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WEB BASED SOLUTION TO IDENTIFY AND SOLVE DISEASE IN PLANTS/CROPS

Rasheeq Zehra[1], Omkar Sharma [2], Mr. Vinayak[3]

[1,2]Student, Department of Computer Science & Engineering, BBDITM, Lucknow, UP, INDIA
[3]Assistant professor, Department of Computer Science & Engineering, BBDITM, Lucknow, UP, INDIA

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Abstract - Dedicated to the welfare of Indian farmers, this research unveils 'Green Doctor,' a groundbreaking web-based solution aimed at combating plant diseases in India's agricultural sector. Leveraging MobileNet Convolutional Neural Network (CNN), Green Doctor promises swift and precise disease identification in plants and crops. Through a robust methodology utilizing Indian plant disease datasets and a streamlined CNN architecture, this solution offers a beacon of hope for farmers. Results showcase the efficacy of rapid disease detection, facilitating timely intervention to mitigate crop losses and bolster agricultural productivity. Positioned as a free and user-friendly tool, Green Doctor embodies accessibility, speed, and contextual relevance, serving as a tribute to the Indian farming community. By reducing pesticide reliance, enhancing product quality, and bolstering farmer income, Green Doctor paves the path towards sustainable agriculture while enlightening stakeholders about plant diseases.

Keywords: Plant diseases, Web-based solution, MobileNet CNN, Disease detection, Agricultural productivity, Sustainable agriculture.

1.INTRODUCTION

The pivotal role of plants in India's environment and economy underscores the urgency to combat plant diseases. With agriculture serving as the nation's economic backbone, crop losses due to pests, diseases and weeds are approximately assessed to be ranging between 10 to 30% of crop productions. If we consider, on a average, crop loss of 20%, and the present gross value of our agriculture produce as Rs, 7 lakh crore, the loss comes to Rs. 1,40,000 crores, which is colossal (Kumar and Gupta, 2012). Even if we could save 50% by using plant protection, it will add Rs. 70,000 core additional income to our farmers.

The significance of staple crops like rice and wheat further accentuates the need for effective disease management. According to a report by the Indian Council of Agricultural Research (ICAR) major pests and diseases that affect rice and wheat in India are:

• Rice: Brown spot, blast, bacterial leaf blight, sheath blight, and tungro virus.

• Wheat: Rusts, smuts, Karnal bunt, and head scab.

Urban gardening turns increasingly popular in India, as more and more city dwellers realise the benefits of cultivating their own food. Urban gardening could help to improve air quality, cut food miles, and give inhabitants with fresh, healthful food. A number of urban farms have also been established in cities across India. As more city dwellers become aware of the benefits of producing their own food, the trend of urban gardening is expected to rise in the coming years but urban gardening generally fights with increased insect pressure. Pest and disease problems can be exacerbated by fewer natural predators and increased levels of air pollution.

Many urban gardeners find existing AI-based systems unattainable due to subscription fees and they require prior experience. To bridge this gap, we introduce "Green Doctor," a free online platform designed to support both rural farmers and urban gardeners across country. By harnessing the power of MobileNet CNN, Green Doctor swiftly detects diseases, offering timely interventions to mitigate losses. The feasibility study ensures the solution's viability and user-friendliness, aiming to revolutionize plant disease management while empowering stakeholders.

The aim of the study is to provide a solution for urban and farmers fixing the issue without prior experience. Anyone with an internet connection and a camera-equipped gadget will be able to use the solution. Green doctor will provide a quick solution to the issue as well as all relevant details. It can assist farmers and urban gardeners in identifying illnesses early and taking appropriate steps to reduce crop losses and plant health.

2. REVIEW OF PRIOR WORK

Bagga & Goyal, 2024 studies the early detection of plant diseases with the use of image processing that is realized through deep learning. It is a deep dive into the deep learning architectures such as CNNs which examines how they are trained on image datasets to identify the diseased plant tissues. On top of it all, the evaluation might review the evaluation metrics, agricultural applications and future trends on the improvement of model accuracy and the usability of such deep learning models [1].

Ramanjot et al., 2023 provided an in-depth examination of deep learning models for plant disease detection and classification. The authors explain the several deep learning models that have been employed for this job, as well as the advantages and disadvantages of each technique. They also go through the various datasets used to train and assess plant disease detection and classification algorithms. Deep learning methods, the scientists believe, have the potential to revolutionise plant disease detection and categorization. They do, however, acknowledge that several hurdles remain before deep learning models can be extensively used in the real world. These issues include the requirement for big and well-labelled datasets, effective and scalable training techniques, and models that are resistant to noise and environmental fluctuations [2].

Ahmad et al., 2023 investigates the utilization of deep learning techniques in the realm of plant disease diagnosis, underscoring the imperative for sophisticated tools within the context of smart agriculture. The authors conduct a comprehensive evaluation of current methodologies, spotlighting areas ripe for further advancements. Their contribution extends to shaping the dynamic landscape of technology-driven solutions geared towards addressing and surmounting challenges in the field of agriculture [3].

Ahmad et al., 2023 delves into the application of deep learning techniques for plant disease diagnosis, offering a comprehensive overview. Emphasizing the need for advanced tools in agriculture, it systematically reviews existing methodologies. The paper provides valuable insights, recommending directions for the development of suitable tools. This survey contributes significantly to the evolving landscape of technology-driven solutions in the realm of smart agriculture [4].

Bi et al., 2023 focuses on the identification method of corn leaf disease, employing an improved MobileNetV3 model. Addressing the imperative for accurate disease detection in agriculture, the research builds upon existing methodologies. By enhancing the MobileNetV3 model, the authors contribute to the evolution of techniques for corn leaf disease identification. This study adds valuable insights to the field, offering a refined approach to leveraging deep learning for precision agriculture [5].

Gai et al., 2023 presents a detection algorithm for cherry fruits, leveraging an improved YOLO-v4 model. Recognizing the significance of efficient fruit detection in agricultural applications, the study builds upon the established YOLO-v4 architecture. By enhancing the model for the specific task of cherry fruit detection, the authors contribute to the advancement of computer vision techniques in precision agriculture. This research aligns with the broader trend of utilizing deep learning models for accurate and real-time object detection in diverse domains. The study's findings offer valuable insights for optimizing fruit detection processes, with potential implications for improved agricultural practices and resource management [6].

C. K. et al., 2022 addresses a cardamom plant disease detection approach employing the EfficientNetV2 architecture. Recognizing the critical role of accurate disease identification in agricultural sustainability, the study contributes to the evolving field of computer vision applications in precision farming. This research aligns with the broader trend of leveraging advanced neural networks for efficient and reliable disease detection in plant species. The study's findings offer valuable insights into the application of state-of-the-art deep learning models for addressing challenges in cardamom cultivation, emphasizing the potential impact on crop management practices and agricultural productivity [7].

Bansal et al., 2021 delves into the effectiveness of both EfficientNet and DenseNet in the context of apple leaves disease detection, offering insights into the comparative performance of these architectures. This research aligns with the broader trend of utilizing advanced neural networks for accurate and efficient disease identification in agricultural settings, providing valuable contributions to the intersection of deep learning and plant pathology[8].

Li et al., 2021 provided an investigation on plant disease detection and classification using deep learning. They discuss the benefits of deep learning models over traditional approaches, as well as the difficulties of designing and implementing deep learning models for plant disease detection and classification. They also address the potential of deep learning to revolutionise plant disease diagnosis and management by reviewing state-of-the-art deep learning models for plant disease detection and classification [9].

Chowdhury et al., 2021 focuses on the automatic and reliable detection of leaf diseases using deep learning techniques. Acknowledging the critical need for precise disease identification in agriculture, the study contributes to the expanding realm of computer vision applications in precision farming. Leveraging deep learning methodologies, the research aims to enhance the accuracy and reliability of leaf disease detection, addressing a significant challenge in crop management. This study aligns with the broader trend of utilizing advanced neural networks for efficient and automated disease identification in plant species [10].

Liu et al., 2018 focuses on object detection utilizing the YOLO (You Only Look Once) network. Object detection is a fundamental task in computer vision with applications ranging from surveillance to autonomous systems. The study contributes to the literature by exploring the effectiveness of YOLO in the context of real-world applications. By evaluating and potentially enhancing the YOLO network, the research adds valuable insights to the ongoing discourse on efficient and accurate object detection techniques. This work aligns with the broader trend of leveraging deep learning for object recognition, emphasizing its significance in diverse domains such as robotics, security, and image analysis [11].

Chakraborty, et al., 2021 provide a deep learning strategy for plant disease categorization. They test their method on 50,000 photos of plant diseases and get an accuracy of 99.5%. They also examine the possibility of using their technique for real-time plant disease diagnosis in the field [12].

Devi, et al., 2021 conducted a thorough assessment of plant disease detection strategies and presented a Convolutional Neural Network (CNN)-based methodology based on transfer learning. This review, published in "Sustainable Computing: Informatics and Systems," provides a thorough overview of existing methodologies and highlights the benefits of utilising CNNs for plant disease identification. Their suggested CNN-based technique has the potential to improve the accuracy of plant disease identification [13].

P. K. Behera, et al., 2021 observed a plant disease detection and recommendation system based on MERN stacks. A React front-end, an Express back-end, and a MongoDB database comprise their solution. The front-end allows users to input photos of plant leaves, while the back-end classifies the illnesses using a TensorFlow.js model [14].

N Sharma et al., 2021 proposed a mobile-friendly MERN stack application for plant disease detection. Their programme is made up of a React front-end, an Express back-end, and a MongoDB database. The front-end allows users to input photos of plant leaves, while the back-end classifies illnesses using a TensorFlow.js model [15].

Mohanty, et al., 2020 provides a deep learning model for plant disease categorization. ResNet50 is a CNN architecture created by Microsoft Research. It has been demonstrated to be useful for a wide range of picture classification applications, including plant disease classification. The ResNet50 model was trained on a dataset of over 50,000 photos of plant leaves labelled with 25 distinct illnesses by the authors of this publication. The model detected and identified the 25 illnesses with an accuracy of more than 95%. The algorithm was also tested using a dataset of over 10,000 photos of plant leaves obtained from farmers' fields by the authors. The algorithm detected and identified the 25 illnesses in this dataset with an accuracy of more than 90% [16].

Murala, et al., 2020 addressed the problem of detecting plant diseases with limited datasets. Their research, published in the "Journal of King Saud University-Computer and Information Sciences," emphasises the usage of convolutional neural networks. The study presents novel approaches to overcoming data constraints in agriculture. Their study emphasises the relevance of using CNNs in circumstances with limited data availability [17].

Punn, et al., 2020 provide an overview of plant disease detection strategies based on deep learning. They highlight the benefits of deep learning models over older approaches, as well as the difficulties of designing and implementing deep learning models for plant disease detection. They also cover the current state of the art deep learning models for plant disease detection, as well as the future directions of this study [18].

Singh, et al., 2020 contrasted with other real-time plant disease detection tools, their solution beats others in terms of accuracy and speed. The authors test their programme using a publicly available dataset of plant leaf photos and reach an accuracy of more than 97% [19].

S. S., Behera, et al., 2020 gives an in-depth look at the current state of the art in deep learning-based plant disease detection and classification. It also examines the field's problems and prospects, as well as the prospective influence of this technology on illness detection and management [20].

Singh, et al., 2019 proposes a deep learning model for plant disease identification based on the InceptionV3 architecture. It has been demonstrated to be useful for a wide range of picture classification applications, including plant disease identification. The authors of this research used a dataset of over 10,000 photos of paddy leaves labelled with three distinct diseases: blast, brown spot, and leaf blight to train their InceptionV3 model. The model detected and identified the three illnesses with an accuracy of more than 90%. The algorithm was also tested using a dataset of over 5,000 photos of rice leaves obtained from farmers' fields by the authors. The algorithm detected and identified the three illnesses in this dataset with an accuracy of more than 85%. This research shows that deep learning models built on the InceptionV3 architecture may be utilised to create excellent plant disease detection systems. Farmers might employ such devices to detect plant illnesses early on, before they cause substantial crop harm[21].

Barbedo, et al., 2019 performed a review on the usage of convolutional neural networks in agriculture. The author of this work, published in "Computers and Electronics in Agriculture," presents a thorough review of CNN applications in agriculture, including plant disease detection. This review article is an excellent resource for comprehending the larger context of CNN uses in agriculture [22].

Fuentes et al., 2017 provided a strong deep learning-based detector for real-time tomato plant disease and pest detection. Their discovery, which was published in the journal "Sensors," demonstrates a unique technique to real-time monitoring and detection of diseases and pests in tomato plants. The study demonstrates the utility of deep learning in tackling agricultural difficulties, hence helping to the development of smart farming solutions [23].

Sladojevic, et al., 2016 introduced deep neural networks for the identification of plant diseases using leaf picture categorization. The scientists proved the potential of deep learning in reliably diagnosing plant illnesses based on leaf photos in their paper in "Computational Intelligence and Neuroscience." This pioneering effort lays the groundwork for future research in the field of computer vision for agriculture [24].

3. METHODOLOGY

It can be seen that there is a paucity of models that can identify numerous illnesses in multiple crops. The vast majority of existing deep learning models have been trained to identify a single illness or a limited number of diseases in a single crop. Secondly, it is critical to discover plant illnesses early on, when they are most curable. Many deep learning models, however, struggle to detect early-stage illnesses since the symptoms might be mild or non-existent.

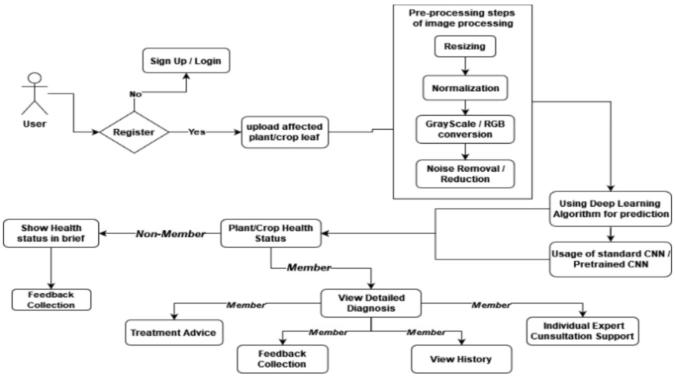


Fig. 3.1 Process flow Architecture

In conclusion based on the result of the research papers:

- The idea is centred around a developing a solution that can detect numerous illnesses in multiple crops by employing a drop-down list to offer information about the type of plant being recognized, allowing users to pick the type of plant they are attempting to identify from a drop-down list can assist to enhance prediction accuracy by adding additional information to the model.
- Using a bigger dataset of early-stage disease photos, create a deep learning model that can detect diseases in their early stages. This would allow the model to understand the delicate characteristics of early-stage illnesses.
- Another research need is the need for more efficient and scalable plant disease detection methods. Many existing techniques are computationally costly and need specialised hardware, making them unsuitable for real-time applications.
- Furthermore, greater study on plant disease identification under difficult settings, such as low light, occlusions, and complicated backdrops, is required. Existing algorithms frequently fail to perform effectively in these situations, limiting their application in real-world scenarios.
- Finally, greater study on the integration of plant disease detection systems into practical applications is required. More effort is needed, for example, to build mobile-friendly plant disease detection applications.

4. PROPOSED APPROACH

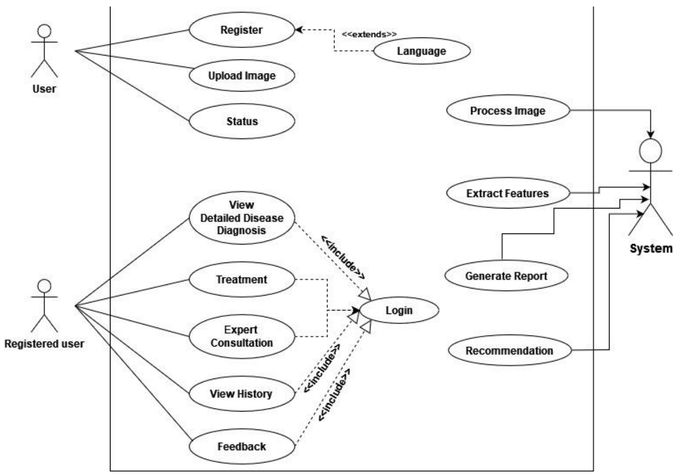


Fig. 4.1 Use Case Diagram of System

1) Camera Handler: This module will be in charge of capturing and processing photos from the user's device. It will load and execute a pre-trained **MobileNet** model on the user's smartphone to detect any illnesses in the image using TensorFlow.js.

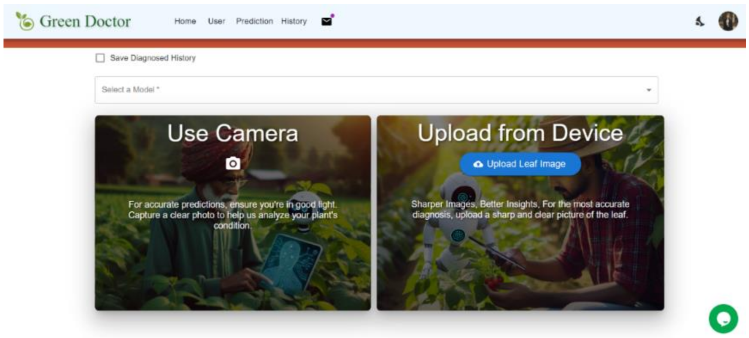


Fig. 4.2 Camera Handler

2) Model Loading System: The Model Selecting module will use this module to load the pre-trained MobileNet model from a remote server. It will load the model with **TensorFlow.js** and maintain the model's state with **ml.js**.

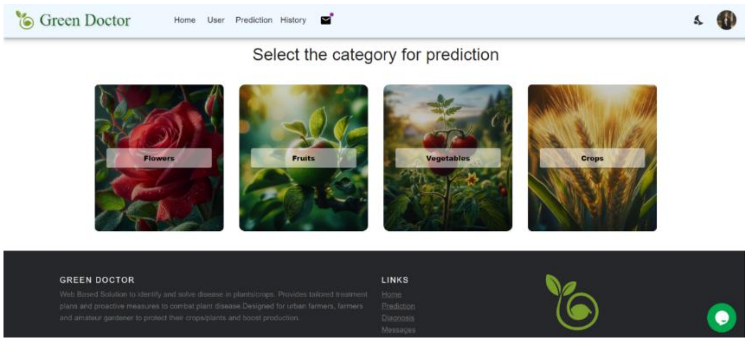


Fig. 4.3 Model Loading System.

3) Disease Detection System: The MobileNet model will be used by this module to detect any illnesses in the picture recorded by the Camera Handler module. It will generate a list of probable illnesses and their probability.

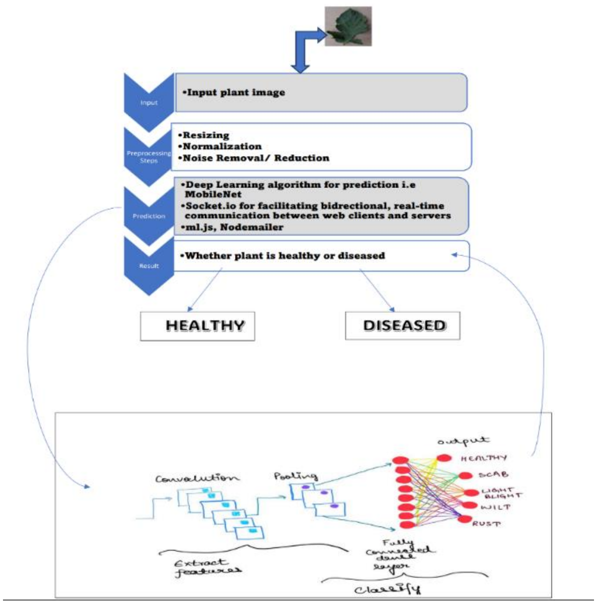
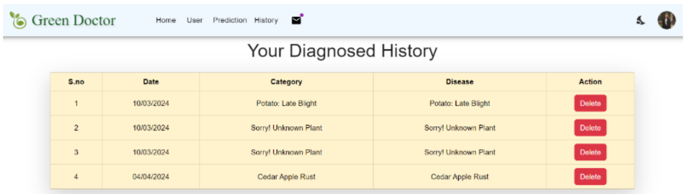


Fig. 4.4 plant disease detection pipeline

4) Diagnosed History: It is a pivotal component of the disease detection project, enabling users to conveniently view and track predictions and diagnosed history of crop and plant ailments.



Green Doctor Home User Prediction History

Your Diagnosed History

S.no	Date	Category	Disease	Action
1	10/03/2024	Potato: Late Blight	Potato: Late Blight	Delete
2	10/03/2024	Sorry! Unknown Plant	Sorry! Unknown Plant	Delete
3	10/03/2024	Sorry! Unknown Plant	Sorry! Unknown Plant	Delete
4	04/04/2024	Cedar Apple Rust	Cedar Apple Rust	Delete

Fig. 4.5 Diagnosed History of the user.

5. RESULTS AND DISCUSSION

Swift diagnosis: Achieves rapid disease detection, taking only 1.3 seconds per diagnosis, enabling quick action by farmers.

Improved quality of agricultural products: By detecting and treating plant diseases early, farmers can produce higher-quality agricultural products that are less likely to be contaminated by pathogens.

Increased farmer income: By reducing crop losses and improving the quality of agricultural products, a web-based plant disease detection solution can help farmers to increase their income.

Extensive disease coverage: Capable of identifying over 100 diseases in different plants, providing comprehensive protection to crops.

Reduced environmental impact: The extensive use of pesticides and herbicides to stop plant diseases can either have negative or good consequences on the environment. The web-based plant disease detection system can assist farmers to cut down the usage of these chemicals which in turn will lead to the development of a more sustainable agricultural sector.

Educate farmers about plant diseases: The solution may also help farmers identify several types of plant diseases including their signs, causal factors and procedures for management. It is but a tool for farmers to better understand and manage their crops, which will minimize the risk of infections effects.

Versatile solution: The results show that the new method can be applied to many plant species and that the diagnosis of the crops' diseases can be done with a high level of accuracy.

6. CONCLUSION AND FUTURE WORK

Plant diseases are capable of causing drastic crop losses. This leads to a situation where farmer's face shortage of customer satisfaction and eventually entire economy suffers. Naturally, the early diagnosis and control of plant diseases is pivotal so as to lessen the stated surprises. Nevertheless, the conventional techniques of plant disease detection are frequently time-consuming and need expertise developed.

We in Green Doctor are suggesting a website-based method to identify and cure diseases in crops and plants using MobileNet CNN in a mobile platform. MobileNets is a lightweight and minimalistic type of the CNN architecture which is very suitable for mobile web and applications due to its capacity. The solution we propose will be a helpful tool for farmers and other participants in the agricultural sector. It will let specialists just to glance at the disease of plants and state the treatment for an illness. Crop losses will be drastically reduced while the yields per unit area will be substantial which will definitely multiply the agricultural output.

6.2 Future Work

Integration with other agricultural management systems: The integration of this solution with other agricultural management systems like irrigation and fertilization systems is a ultimately reliable way to supply farmers with an all-rounding solution for the crop management. This might provide farmers with an opportunity to lift the yields of farms and bring the associated expense towards the lowest.

Mobile app version: A mobile application version of the solution would be very helpful for farmers as it would enable them to use the solution in the field without carrying a laptop or a tablet. The app is also expected to have more useful features like GPS location tracking that is an added advantage offline functionality that would lend a hand to farmers in remote areas.

Partnerships with agricultural research institutions: To broaden the application of AI to agricultural research, as well as the development of new algorithms for plant diseases identification and diagnosis, a collaboration with the research institutes of this field looks very promising. These institutions have a lot of knowledge and information that could be used to enhance the working and reliability of the solution.

Provide multilingual user support: The implementation of the system into various languages would mean that it could be used by a large number of farmers from different parts of the world. This is particularly significant considering the where-in-the-world the world is an even industry.

Integration with other agricultural management systems: Integrating the solution with other agricultural management systems, such as irrigation and fertilizer systems, would be a great way to provide farmers with a more holistic solution for managing their crops. This could help farmers to improve their yields and reduce their costs**.**

Identifying and recommending new varieties of plants that are resistant to specific diseases: Develop a system for identifying and recommending new varieties of plants that are resistant to specific diseases. This could help to reduce the reliance on pesticides and other chemical treatments.

Providing personalized recommendations to farmers: Develop a system for providing personalized recommendations to farmers based on their specific crops, growing conditions, and financial constraints.

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ABOUT AUTHORS

	Rasheeq Zehra zehrarasheeq@gmail.com Department of Computer Science & Engineering, BBDITM, Lucknow, UP, INDIA
	Omkar Sharma omkarsharma2821@gmail.com Department of Computer Science & Engineering, BBDITM, Lucknow, UP, INDIA