapter

South Asian Diaspora

Writers and Works

Edited by

D. S. Gellman

University of Illinois - Chicago



The Post-Independence era has witnessed inspired writers immigrating to other countries and writing, adopting and advocating socially relevant themes and socialistic approaches. The fall in human values affects our society, thereby breeding many disorders in our life. To those who fail to understand the importance of life and the beauty of relationship in our life, literary creations or compositions will enrich their endeavours by offering new insights and perceptions. This anthology entitled, *South Asian Diaspora: Writers and Works* containing thirty well-researched papers, offers a broad spectrum of scholarly essays on South Asian Diaspora wherein characters are seen straddling on two different cultural constructs. This book has a unique framework on scholarly articles by eminent Indian academics and scholars on such multi-layered themes and multi-cultural approaches as religious extremism and bigotry, intersectional feminist ideology, diasporic vision, women's identity, quest for self-identity, reconciliation with the past, migrant experience, alienation, cultural sensibility, identity, feminine sensibility, dislocated self, hybridity, gendered identity, displacement, ambivalence, patriarchy, existential angst, psychic trauma, tragedy of unfulfilled dreams, diasporic angst, ethnic conflict, etc. This book, it is hoped without any shadow of doubt, will find favour and literary appreciation of all the researchers, teachers, students and even amateur readers and the lovers of literature with a panoramic look at the present-day literary insights and explorations pertaining to the writers of South Asian Diaspora.

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Centering the Margins:
Essays on Dalit Literature

Edited by
Dr Bijender Singh
Dr S. Chelliah

Perception Publishing House
New Delhi & Bareilly

Mapping Islamic Patriarchy in Meera Syal's *My Sister Wife*: A Feminist Approach

Dr Yogesh Kumar Sharma

Experience of migrant writers and creative men qualify a creative man to a special class writer. His focus is divided between the adopted culture and his root culture. These include: Indian, Pakistani migrants and migration from former colonies of England and Europe. These migrant writers contributed immensely to British-Asian literature. This situation of religious cleansing in Pakistan, Bangladesh and Afghanistan has been depicted in her works where the subcontinent was divided into secular India and Muslim Pakistan after the British rule ended in 1947.

Diaspora literature focuses on the divided and bitter social conditions in the migrants' root country which they left. Their bitter reception which they receive in the adopted country, experiences of hostility, racism, rootlessness, a search of lost identity, the roots and the pain from displacement and cultural openness. Therefore, Diaspora literature and postcolonial literature show similarities and overlapping. Diaspora literature also speaks about migration literature. Displacement is an important expression in Diaspora literature applies to all migrant writers. It discusses physical

Centering the Margins: Essays on Dalit Literature

Edited by

Dr Bijender Singh & Dr S. Chelliah

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INTRODUCTION

O, it is excellent

To have a giant's strength; but it is tyrannous

To use it like a giant.

— (Shakespeare, *Measure for Measure* 2.2 107-8)

The whole battle in the world among human beings, birds, animals and other creatures, what we generally reckon, is only for existence, survival or power. The quotation cited above implies that one should acquire power in life being it an instinctive human desire but one should do it quite judiciously because even a small step may be fatal for a person, animal or creature. While claiming rights, people should not forget that their duties are also associated with their rights but human beings become so blind and mired that they forget that human life is transitory. People exploit, humiliate and even do not hesitate to commit sins. Such people are generally seen full of remorse in their old age.

Sometimes this fight for survival turns into selfishness and human beings become so callous that they start running after materialistic pursuits, posts and powers. In the rat race of money and materialistic things, human beings should not let them veer off the noble path of humanity. They should not forget that there is a perfect plan in this world by nature/God that all people take birth in the world empty-handed and they make their last journey to heaven leaving behind all the worldly things—money, jewellery, family members and relatives.

It is also a strange thing that most of the human beings know this fact, but they tend to ignore it. Everything in the world, living or nonliving, has a unique identity/name. It is a natural feeling to have one's own identity. This identity is one's image. Even a stone is worshipped when it is chiselled, carved,

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**Journey towards Self: A Study of
Rajni Tilak's *Apni Zameen Apna
Aasman***

Dr Saroj Bala

From time immemorial, across geographical locations and social spaces, woman has been assigned a status of the 'other'. This has been asserted and affirmed through patriarchy. It is a hierarchical social structure that gives men the status of being 'primary'. Women play in different roles in relation to men. Woman is appropriated as a wife, a mother or a sister. Her identity as an individual with her own perspective is missing. The condition of Dalit women is more difficult because of poverty, caste and patriarchy.

The status of men and women in a society depends on their gender. In patriarchy, the role of women is appropriated in relation to men. Man is considered primary and woman as secondary. According to Simone de Beauvoir, she is the 'other'. Their roles also depend on these social constructs. The role of women is considered to be within their houses which keep them away from arenas outside these boundaries, for example, education, finance, politics, science, etc. This marginalization becomes manifold for Dalit women because of poverty, caste and gender. They suffer on account of patriarchy within their families. Outside their homes, they have to suffer because of being poor and Dalits. Their struggle against these barriers is evident in their writings. In *Apni Zameen Apna Asmaan*, we come

across the life journey of Rajni Tilak. The book reveals her resistance against patriarchy and oppression. From a vulnerable child to an educated person, a teacher, a writer and a social-worker; her life is an inspiration for all Dalit women.

Gender, a socially constructed identity for women limits her role to the boundaries that run up to the four walls of her house and the threshold. Household chores are for women; social, political and economic affairs are for men. These social boundaries have restrained her access to various fields such as education, employment, politics and other public spaces. These boundaries are further increased in the case of Dalit women. They bear the brunt of being a woman and a Dalit. Poverty further adds salt to their wounds. Within their families, they suffer oppression because of patriarchy. Outside their homes, they face atrocities on account of being Dalit. Poverty makes them the most vulnerable group in a society. That is why their sufferings and struggle are more than other women who are from upper socio-economic strata of society. This might sound a little weird in the present times when girls and women have access to education and other public spheres but even today this depends on one's geographical and social locations. But gradually, over the years and through long struggle, they have created a space for themselves in various fields, especially the field of writing. Their writings are testimony of their pain, anguish, helplessness and their grit to fight against all odds. Women have written about their perspectives on their social status and treatment by others keeping her 'self' at the centre of her writings. From the margins in the writings of other writers, she has moved to the centre in her writings. This is visible in autobiographical writings of women as well. Earlier autobiography as a genre did not get much attention but has recently become popular as an effective tool to express her 'Self.' It covers a writer's journey with perspective on issues that touch one's life. Here, it is an attempt to understand the autobiography of Rajni Tilak *Apni Zameen Apna Aasman*. She has broken many barriers in her way because of being a poor, a Dalit and a woman.

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**Deathscapes, Decaying Bodies and Queer Citizenship as seen
through the Lens of the Contemporary Indian English Writings**

Kuhu Sharma Chanana

Fellow, NMML



Nehru Memorial Museum and Library

2021

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Deathscapes, Decaying Bodies and Queer Citizenship as seen through the Lens of the Contemporary Indian English Writings*

Abstract

Citizenship is an important marker to reclaim the space of nation and the significance of it can be seen from the famous assertion of Lissa Duggan where she has asked for the need of 'queering the nation'. Through this paper, I explore the entwining of deathscapes, the dying and the decaying body and their radical potential to create a new kind of appropriation of the land of the nation and thus open a new fissure for queer citizenship. This article is an humble attempt to excavate how queers assert their right on land through the trope of death spaces and decaying bodies (which are marked by the absence/presence of valency and thus are coterminous with visible/invisible entities of queers) as presented in the contemporary literary writings by a specific kind of radicalization of real, lived and imagined spaces (to quote Lefebvre) in a quite potent way. The theoretical apparatus for the same has been borrowed from the writings of Matthew Sothorn, Vincent J. Del Casino Jr., David Bell, Jon Binnie, A. Maddrell, J. Sidaway and Steven Sideman. And the few literary signatures that I could find worth critiquing in this respect are short stories such as "A Married Man" by Dibyajyoti Sarma, "Bargains with Gods" by Sandip Roy, "The Crocodile Tears" by Raj Rao and The Ministry of Utmost Happiness by Arundhati Roy.

Keywords: Deathscapes, queer citizenship, AIDS citizenship, dying and decaying body, alternative family structures.

*This paper is a revised version of a public lecture titled "Queer Citizens and the Contemporary Indian English Writings" delivered at the Nehru Memorial Museum and Library, New Delhi, 13 March 2020.

There have been a lot of critical researches that centre around the death space, dying and decaying body and cemetery and the radical potential of such spaces to revolutionize the exposition of the marginalized entities. Apropos of the significance of the deathscapes,¹ Flynn and Laderman writes: "Throughout history, human communities have converted the dead into sources of living power by grafting symbolic structures onto them and their places of imminent. The impact of these structures on society, however, indicates that the 'dead' are understood as more than physical remains. The dead can be imagined also as memories, spirits, or deities, and the physical or spiritual locations where they reside are essential to the vitality of the symbolism....When conflict arises and the meaning and handling of the dead are disputed by interested parties, the battle for control can lead to important changes in both identity and the distribution of power" (p. 51). In fact as Woodthrope has said that since everyone is an 'insider' when it concerns death, because it has 'universal reach', and unlike otherwise sensitive issues like domestic violence and criminality, death is ultimately going to be experienced by everyone. Thus in one way negotiating queer entities through deathscapes, dying or leaking body becomes more palatable for a straight reader and somewhere blurs the boundaries between the insider and the outsider and works as a potent tool to bridge the gap. Thus, through this paper I have tried to map the trajectory of queer entities and their constant struggle to appropriate land and claim some kind of citizenship even if it is a debatable and dubious kind of citizenship such as AIDS citizenship—(which will be discussed in the first section of the paper) or claiming land even if it entails reappropriating graveyard space as will be discussed in the second section of the article.

Some significant works on the new perspective on space/place through interrogating death, loss and remembrances are quite conspicuous and widely referred to by various researchers (Johnson 1995, Hartig and Dunn 1998, Teather 1998, Kong 1999, Foote 2002, Maddrell 2006, 2009, 2010, Sidaway 2009, Anderson and Smith 2001, Bondi 2005, Smith 2009). Also, scholars such as Becker (1973) and others have incessantly talked about the serious linkages between 'death denial' or considered death a taboo. In fact Gorer has

¹ A. Maddrell and J. Sidaway in their seminal work, *Deathscapes: New Spaces for Death, Dying and Bereavement* affirm that "the idea of a variety of 'scapes' as a means of understanding contemporary social processes was proposed by the anthropologist Arjun Appadurai. His reference to the interplay of ethnoscapescapes, technoscapescapes, finascapescapes and ideoscapescapes has since been supplemented by an edited collection on 'borderscapescapes' (Rajaram and Grundy-Warr 2007) and taken up in work on 'memoryscapescapes' (Ballinger 2003). In a similar context of places, spaces, sites, flows, disjunctures and landscapes, we might think of deathscapescapes. The idea of deathscapescapes was set out by Kong (1999) and employed by Hartig and Dunn (1998) in relation to informal memorials for road accidents. We are adapting the broad heading of deathscapescapes to invoke both the places associated with death and for the dead and how these are imbued with meanings and associations: the site of a funeral, and the places of final disposition and remembrance, and representation of all these" (p. 4).

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gone to the extent of declaring death as pornographic for it has replaced sex as taboo in modern society. Hence convoluted linkages between death and sex as taboo can be built. The overlapping of death drive, forbidden sex and love has been effectively catalogued by Ruth Vanita in *Love's Rite* where she asserts that if marriage is a public statement of life-long unification then joint-suicide or love-death is also analogous to a public statement of intent to be united forever. According to her,

Alan Bray, who has studied the marriage like imagery on tombs of same-sex friends buried together in Western Europe from the fourteen through the nineteenth centuries concludes that the communities who built those tombs understood the relationships to be friendships, not sexual relationships. However, in the case of recent suicides in India, when families accede to the couples' last wish for joint funerary rites, they know the nature of the relationship because couples make it clear in the suicide note...So when the cremation fire is lit for a same-sex couple, it is with the knowledge that they died in part because the wedding fire could not be lit for them (p. 143).

Most recently Madhavi Menon in her book, *Infinite Variety: A History of Desire in India* showcases a connection between forbidden desires and deathscapes by citing the example of the dargah of Jamali and Kamali at Lal Kot, Delhi, who were buried as lovers side by side. She affirms that,

...often described as the gay Taj mahal, Jamali-Kamali's tomb is understood to commemorate a same-sex attachment as intense as the one that inspires Shah Jahan to build the mausoleum for his wife, these tombs are part of the landscape of monuments that mark desire in India (p. 32).

She further talks about the prevalent culture in Sufism of male-male love often resulting in common burial site. She has named it time and again as 'dargah desire'. Thus a kind of overlaps and linkages between same-sex love, death sites and a kind of reclamation of space through dying bodies become conspicuous in the writings of these critics though in a tangential way.

Despite a plethora of work being done in the critical sphere in the direction of showcasing a significant connection among death, dying body-spaces and sexual rights, in the creative space specially in the Indian context using the cemetery, dying and decaying body and graveyard sphere to negotiate queer entity's rights, specially on the land and spaces of significance, has not been much explored. And the few literary signatures that I could find worth critiquing in this respect are short stories such as "A Married Man" by Dibyajyoti Sarma, "Ulrike and Neville" by Meher Pestonji, "Bargains with Gods" by Sandip Roy, "The Crocodile Tears" by Raj Rao and *The Ministry of Utmost Happiness* by Arundhati Roy.

Since citizenship is an important marker to reclaim the space of nation and the significance of it can be seen from the famous assertion of Lissa Duggan where she has asked for the need of 'queering the nation'. Here, I explore the entwining of deathscapes, dying and decaying body and their radical potential to create a new kind of appropriation of the land of the nation and thus open a new fissure for queer citizenship. This article is an humble attempt to find out how queers assert their right on land through the trope of death spaces and decaying bodies (which are marked by the absence/presence valency and thus are conterminous with visible/invisible entities of queers) as represented in the contemporary literary writings by a specific kind of radicalization of real, lived and imagined spaces (to quote Lefebvre) in a quite potent way. The theoretical apparatus for the same has been borrowed from the writings of Matthew Sothorn, Vincent J. Del Casino Jr., David Bell, Jon Binnie, A. Maddrell, J. Sidaway and Steven Sideman.

Decaying Body Space and AIDS Citizenship

The concept of 'sexual citizenship', where the issues pertaining to the appropriation of the nation as a site by queers, first emerged in the writings of David Bell and Jon Binnie in *The Sexual Citizen: Queer Politics and Beyond*. The kind of right a legitimate citizen has on the land of the nation is alien to the so-called inauthentic citizens. Apropos of the significance of citizenship rights, Steven Sideman contends:

Citizenship rights make it possible for individuals to protect themselves against social threat, to participate in public decision making, to make claims about national policy and culture, and so on. At stake is how the lesbian and gay movements approach questions of citizenship. Contestation should be over the basis of citizenship and the meaning of sexual and intimate citizenship. In short we need queer articulation of democratic theory (p. 189).

Thus in order to claim a right on the land of the nation it is important to have citizenship rights. In *The Sexual Citizen*, Binnie and Bell have talked about various kinds of sexual citizenships through which queers can claim their rights on the land of the nation but out of these the most prominent ones are familial citizenship, consumer citizenship (where queers contribute to the pink economy) and a very dubious and radical kind of citizenship known as AIDS citizenship. As opposed to the other kinds of citizenships that are shaped on the model of the 'good gay citizen' and are of homonormative sort, the twisted radical potential of AIDS citizenship is unparalleled. Homonormativity is a kind of queer politics where the queerness is only acceptable till the time it is not destructive to the larger heteronormative structure and does not contest heterosexuality in any concrete fashion. AIDS citizenship

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allows the production of the 'counter republic'. According to Raj Rao, AIDS has hijacked the gay movement to such an extent that homosexuality was being seen as synonymous with AIDS. However in an inverted fashion it has accorded a certain kind of visibility to M.S.M. (men having sex with men) and gay people as can be seen in many literary signatures that I will be discussing in the later part of this section. According to Brown,

AIDS citizenship considers the AIDS quilt as public enunciation (or memorialization) of grief and rage---a kind of subaltern counter-public---which is simultaneously a site for both consciousness-raising (and fund-raising) and for the public affirmation of kinship and collectivity: a time space event of citizenship in civil society, that is many-layered, polysemic, both personal and public (p. 18).

Hence this AIDS quilt provides a certain kind of hybridity between family space (private) and civil society (public) or, in other words, between intimacy and citizenship. Support organizations for AIDS work as a blanket for the inclusion of all categories of AIDS patients in the new form of kinship which is being formed between the home and the 'shadow state' (Brown defines 'shadow state' as a voluntary organization linked to the state via funding and contracting). Brown asks for the broadening of our ideas of citizenship spaces by including the notion of 'buddying relationship' which makes the idea of overlap between citizenship and intimacy all the more conspicuous. He brings into its framework locations like home, the bedside and coffee shops and I will like to include another site to this list and that is the hospital space (which is a semi-public space on account of complex kind of privacy that it exudes despite being a public sphere). But this kind of citizenship is not devoid of problems as Philip Harper quotes from an AIDS patient advocate interviewed in Sullivan's 1996 *New York Times* article on the end of AIDS that there is a trend to reorient life in terms of happy citizen and this certainly is not a pleasant form of citizenship with which anyone will like to be associated and thus there is a tendency to slip back into a normative form of citizenship. However Sullivan, Brown and Binnie contend, "Indeed, why a pleasant existence should be constructed specifically in terms of citizenship in the first place---is not at all clear to me" (p. 19). Nevertheless it creates a certain kind of commotion in the fixed ideas of state (by forming the assumption of shadow state), space and civil society and creates a hybrid between the public and the private.

Moreover in the context of India, the big question is whether in the developing countries, the concept of 'shadow state' is actually applicable because the kinship between home, state and funding agencies is still at a juvenile stage and thus the assumption of

'shadow state' demonstrates numerous contradictory and ambivalent positions. Thus despite a lot of contradictions, AIDS body space not only creates radical slippages in the concept of citizenship by the formation of the 'shadow state' and 'counter republic' as discussed above, it also brings into discussion the social spaces of bed sides, home, hospitals and the spaces of public protests(through rallies against AIDS discrimination). Apart from this when we perceive body as a space, the body of an AIDS patient evokes a different sense of time-space compression as it is not oriented towards the future, longevity and respectability. Apropos of this kind of time-space compression produced through the body space of an AIDS patient it is pertinent to quote the observation of Matthew Sothern in "HIV+ Bodyspaces: AIDS and the Queer Politics of Future Negation". He observes that the AIDS body space "squeezes new possibilities out of the time at hand...(where AIDS) is not only about compression and annihilation; it is also about the potentiality of a life unscripted by the conventions of family, inheritance and child rearing. These new queer geographies of 'what if' are not a politics organized around an assumption of stable identity but instead a politics of liminal, non-identity that offers potential subversion to neoliberal formations of time and space...AIDS disrupts the assumed naturalness of time and place scripted by the assumption of what counts as the 'normal' life subject to the laws of the intelligibility"(p. 185). Thus AIDS creates slippages in the idea of nation space on account of the appropriation of the land by queers; firstly, through the introduction of dubious, oblique but equally potent kind of citizenship claims; secondly by creating new social spaces of coalition politics and solidarity like bed sides of home and hospitals and public sites of protests; thirdly an HIV+ body space is not oriented towards a future and creates a different sort of time-space compression.

The literary interpretation of these spatial gaps created by an HIV+ body can be seen in short stories such as "A Married Man" by Dibyajyoti Sarma, "Ulrike and Neville" by Meher Pestonji, "Bargains with Gods" by Sandip Roy and "The Crocodile Tears" by Raj Rao. The stories by Dibyajyoti Sarma and Raj Rao are significant because they put the issue of queerspawn (the child of queer parents) and the HIV+ body space at the center of the discourse and therefore I have taken into account only these two stories while shaping the trajectory of critical inquiry pertaining to this issue. Matthew Sothern in his seminal essay on HIV+body space has talked about the futuristic figure of a child or a queerspawn in contrast with the HIV+body space which is a 'living dead' (to quote William Harver's term) or the space of future AIDS corpse (to quote Sothern's term). The image of a queerspawn is generally associated with a homonormative gay or lesbian couple and therefore it

commensurates with the neoliberal capitalist agenda of heteronormative structure. The queerspawn of a heterosexual couple in which one of the partners is a closet gay and suffers from AIDS dismantles the logic of placing a queerspawn in the heteropatriarchal paradigm because the space of the HIV+ body entails "a figure over-determined by its subjection to a lack of futurity and therefore excluded a priori from the promise of the future afforded by The Child" (p. 182).

The acceptance of the homonormative family (with two queer parents and queerspawns) is on account of their membership to consumer citizenship (due to the emergence of pink economy because now the gays and lesbians have disposable income and the market wants it) and also due to the familial citizenship (family is the smallest unit of nation and producing future citizens warrants a claim on land). As opposed to the futuristic picture of child, the HIV+ queer body is synonymous with living dead and disrupts the homonormative familial structure (which is their way of claiming the position of a 'good gay citizen') in more than many ways. The state recreates conservative political structures as it by and large tries to invest in the conservative cultural politics of family, even if it means homonormative family "and self responsibility where the ideals of the long, productive and respectable life buttress the logics of flexible capital accumulation to ensure that 'everything has a time and place'" (p. 185). In this manner the decaying and dying body of an AIDS patient disrupts the time-space compression by presenting an embodied expression of alternative queer space and time with no futuristic goals of permanence. It is in this way that the HIV+body spaces reorient not only the straight spaces that they inhabit but also radicalize the queer spatial formations of such places. Secondly the funding of NGOs that work towards the welfare of AIDS patient unwittingly helps in the formation of 'shadow state' and 'counter republic' that give impetus to the idea of AIDS citizenship as mentioned by Binnie and Bell in *The Sexual Citizen*.

Decaying Body Space: 'A Married Man'

Now let us come back to the antithetical images produced by the child (a symbol of future and citizenship) and HIV+body space (which is a metonymic signifier of the negation of future) that form the center of these two stories written by Raj and Dibya. These stories have somewhat a similar kind of plot as the two men in question have heterosexual marriages and have children and both the protagonists of these two stories are closet gay men who suffer

from AIDS. In "A Married Man" the protagonist dies, leaving his lover and child to form a foster alternative family structure with his wife. Let me first examine "A Married Man" by Dibyajyoti Sarma and give a brief sketch of the storyline. The protagonist of the story is a successful closet gay, Mayank Mehta who is supposedly happily married to Aditi for six years and they have a child. A normal cold caught by Mayank takes a sinister turn and he has to be admitted to a hospital where a series of tests reveals his HIV+status. Heteronormativity is so much embedded in our psyche that all the time Aditi's mind keeps on hovering towards Mayank's prospective women lovers and not even once she suspects him of being gay. It is specifically strange as it is a common knowledge that MSM (men having sex with men) is one the most vulnerable groups for contracting AIDS. Generally the first reaction to this disease veers around the promiscuities surrounding illicit heterosexual liaisons. The same happens with Aditi. On constant pestering Mayank tells her that he is a gay. Thus AIDS works a catalyst to 'out' him and the hospital becomes the most conducive space for his 'coming out'. The hospital space in this way became the most appropriate site for coming out in many stories including films like "My Brother Nikhil". Thus in a dubious fashion, the stringent state-scrutinized hospital site becomes a site of contestation and from there on it reorients the home, living room and bedside as has been depicted in the story, "Ulrike and Neville" by Meher Pestonji. In fact Mayank's lover Probhat visits him daily at the hospital and the hospital bed-side becomes the micro-space of their verbal and non-verbal interactions. Such is the radicalization of the hospital space that when the doctor tells Aditi that Mayank's lover visits him daily, there is some kind of approval of their relationship in his tone. To quote from the text,

'Doctor, tell me, didn't Mayank ever tell you that he used to sleep with men? Aditi felt bitterness filling her mouth while uttering these words. 'No. But I guessed as much after meeting his friend'. 'What friend'? 'His name is Probhat. He is the only person who is visiting Mayank for the last one week'. Aditi did not like the doctor's voice, as if he was comparing Aditi with Mayank's new friend and had found her wanting (Sarma, p. 417).

Coming back to the story, one notices that the hospital space has been revolutionized so much so in this story that the identity of Mayank's gay lover has been revealed by the doctor right in his clinic in the hospital. That they should meet at the cafeteria is a suggestion made by the doctor. "Then she said aloud, 'This friend of his, what's his-name, is he here?' Dr. Batra looked at his watch. 'He should be. Visiting hour is not over yet', he said. 'Do you think I can have a chat with him?...Do you think you arrange a meeting somewhere else, maybe the cafeteria downstairs'?' For a hospital, the cafeteria was nice and cosy"(416). And

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she finally meets the gay lover of her husband at the coffee shop and builds a life-long connection with him. Thus the hospital with its micro spaces like bedside and cafeterias assumes the form of an ideal sphere to realize 'buddying relationships', to quote Brown's term. Brown emphatically mentions these spaces where a 'buddying relationship' takes place and here it is visible in the amiable negotiation among doctor, Aditi and her husband's gay lover, and a peaceful co-existence of homo and hetero desire can be seen at the hospital site. In this story the hospital space---which is otherwise considered a space of exclusion, on account of stringent rules and regulations as there is a strict enforcement of space (as there are plenty of restricted spaces at hospitals where entry is not allowed) and time (some parts of hospitals are open for a certain period of time only), and constrains the embodied experience of an AIDS patient---gets refashioned in such a way that the significant fissures open up. And it is a unique kind of semi-public sphere where a certain kind of privacy is warranted.

Now coming back to the story, a friendship develops between Aditi and her husband's gay lover, Probhat and after the death of her husband Probhat becomes the foster father of Aditi's child whose presence can be marked throughout the story. In fact the section which depicts the father-daughter bond between the little daughter of Aditi and Probhat is entitled as "How Probhat Nandi Found 'A Family'". Now the presence of a child is contrasted with the decaying body space of an AIDS patient and it evokes multiple convoluted meanings. As mentioned above, the futurity of the child is the primary signifier that is at the center of a homonormative family structure and when this child image is contrasted with the HIV+body space (that defines the disruptive potential of queer space and time), one can presume as how the queerspawn is conducive for both homonormative queers and the state's agenda of providing citizenship rights based on the familial structure. Apropos of this Sothern contends that "the HIV+ body space is a one that exudes a radically different non-future. This opposition of The Child as the signifier of the future (the phantasmic projection that is the stuff of the political) and the future negating queer (epitomized by the figure of the living-dead HIV+body---the body that spreads death) causes major problems for liberal gay and lesbian politics of homonormativity and their argument about gay benignity" (p. 190). Now AIDS in this fashion reckons the non-conformist queer politics without the tyranny of future by radicalizing the queer time and space in an entirely different fashion so that something altogether anew emerges out of it. HIV+ body space refuses to succumb to the 'fascism of the baby's face' (to quote Edleman's term). Now when we examine the story, "A Married Man"

in this light we find it lacking on many aspects as the constant presence of the child is not only indicative of normative time, space and future but also it points towards the formation of homonormative family structure because Probhat (the gay lover of Aditi's husband), Aditi and her little daughter Sia form an alternative family structure and even Aditi contemplates that probably Mayank would have liked it that way. In fact the erasure of explosive AIDS body can only give way to the homonormalization of this family and family is the smallest unit of nation formation and thus familial citizenship is an effective way to assert right on the nation. The heteronormative need to retain the future through the child is expressed in these words: "Yes, Mayank might have wanted it this way. But their strange family would not have been possible as long as he was alive. His own presence has been the flaw in the plan that he hadn't considered" (Sarma, p. 425). In this way the stable economy of identities remains intact. Hence through the formation of this kind of homonormative family (which is conducive to the larger heteropatriarchal politics as it produces 'good gay citizens' who may create harmless mutations at the boundary but can never effectively replace center) the rabid potential of HIV+ bodyspace has been hugely compromised. Embodied expression of AIDS body that can reinvent the temporal spatiality of any sphere has not been realized in this story at all. In this connection, Vincent J. Del Casino Jr. in "Health/ Sexuality/ Geography" comments: "HIV can be both enabling and disabling, productive of new sexual possibilities and limiting in other ways, particularly as antiretrovirals at least in the Western economies shift the temporality of HIV and recreate it as a chronic illness. HIV could enable the emergence of new communities of self-identified HIV positive individuals engaging in sexualized practices that are not tied to concerns about contracting HIV or even other sexually transmitted diseases. Once HIV manifests itself physically in outward appearance the relationships to sex and sexuality may once again shift as those HIV+ individuals with outward illness are marginalized in their sexuo-social communities as deceased. It is possible that a person living with HIV disease will move in and out of the regulatory frameworks of normative constructions of health and illness and therefore move between being constituted as sexual and asexual. Importantly this suggests that the embodied practices of various disabilities challenge the presumptions of a singular unitary and bounded body" (p. 49). Thus by annihilating the HIV+ body space through death and replacing it by a homonormative family structure, the normalcy of neoliberal conception of time and space has been retained and it is in this aspect that this piece of fiction does not adopt a radically affirmative stance, but on account of reorienting certain social spaces like hospital, bed-side and cafeteria coupled with asserting a unique kind of citizenship right by consuming state funded welfare

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means (which forms the basis of 'shadow state' or 'counter republic' as mentioned by Brown), the slippages created by the embodied expression of an AIDS patient are quite visible.

AIDS Citizenship: 'The Crocodile Tears'

Interestingly the story, "The Crocodile Tears" by Raj Rao presents an interesting intervention in the AIDS saga revolving around HIV+ body space. The narrator of the story is a gay lover of an AIDS patient, Ashutosh who is married to a woman for heterosexual privileges and they have a son. Once Ashutosh contracts AIDS, the protagonist has to assume the role of a foster father. Even before Aushtosh has been diagnosed with AIDS due to the narrator's upper-middle class, English speaking background, he goes to school with Aushtosh for the admission of his son, Aakash. They bear the semblance of a homonormative couple at the regulated space of school. To quote from the text: "We made a queer sight on the day of the interview. Where moms and dads accompanied other tiny tots in red, blue and yellow, it was Ashutosh and I, both daddies, who stepped into the principal's office with Aakash that morning. When committee members asked where the boy's mother was, I lied. 'You see, her uncle suddenly passed away in Gujrat, I said. And she had to rush there for the funeral'" (p. 258). The marginalization of a straight woman in this kind of framework is quite obvious and throughout the text we get significant glimpses of it. Now it creates a homonormative family within the heterosexual familial structure. Interestingly enough, this homonormative structure is replaced by a heterosexual family pattern in which Aakash (son of the narrator's gay lover), the narrator and the wife of his gay lover bear a semblance of a normative family when they go to a holiday to please Aakash without Ashutosh who has been reduced to an HIV+ body space. The narrator reminisces: "Here in the car, Aakash sat with me in front, while his mother occupied the backseat, the picnic baskets all about her. Caretakers, gardeners and watchmen at the cottage all thought of us as man, wife and son as we offloaded our bags from the boot and settled down for the weekend" (p. 262). Now it could have been a regressive, the hetronormative familial structure, queer tale of succumbing to heteronormative familial structure like in "A Married Man" but there is a twist in the tale. Unlike "A Married Man" by Raj Rao, here the HIV+ body space has not been annihilated through death, rather it co-exists with the 'child figure'. Now in this story the symbolic crystallization of futuristic stable normative compression of time and space (in the form of

child) co-exists with the explosive, ever-dynamic unstable and unique queer time and space as represented by the HIV+ body space of Ashutosh. In fact Ashutosh lives a perfectly normal life with these multiple set of family formations co-existing side by side. All these contrasting embodied spatial experiences create various contradictory contesting sites which are not antagonistic to one another (despite the fine balancing of futuristic goals and negation of future) but rather being negotiated in such a way that they create an all encompassing third space. The antagonism between the future time and the time incorporated in the living dead body of an AIDS patient has been reconciled beautifully in the last paragraph of the story. To quote from the text: "At times Ashutosh was envious of his own son. You love him more than you love me, his moist eyes would say. I would keep mum. Who was to tell Ashutosh that I loved Aakash because at the end of the day, he was born of Ashutosh's cell? In appearance too, Aakash resembled Ashutosh. He had the same bone structure that made him stoop slightly, like his pa. One day I will be sixty and retire from the company. Aakash will be nearly twenty then. The age his pa was when I joined the company, met him, moved by his tears. The wheel of karma will come full circle" (Rao: "The Crocodile Tears" 268). Now despite having a similar story line, "A Married Man" and "The Crocodile Tears" are remarkably different as the first story caters to the issues of AIDS citizenship and appropriation of certain supposedly normative spaces in a farfetched way but neither it opens sites of contestations nor creates unique third space as the story "The Crocodile Tears" does and presents a specific kind of radicalization of real, lived and imagined spaces (to quote Lefebvre). However both these stories are able to create necessary fissures in the stringent ideas of citizenship rights, through liminality of dying bodies, even if it is in an oblique fashion.

Graveyard Space and the Right on the Land: *The Ministry of Utmost Happiness*

Another important literary example in this regard is Arundhati's *The Ministry of Utmost Happiness* which centers around a hijra's constant struggle to find a safe refuge in the country's capital and how her/his efforts to find a safe home are constantly thwarted by the social opprobrium. However finally by using the politics of inversion or as Foucault has cogitated that power illicit its own origin, the protagonist uses the same tools of oppression for reversing the paradigm and asserting a claim on a piece of land (even if it is a land of a graveyard) and tries to assert her/his right as a citizen. Since transgenders are among the most marginalized entities within the LGBTQIA community, it will be interesting to critique as

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how they assert their right on land or on the spaces of significance including public spaces and how deathscapes contribute to it.

This text is saturated not only with the tangible site of graveyard but also the metaphors of mourning, death and cemetery are present throughout the novel. According to Maddrell:

Mourning is inherently spatial as well as temporal phenomenon experienced in and expressed through/in corporeal and psychological spaces, virtual communities and physical sites of memorialisation...[these include] individual mappings of bereaved people's experiences of significant spaces/places and how these change over time, how they are expressed through performance in space written as corporeal, landscape or literary texts; and how these individual [and collective] emotional maps impact on particular places (p. 123).

And this aspect of mourning has been potently exploited by Arundhati Roy by portraying graveyard as a counter utopia and safe refuge not only for the gender and sexual exiles but also for the other minorities.

Let me briefly sketch the story line of the novel. *The Ministry of Utmost Happiness* is set in Delhi and features a number of marginalized entities, hijras, dalits, Kashmiri migrants and an abandoned child. The writer takes us towards the unpredictable journey from Delhi to blood soaked Kashmir (the two extremely significant spaces of national discourse) and the negotiation between these two spaces is brought about by a cemetery run by a hijra, Anjum who after finding no space in this normative world (or *duniya* as s/he calls it) creates an alternative utopia in a graveyard that has place for everyone who has been shunned by the society, be it a pregnant dog with puppies, an abandoned child, religious minority, dalit or fellow hijras. Right in the center of Delhi, this space is run by a hijra and is called Jannat Guest House. Amidst the lost plot and series of lost characters and multiple stories it is only Anjum and her/his graveyard utopia, Jannat that binds the loose plot and characters and no wonder the story begins and ends with Anjum. The very first line connects the city space of Delhi (the capital of India, a power corridor and a metonymic signifier of India) with the trans-identity of Anjum. To quote from the text: "She was fourth of the five children, born on a cold January night, by lamplight (power cut) in Shahjahanabad, the walled city of Delhi. Ahlam Baji, the midwife who delivered her and put her in her mother's arms wrapped in two shawls, said, 'It's a boy'. Given the circumstances, her error was understandable...The next morning when the sun was up...that was when she discovered, nestling underneath his boy-parts, a small, unformed, but undoubtedly girl-part" (p. 7).

Interestingly enough to cure her child Anjum's mother takes her to a famous dargah in Delhi known as Hazrat Sarmad Shaheed's dargah and the writer narrates that this particular fakir was Jewish American and had travelled to Delhi from Persia in pursuit of the love of his life, Abhay Chand. Thus at the very outset of the novel the linkages have been built between the capital of India, Delhi, non-normative sexual and gender entities and 'dargah desire' (to quote Madhvi Menon as mentioned in the introduction of this article).

While Delhi's historicity is significant, there are chances of it creating an aura that leads to impediments in people's relations and interactions with the contemporary city that is rapidly transforming from the one chronicled in the history books. Delhi's broken history/ies of invasions and plunders lends itself well to the clichéd symbol of the phoenix that rises again with resilience after destructions. And that is where there is a great similarity between Khushwant Singh's Bhagmati, the hijra (as depicted in his novel, *Delhi*) and Anjum because they both are battered time and again but both resurrect just like Delhi after a horrible mutilation. Importantly, they not only resurrect themselves but also help the other marginalized human beings around them to get resuscitated. Apropos of the claim on the city of Delhi by hijras Ustab Kulsam Bi, the revered guru of hijras has proclaimed with utmost pride that they are not just ordinary hijras but 'Hijras of Shahjahnabad'. Tracing the spatial history of hijras vis-a-vis the capital of India she affirms: "When Shahenshah Shah Janan built the Red Fort and the Jama Masjid, when he built this walled city, he built our little haveli too. For us. Always remember---we are not *just* any Hijras from any place. We are the Hijras of Shajahanabad. Our Rulers trusted us enough to put their wives and mothers in our care. Once we roamed freely in their private quarters, the zenana, of the Red Fort. They're all gone now, those mighty emperors and their queens. But *we* are still here. Think about that and ask yourselves why that should be" (p. 49).

Significantly at one level Delhi is called a city of migrants, but on the other being the capital of India, it is also the center of power and thus relentlessly pushes its marginalized entities farther and yet there are radical ruptures available for these powerless identities. Similarly the places that cannot be accessed by women are invaded by their allies or MTFs (male turned female) and in this way they create much needed mutations. One fine example can be cited from the text where the writer depicts how women are prohibited at certain religious spaces but hijras have no such restriction as they do not menstruate. To quote from the text,

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They visited Jama Masjid and those dargahs that allowed them into the inner chambers (because unlike biological women, hijras were not considered unclean since they did not menstruate (p. 21).

Thus entry and invasion at certain restricted spaces by hijras create ruptures for the liberalization of women as well because on account of their sartorial identity, gestures and also due to their burning desire to look like a woman, hijras bear close semblance with women.

Thus coalition politics indubitably works here. As Anjum grew, she increasingly became more and more fascinated by the hijras who built their safe refuge right in the middle of the city and this home is known as Khwabgah---The House of Dreams. The spatial imagination (as manifested in the form of naming this hijra home as 'house of dreams' where so many subjugated individuals live) demonstrates the politics of inversion by naming a space as a utopian ideal in order to temporarily escape from the harsh daily realities of their lives. Interestingly, this is how Anjum's spatial identity takes form, the moment she enters Khwabgah.

It was the only place in his world, where he felt the air made way for him. When he arrived, it seemed to shift, to slide over, like a school friend making room for him on a class room bench. Over a period of few months, by running errands, carrying their bags and musical instruments when the residents went on their city rounds, by massaging their tired feet at the end of the working day.... He entered that ordinary, broken-down home as though he were walking through the gates of paradise (p. 20).

In fact that is why Khwabgah is called Khwabgah as has been told by the matriarch of the house, Ustad Kulsam Bi. She addresses normative world as 'Duniya' and states that ordinary people living in 'Duniya' have no idea as what it takes to live a life of a hijra. And 'Duniya' is synonymous with all kinds of oppressions and therefore there was a need to build a counter utopia and that is how Khwabgah came into existence.

The Khwabgah was called Khwabgah, Ustad Kulsoom Bi said, because it was where special people, *blessed* people, came with their dreams that could not be realized in the Duniya. In the Khwabgah, Holy Souls trapped in the wrong bodies were liberated. (The question of what would happen if the Holy soul were a man trapped in a woman's body was not addressed) (p. 53).

However his/her happiness was short lived as s/he was banished from this space on account of his/her scuffle with the inmates.

Emplacement is a constant part of the hijras' existence but it is not always disadvantageous. Their emplacement and their lack of stable location in the society which are

reasons for their opprobrium also inversely serve as tools of liberation. Their nomadic existence gives them an inverted freedom that is alien to women. Apropos of this in the PUCL report (2003), there is an interesting observation. To quote from the report,

The linking of the criminal tribes to sexual non-conformity was due to the perception on the part of the colonial administration that the itinerant communities had a licentious lifestyles. The itinerant communities comprised entertainers such as acrobats, singers, dancers, tightropes walkers, and fortune tellers, who were perceived as a threat to the order of sedentary societies. As Meena Radhakrishna notes in PUCL report, '...the nomads' lack of property, and supposed lack of due regard for others' property, is seen to be a threat to the established order, and their independence from rigid norms and constraints of sedentary societies is found highly objectionable. In fact, itineracy is seen as a possible escape route for the so-called outcasts and refuse of sedentary societies...In addition, for the keepers of social morality, (their) lack of visible social institutions implied complete disorder in their community life. Their lack of written codes of conduct, and absence of articulated norms of morality implied absolute licentiousness (p. 44).

In this manner emplacement also provides relative freedom and new opportunities and this is exactly what Anjum does. Banished from Khwabgah, she finds refuge in a graveyard and this incident is loaded with multiple meanings. At one level it is indicative of the fact that for sexual minorities like hijras there is no space in the normative world and death and graveyard are their ultimate domains, while on the other Anjum is able to reconstitute and change the meaning of the space of death and cemetery by turning this graveyard space into a place where all kinds of marginalized identities are not only welcomed but also live together. S/he also names it as a Jannat guest house which is reflective of politics of inversion. Anjum uses the same tool of oppression to invert her/his position vis-a-vis space and makes it a source of empowerment not only for herself/himself but also for many others like her/him. Describing her sense of liberation at graveyard space away from all kinds of social restrictions and protocols Anjum cogitates,

Not that anyone in the graveyard troubled her...no djinns arrived to make her acquaintance, no ghosts threatened a haunting... In that setting Anjum would ordinarily have been in some danger. But her desolation protected her. Unleashed at last from social protocol, it rose up around her in all its majesty---a fort, with ramparts, turrets, hidden dungeons and walls that hummed like an approaching mob (p. 61).

S/he builds a shack there and slowly encroaches that space, after which Municipal authorities started sticking notices every month stating that living in a graveyard is strictly prohibited and they will demolish it soon. To which,

She (Anjum) told them that she wasn't living there in the graveyard, she was dying in it----and for this she didn't need permission from the municipality because she had the authorization from the Almighty Himself (p. 67).

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None of the Municipal officers dared to fight with her as they were scared of hijras' curse, thus fear mixed with phobia that encapsulates a hijra's identity works to her advantage. Hijras' liminal identity gets beautifully reconciled with the in-between space of a graveyard which is a negotiation sphere between the living and the dead. Slowly s/he expands the boundaries of her/his graveyard home, Jannat Guest House.

Over time Anjum began to enclose the graves of her relatives and build rooms around them. Each room had a grave (or two) and a bed. Or two. She built a separate bathhouse and a toilet with its own septic tank. For water she used the public handpump...The advantage of the guest house in the graveyard was that unlike every other neighbourhood in the city, including the most expensive ones, it suffered no power cuts. Not even in the summer. This was because Anjum stole her electricity from the mortuary where the corpse required round-the clock refrigeration (The city's paupers who lay there in air-conditioned splendour had never experienced anything of this kind while they were alive). Anjum called her guest house Jannat. Paradise (pp. 67-68).

Thus by reversing the paradigm and using the space and the resources of the state, Anjum is able to create her/his own alternative paradise which over a period of time becomes a safe refuge for the other kinds of disenfranchised citizens also.

Hence in the graveyard space an entirely new mode of kinships and alternative family structures take form and all this revolutionize the whole concept of family and home space. In this regard, it is significant to bring into discussion Park's (1967) concept of communities which he divides into three categories. The first one is based on locality, where communities are mapped around place, e.g. neighbourhood; the second one is ethnic community, based on cultural ties and institutional forms like clubs and associations; The third one is affective community—based on shared identities and interests that provides a sense of belonging. These 'affective communities' are just one of the ways in which one is witnessing a return to forms of group/communal celebrations as the traditional family and kinship systems are disappearing. In this manner the affective community created by Anjum with other marginal entities revolutionizes the city space through graveyard metaphor as the decaying modern city of Delhi bears a close semblance with the graveyard, specially when linkages are built between Delhi and the bloodied Kashmir. It fully exemplifies De Certeau's concept of the role of people's everyday practices in making an alternative space in the city that runs parallel or in defiance to the spatial order of planners defined by maps and schemes. Also as suggested by Mary Murray the cosmological cartographies of the burial spaces are considered to be profoundly 'other' to the ones that are inhabited by the living beings. Thus the 'othering' of hijras and their liminal corporeal selves are coterminous with the graveyard

space on account of the 'living dead' or absent/ present proposition of burial spaces and thus provides a flourishing ground for the exploration of the queer entities.

Hence deterritorialization and loss of space are incongruous with transgender and hijra identity as their unique corporeal selves make them both visible and invisible at the same time. Thus camouflage and secrecy as tools cannot be potently employed by them and emplacement, deterritorialization and reterritorialization are constant part of their lived realities, and they have to create tools within this limitation to assert their identity at any given space. However in India because of certain sort of religious sanction and fear mixed with awe (as they are supposed to have power to confirm fertility or curse) they are accepted at certain spaces though unwillingly, be it the domestic spaces at the time of childbirth and marriage or public spaces like streets which they reclaim through begging or *danda* work (prostitution). Their liminal identity challenges the polarity of gendered spheres. Their non-normative sexually suggestive behavior and the nuisance value radicalize street and public spaces in such a way that new fissures give way to other kinds of deviancies as well. In this fashion they are powerful catalysts in coalition politics as I have demonstrated when aligned with transfeminism (as depicted in *The Ministry of Utmost Happiness*). They bear a close semblance with street urchins in this respect because like them, hijras too are expected to puncture the so-called codes of behavior at public spaces and Anjum does it at a very unique kind of public space and that is graveyard space. Ranjani Majumdar talks about the tapori figure who by puncturing the idea of normalcy vis-a-vis language and public behaviour takes the possession of the city,

Drawing attention through linguistic and stylistic performances, the tapori creates a space where control is possible... In performing and depicting marginal figures whose narrative predicaments seem to mirror their psychological states of marginality, we see a social and verbal alienation expressed in tapori's performance. This alienation is countered through both shock and play with the signs of every day (p. 42).

Thus in a similar fashion, hijras reconfigure public spaces through specific use of language and gestures and this has been significantly exhibited in this text. Specially in terms of reclamation of the graveyard land by hurling curses and abuses on the officials who came to vacate the graveyard space. Another strategy to control is to operate in such a fashion that particular sites specially cemeteries appear run down sites and these tools can be littering, hanging around and vandalism to puncture the idea of conducive space so that the non-normative identities can get hold of these spheres. Anti social behavior that has been the greatest reason of opprobrium of these marginalized entities works to their advantage in

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getting the control of a space. Bel Deering in "From Anti-Social Behaviour to X-rated: Exploring Social Diversity and Conflict in Cemetery" writes in this connection: "Littering, hanging around and vandalism do have a negative effect. Evidence suggests that when these activities cause a site to appear run-down and/or neglected, other potential users are deterred, interpreting this as signs of a lack of social control. Indeed this may well be intentional--- litter can be a tactical move, a way of claiming a space and exerting power and control over others (Delaney 2005). Many are influenced by the visual effect of littering and related activities and will avoid such spaces out of fear of crime" (p. 88). Thus all kinds of tactics have been employed by Anjum to get the control of graveyard space and use it for her and other minorities' advantage.

Another significant aspect in this regard is even using the mundane surroundings of the burial ground to celebrate the child birth and bringing a joyous reconciliation between the dead and the living. Thus at one level to control the space, resorting to antisocial activities have proven useful, while on the other the normative joys of the life have also been celebrated here; the burial ground is in fact used as a site for festive occasions or recreational space. According to Bel Deering, cemeteries and churchyards have a rich role to play in hosting recreational activities. And these activities can work as a catalyst to cast these places as 'sites of disagreement and conflict'. Celebration of life takes place when an unwanted mother and child duo come to Jannat guest house at the graveyard and a grand party is thrown by Anjum creating a contesting domain. In fact by turning the graveyard space into a place for merriment she has not only been able to satiate the homeless and poor but also could entice the municipal officers and had been able to make the state machinery work for her. To quote from the text,

The addict and homeless people from the periphery of the graveyard gathered to partake of the feast and the merriment...A few kebabs and some biryani were kept aside for the municipal officers who will surely come by later in the day. 'Those fellows are just like us Hijras,' Anjum said and laughed affectionately. 'Somehow they smell a celebration and arrive to demand their share' (p. 306).

Thus she draws a close parallel between hijras and municipal officers and a wicked nexus is built by revolutionizing the burial space into a recreational sphere.

Using cemeteries as recreational space has been documented by various scholars like Aries (1994), Dunk and Rugg (1994) and Sloane (1991). According to Bel Deering,

Planners and designers of new cemeteries had a vision of them as parks or gardens, where people might walk and indulge in 'rational recreation'....The main object of the burial ground is, the disposal of the remains of the dead...the secondary object is or ought to be, the improvement of the moral sentiments and general taste of all classes, and specially of the great masses of the society (Dunk and Rugg 1994, Warpole 2003) (p. 76).

Thus the usage of the death-space for festivities also brings into consideration Mikhail Bakhtin's concept of 'carnavalesque' that talks about as how a festival site recreates a symbolic 'second life' that is helpful in dismantling the hegemonic pattern as the spirit of festivities creates a symbolic space of utopian freedom. This utopian freedom is missing in the real world of day to day life. Thus the festivities specially create a thinly veiled virtual world which operates in a way where a certain kind of non-normativity, though temporary, is acceptable. In fact Deleuze's theory of 'affect' has been used in an interesting fashion by Jason Lim in his outstanding essay, "Queer Critique and the Politics of Affect" to illustrate the porous nature of queer geographies in this regard. He tries to forge a bond between temporary virtual spaces and Deleuze's theory of 'affect' that postulates the idea that an event can be considered a liminal entity between the actual and the virtual. He affirms that,

For Deleuze the 'event' can be thought of as virtual (and hence as enveloping a multitude of virtual worlds), as distinct from the actual 'states of affairs' by which events come to pass. Events are always (just) past or just about to come, but are never the present state of affairs, although they are contemporaneous with the present. Events are intimate to bodies (Deleuze 5) but not actually corporeal themselves.... This sense neither originates in the subjectivities of individuals nor is fixed in place by an objective reality (p. 56).

Thus the partially imagined world of festivities mitigates fixities and definitives, and a certain kind of allowance for deviation takes place and that is why the coalition regarding the graveyard space not only takes place between hijras, Anjum and other minorities but also between Anjum and municipal officers. Hence the festivities at burial space create contesting site to make the stringent boundaries of such places porous and radical mutations in the hegemonic structures become visible.

Hence the contesting domain which has been excavated through *The Ministry of Utmost Happiness* is a burial ground that functions as a counter utopia. In this regard *The Ministry of Utmost Happiness* indubitably radicalizes graveyard space through the re-appropriation of it by a hijra who not only establishes his/her claim on it but also uses her/his position as a potent agent to revolutionize and counter the hierarchal dispositions prevalent both in the heteropatriarchal and the homosexual world by turning this cemetery into a safe

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refuge for the various kinds of other minorities. Kate Woodthorpe in her seminal essay, "Buried Bodies in an East London Cemetery: Re-visiting Taboo" questions as to whom and why buried bodies in cemetery matters.

One principal reason is the way in which the dead body—before burial even—challenges the boundaries of the ideal contained and controlled body. In a society... where bodies are ordered and controlled (Evans 2002), the uncontrollable, decomposing person-that-once-was presents an absolute rejection of efforts to order and control the body (p. 64).

Conclusion

Thus the radical potential of dying and decaying bodies, bereavement and graveyard space has been utilized with utmost efficiency by both Raj Rao and Arundhati Roy to lend a certain kind of citizenship rights to the queer protagonists of their fictional works. And the sheer liminality of death and life, imbued in these spheres, becomes coterminous with the non fixities and definitives of the queer lives as outside the graveyard, the spaces are infested with unhealthy coercion and here any kind of control over the body is mitigated by the spatial dynamics of the burial spaces. Apropos of this Rugg notes,

Burial space is essentially mutable: its meaning does not remain static over time; and its significance is not uniform all over the cultures. Even at a basic level, the significance of such spaces alters as time accrues between the living and the dead (p. 111).

In the end any discussion on this issue of depicting a tense negotiation among city spaces, graveyard sites, leaking and decaying bodies and queer entities through the lens of contemporary literature can be best summed up in the words of Berger,

Freed from the boundaries of time and space, I co-ordinate any and all points of universe, wherever I want them to be. My way leads towards the creation of a fresh perception of the world. Thus I explain in a new way the world unknown to you (p. 17).

Thus the radical potential of dying and leaking bodies along with death spaces to negotiate a unique sort of citizenship rights on the land of the nation is conspicuous from the above discussed texts. And this paper is an humble attempt to showcase the subversive potential of deathscapes to reorient the whole idea of citizenship specially when viewed through the lens of queer studies and death studies.

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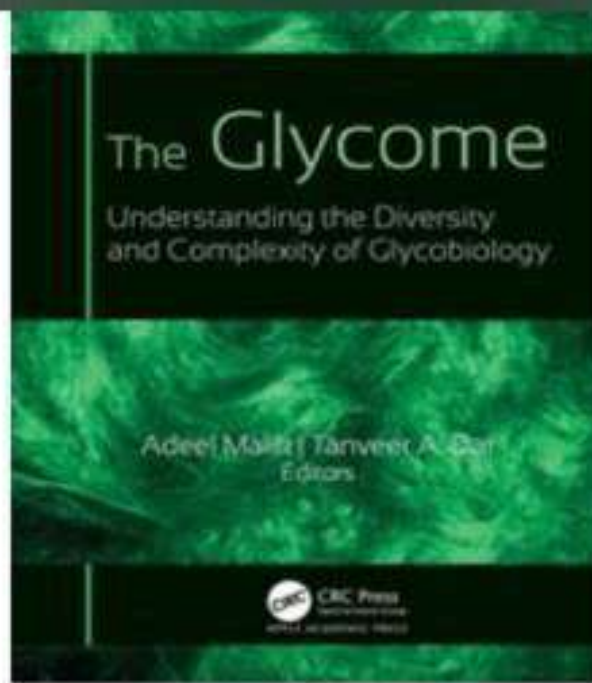
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रामकथा के विविध आयाम



प्रो. प्रवीण गर्ग | प्रो. विनीता कुमारी

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रामकथा के विविध आयाम

डॉ. कमलेश सरीन

भारतीय साहित्य में और भारत के इतिहास में शायद ही कोई ऐसा क्षेत्र और व्यक्ति होगा जो राम के चरित्र और नाम से अपरिचित हो। भारतीय चिंतनधारा में राम की चरित्र गाथा अबाध रूप से कही जाती रही है। संस्कृत साहित्य में, बौद्ध साहित्य में, जैन साहित्य में, भक्तिकाल के साहित्य में और यहाँ तक कि परवर्ती साहित्य में भी राम की महिमा का गुणगान होता रहा है। एक परम्परा ने राम के नाम को सर्वोपरि माना तो दूसरी परम्परा ने राम के चरित्र को मर्यादा पुरुषोत्तम के रूप में स्थापित किया। महाकवि तुलसीदास ने जब 'रामचरितमानस' लिखा तो उसमें उन्होंने राम का ऐसा चरित्र प्रस्तुत किया कि जार्ज ग्रियर्सन तक को उसकी लोकप्रियता का लोहा मानना पड़ा। दूसरी ओर कबीर और उनके काव्य आदर्शों का पालन करने वाले सन्त भक्त कवियों ने राम नाम की महिमा गायी। इस परम्परा के अनुसार राम कोई व्यक्ति विशेष नहीं है बल्कि ब्रह्म का एक नाम है। इस प्रकार राम का नाम और राम का चरित्र ये दो धाराएँ हिन्दी साहित्य में समान्तर रूप से प्रवाहित रही हैं। एक काव्यधारा का नेतृत्व कबीर और नानक सरीखे सन्त भक्तों ने किया है, तो दूसरी काव्यधारा का नेतृत्व गोस्वामी तुलसीदास जी ने किया है।

गुरुमुखी लिपि में रामकाव्य की इन दोनों धाराओं का मिलाजुला रूप मिलता है। गुरु गोविन्द सिंह से पहले तक की गुरु परम्परा में राम नाम की महिमा अधिक है। गुरु गोविन्द सिंह तथा उनके आश्रित कवियों और अन्य कवियों ने रामचरित का गुणगान किया है। गुरु ग्रन्थ साहिब में राम नाम की अनेकों बार चर्चा आती है। भले ही इसमें राम ईश्वरीय चेतना के प्रतीक हैं तथापि 'हुक्मै होय दस अवतारा' के अनुसार गुरुवाणी में राम को अवतार के रूप में भी स्वीकार किया गया है। इन अर्थों में राम विष्णु के अवतार है। जिन्होंने त्रेतायुग में अवतरित होकर धरती पर रहे अत्याचारों को दूर करने के लिए रावण का वध किया था। ऐसा विश्वास किया

*एसोसिएट प्रोफेसर, हिंदी विभाग, स्वामी श्रद्धानंद महाविद्यालय, दिल्ली विश्वविद्यालय, अलीपुर, दिल्ली।



स्वामी श्रद्धानंद कॉलेज दिल्ली विश्वविद्यालय के अंतर्गत उच्च शिक्षा प्रदान करने वाला अलीपुर, दिल्ली 110036 में स्थित एक प्रतिष्ठित महाविद्यालय है, जो भारत के महान समाज सुधारक संत स्वामी श्रद्धानंद के नाम पर रखा गया है। सन् 1967 में ग्रामीण अंचल के विद्यार्थियों को उच्च शिक्षा प्रदान करने के सद् उद्देश्य से नरेला के गाँधी आश्रम में यह कॉलेज प्रारंभ किया गया और दो वर्ष पश्चात् अलीपुर में स्थानांतरित किया गया। कॉलेज ने गत 54 वर्षों से निरंतर गुणवत्तापूर्ण उच्च शिक्षा प्रदान करने में सफलता प्राप्त की है। कॉलेज में मानविकी, चाण्डाल्य, विज्ञान, कंप्यूटर आदि सभी विषयों के योग्य एवं प्रशिक्षित शिक्षक हैं। उत्कृष्ट प्रयोगशालाएँ, समृद्ध एवं विशाल पुस्तकालय है। प्रकृति के सुम्य वातावरण में स्थित कॉलेज में दिल्ली एवं भारत के विभिन्न अन्त्र राज्यों से विद्यार्थी यहाँ शिक्षा प्राप्त कर लाभान्वित होते हैं। यहाँ से स्नातक एवं स्नातकोत्तर की उपाधि प्राप्त करके अनेक विद्यार्थी कई उच्च पदों पर सेवारत हैं और राष्ट्र-प्रगति में सहयोगी बन रहे हैं। शैक्षणिक गतिविधियों के अतिरिक्त खेल और सांस्कृतिक गतिविधियों में भी कॉलेज के विद्यार्थियों को अपनी प्रतिभा को विकसित करने का सुअवसर प्राप्त होता है। खेल के क्षेत्र में कॉलेज से प्रशिक्षण प्राप्त करके अनेक विद्यार्थियों ने राष्ट्रीय, अन्तरराष्ट्रीय स्तर पर ख्याति अर्जित की है।



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