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BIRATNAGAR

A Proposal on

FARMER ASSISTANT WITH PLANT DISEASE DETECTION USING CONVOLUTIONAL NEURAL NETWORK ALGORITHM

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1. INTRODUCTION

Farmer Assistant with Plant Disease Detection using Convolutional Neural Network algorithm is a web project to assist farmers by letting them solve their problems with the means of computers and modern-day technology. We have created a way for farmers to get solutions to their problems by contacting experts as well as by using machine learning. One of the features we have incorporated is predicting the disease of a plant and providing remedies.

One of the major sources of yield in Nepal is the production of crops. It is of enhancing the technological advancement in the fields related to crop productivity. Here farmers cultivate a maximum diversity of plants and crops. More studies are built with the important domain of qualitative and efficient farming is concentrated on enhancing the yield and food crop productivity at a minimum time with a greater outcome. The detection of plant disease by human visualization is a more difficult task and at the same time, less efficient, and it's done with a limited set of leaf images and takes more time. Whereas the automatic identification technique will take less effort and time and a more accurate program. Here we use image processing to detect the diseases. We can put the image into a system and a computer can perform various phases for identification and detect the related classes to which that image belongs. This work aims to make a leaf recognition technique based on the specific characteristics derived from images.[1]

Common diseases like viral, bacterial, and fungal infections can be difficult to distinguish, and these symptoms can be represented in the difference in color, function, and shape in which plant responds to the pathogen. Smaller datasets are less efficient and affect the model performance. Training a large set of data can not only reduce overfitting but can enhance a model's overall performance. The quality and type of training dataset massively impact the model capabilities. The training data contains noise the classifier's accuracy becomes dependent on this composition. This topic of early detection is explored due to a limited number of datasets, and it consists of less accuracy and detection. This system avoids the gathering of more leaf inputs for studying them in the laboratory because preexisting images and datasets are taken and identify the plant diseases. it imparts a feasible functioning approach that can use not be costly and complex. It works by using

CNN to detecting the leaf is healthy or diseased and if it is a disease it identifies the diseases like fungi, viruses, bacteria, black spots, powdery mildew, downy mildew, blight, canker, etc., and also provides remedies for recoverability of these diseases.[1]

Farmer Assistant with plant disease detection using CNN project helps the farmer to test four most cultivated plants, they are **rice plant, maize(corn) plant, potato plant, and tomato plant.** Our project aims to identify common diseases by detecting leaves of rice, maize, potato, and a tomato plant . Common diseases are as follows:

Table 1: Common Diseases in Plant

Plant	Diseases
Rice	Brown Spot, Hispa, Leaf blast
Maize(corn)	Cercospora leaf spot(gray leaf spot), Common rust, Northern leaf blight
Potato	Early blight, Late blight
Tomato	Bacterial spot, Early blight, Late Blight, Septoria leaf spot

2. PROBLEM STATEMENT

Farmers face lots of problems regarding farming but there is not any platform where they can freely talk about these problems, due to which efficient solutions are not obtained for those problems.

Various diseases in crops stop the production of crops. Farmers observe the disease and identify the disease with their eyes, but this method is very time-consuming.

Farmers are not aware of the pesticides and insecticides to be used after identifying the disease. They use manure and cow dung instead in all crops to overcome the disease which sometimes creates more adverse harm to the crops. Farmers are also not aware of remedies and how to use pesticides or other organic insecticides in their crops.

Farmer assistant with plant disease detection using the CNN project helps farmers to get solution of their submitted problems by the expert and to identify the disease of the plant

automatically and provide the name of pesticides, remedies and the way to use pesticides in their plants to overcome the identified diseases.

2.1. SCOPE

- The scope is to assist farmers by connecting them with experts.
- Helping farmers to diagnose the disease of rice, maize, potato and a tomato plant.

3. OBJECTIVES

- To identify diseases of rice, maize, potato, and tomato plant automatically using CNN.
- To suggest the name of pesticides and insecticides and provide remedy for the disease to be used after identification of the disease.

4. METHODOLOGY

4.1. REQUIREMENT IDENTIFICATION

4.1.1. Study of Existing System/Literature Review

Agriculture occupies an important position in the Indian economy. Indian farmers today are facing the problem of low income due to the lack of information about government schemes, fertilizers, farming equipment, etc. Some smallholders and marginalized farmers have low awareness as most of them live in remote areas and don't have access to information about soil properties, seeds, recently used tools, fertilizers, etc. The document proposes an intelligent, portable system that uses natural language processing methods to help farmers use different farming methods, and further help them to answer their queries and solve their basic and intermediate-level doubts using a chatbot which will save them time. To meet all the requirements of farmers, a chatbot is proposed using natural language processing technology. The system will act as an interactive virtual assistant for farmers, answering all queries related to agriculture. This paper will go through the implementation of the chatbot using the chatterbot libraries and Django framework.[2]

Farmers face several challenges when growing crops like uncertain irrigation, poor soil quality, etc. Especially in India, a major fraction of farmers do not know to select appropriate crops and fertilizers. Moreover, crop failure due to disease causes a significant loss to the farmers, as well as the consumers. While there have been recent developments in the automated detection of these diseases using Machine Learning techniques, the utilization of Deep Learning has not been fully explored. Additionally, such models are not easy to use because of the high-quality data used in their training, lack of computational power, and poor generalizability of the models. To this end, we create an open-source easy-to-use web application to address some of these issues which may help improve crop production. In particular, we support crop recommendation, fertilizer recommendation, plant disease prediction, and an interactive newsfeed. In addition, we also use interpretability techniques in an attempt to explain the prediction made by our disease detection model.[3]

The major reason for minimizing crop productivity is various diseases in plants. To eliminate the disease-induced losses in plants during growth as well as to increase crop productivity, former disease detection and prevention on the crop are the most challenging factors. Thus, it is a suitable decision that can be taken by the farmers or villagers to avoid further losses. The project works on the technique of image processing which identifies the various diseases in plants. Here we use an efficient convolutional neural network algorithm (CNN) algorithm which can detect the type of diseases in various leaves. Our proposed paper includes implementation steps like datasets gathering, training, segmentation, feature extraction, testing, and classification, using CNN to classify the leaves which are diseased or healthy based on data. This work implemented in giving the input leaf in real-time from the source of Google or dataset is trained under the system helps in disease detection and represents remedies for overcoming the deficiency. After the validation step, the project provides an accuracy of 99.5%.[1]

A survey of research initiatives that use convolutional neural networks (CNN), a type of DL, to address various plant disease detection concerns was undertaken in the current publication. In this work, we have reviewed 100 of the most relevant CNN articles on detecting various plant leaf diseases over the last five years. In addition, we identified and summarized several problems and solutions corresponding to the CNN used in plant leaf disease detection. Moreover, Deep convolutional neural networks (DCNN) trained on image data were the most effective method for detecting early disease detection. We

expressed the benefits and drawbacks of utilizing CNN in agriculture, and we discussed the direction of future developments in plant disease detection.[4]

Agriculture is one field that has a high impact on the life and economic status of human beings. Improper management leads to a loss in agricultural products. Diseases are detrimental to the plant's health which in turn affects its growth. To ensure minimal loss to the cultivated crop, it is crucial to supervise its growth. Convolutional Neural Network is a class of Deep learning used majorly for image classification, and other mainstream tasks such as image segmentation and signal processing. The main aim of the proposed work is to find a solution to the problem of 38 different classes of diseases detection using the simplest approach while making use of minimal computing resources to achieve better results compared to the traditional models. VGG16 training model is deployed for the detection and classification of plant diseases. Neural network models employ automatic feature extraction to aid in the classification of the input image into respective disease classes. This proposed system has achieved an average accuracy of 94.8% indicating the feasibility of the neural network approach even under unfavorable conditions.[5]

Crop cultivation plays an essential role in the agricultural field. Presently, the loss of food is mainly due to infected crops, which reflexively reduces the production rate. Identifying the plant diseases at an untimely phase is not yet explored. The main challenge is to reduce the usage of pesticides in the agricultural field and to increase the quality and quantity of the production rate. The proposed system explores the leaf disease prediction at an untimely action. The enhanced CNN algorithm to predict the infected area of the leaves. A color-based segmentation model is defined to segment the infected region and place it to its relevant classes. Experimental analyses were done on sample images in terms of time complexity and the area of the infected region. Plant diseases can be detected by image processing techniques. Disease detection involves steps like image acquisition, image pre-processing, image segmentation, feature extraction, and classification.[6]

4.1.2. Requirement Analysis

Functional Requirements:

i. **For Farmers:**
   - **a.** Farmers submit any problem regarding farming.
   - **b.** Farmers upload an image for testing.

ii. **For Experts:**
   - **a.** Experts view farmer's problems and suggest solutions for farmers.

iii. **For Admins:**
   - **a.** Admins shall manage the database and shall do relevant task to the same. Admins monitor user activities and control the system.

iv. **For System:**
   - **a.** System detects image and keeps description of diseases as an output.
   - **b.** System suggests pesticides/insecticides and provide remedy to farmers.

Non -Functional Requirement:

- **Portability:** Since this is a web-based application, the system would be easily accessible from any geographical location.
- **Usability:** The system would be easy to navigate throughout.
- **Reliability:** The system will work flawlessly if a farmer submits an image of plant leaf for detection of disease and problems regarding farming, it should be instantly executed.

4.2. FEASIBILITY STUDY

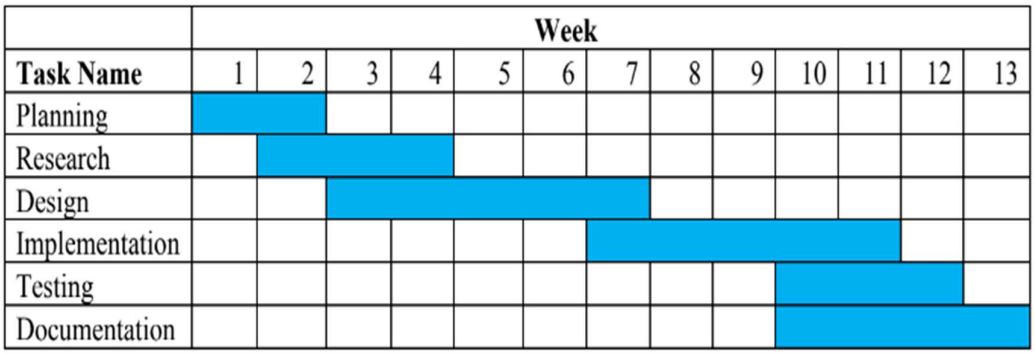
A feasibility Analysis was done before the development of our project. Feasibility Analysis evaluates whether our project has the potential for success or not. We performed the following feasibility analysis before working on our project:

- **Technical Feasibility:** The web application complies with current technology both in terms of hardware and software, and is hence supposed to be technically feasible. Almost all the latest web browsers can support this web application and can be run on modern days systems. This application is aimed to have easy navigation where a farmer can get a prediction of the diseases seen in their plants and take steps to recover them on time before their crops get destroyed.

- **Operational Feasibility:** The web application solves problems faced by farmers regarding plant diseases. Each year many farmers face great economical loss due to plant diseases and are essential for farmers to their effective timely prevention before their entire production goes to vain. Furthermore, we have easy navigation, rich density of information and a cost-effective solution to the problem hence we see that the web application is operationally feasible for farmers and general people who want to predict diseases in their plants and take effective mitigating measures.

- **Economic Feasibility:** Economic feasibility is all about a determination of whether the project will be acceptable to the people or not. And, according to our research, we have hope that it would be a great opportunity for the farmers for being able to take effective measures to prevent their plant disease. These is essentially cost-effective measures that a farmer can take to prevent their crop diseases and get suggestion on pesticides that they can use as a result of the certain disease being caught by their plants.

- **Schedule(Gantt Chart showing the project timeline):**



4.3. High-Level Design of System

4.3.1. Methodology of the proposed system

We are using Deep Learning (DL) for the development of our project. As we are working with image data, deep learning works well for this project. Within deep learning, Convolutional Neural Network (CNN) is used for classification. Here we have two folders train and test. Training used for building the system on plant leaves and the test consists of testing the system and detecting the accuracy of the work. [1]

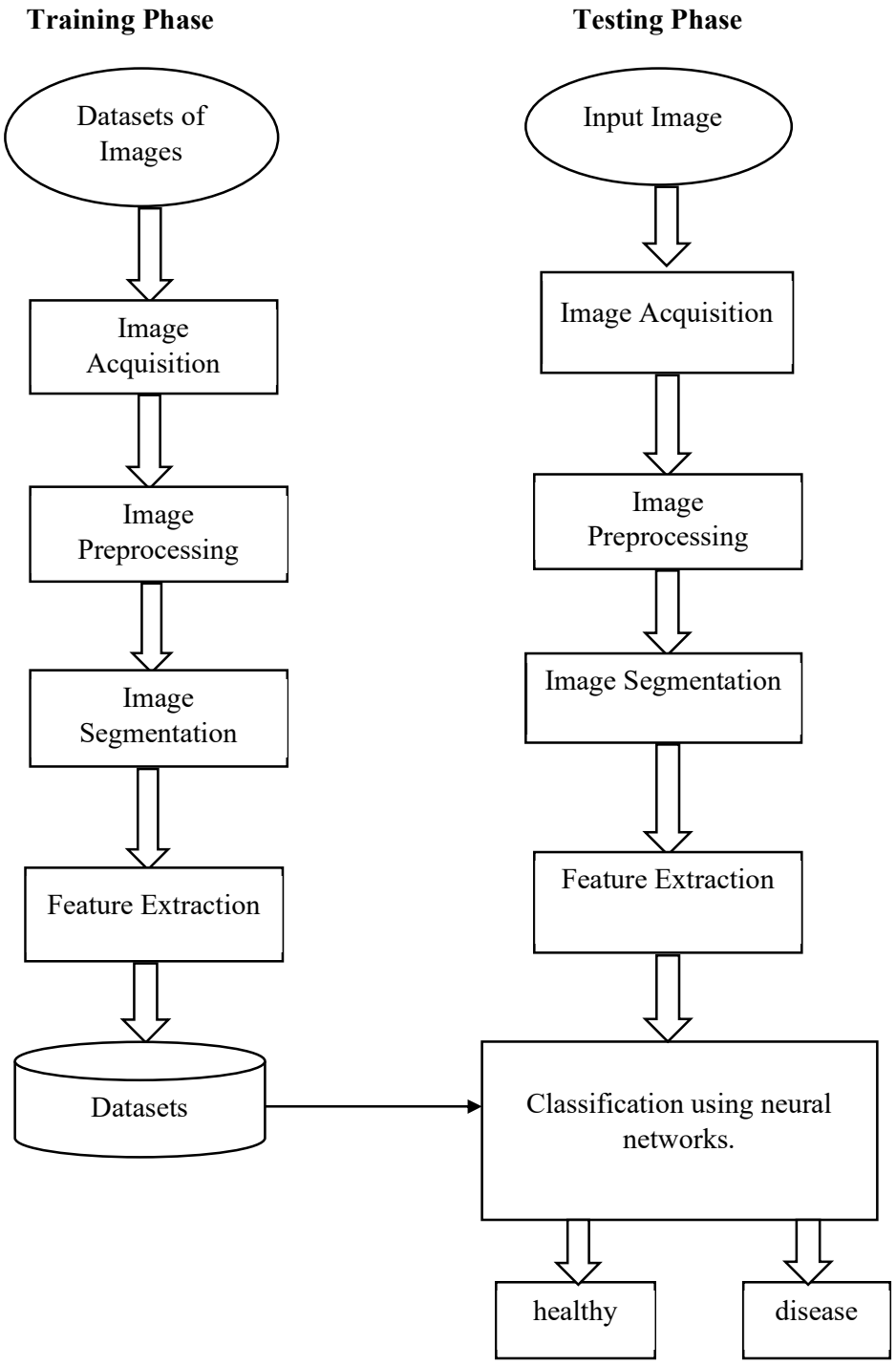


Figure 1: Training phase and testing phase[1]

Dataset: This is a set of images for specified purposes. We use a plant leaf dataset and each of them is divided for preprocessing and classification. The Leaf dataset consists of more than 1000 images of various plants. This contains both healthy and diseased leaves. The

diseased class includes in name of the specified disease and provides remedies for overcoming the deficiency. Here we train the large dataset and detect the disease present on each leaf.[1] We use the Kaggle dataset for our project.

Table 2: Leaf Category with number of images

Leaf category	Number of images
Rice	333
Maize(Corn)	384
Potato	215
Tomato	838
Total	1770

Image acquisition: To put the desired leaf image from the dataset or real-time source from Google is also established, the sampled images of the diseased and healthy leaves are gathered and used in training the system for acquisition. [1]

Image preprocessing: preprocessing of leaves is bringing all the image sizes to be reduced to uniform size like 50*50 resolution. The main motive of this step is to remove the noise or other unwanted objects from the image.[1]

Segmentation: segmentation is a phase of image processing it segments the leaves into several parts and derives useful and meaningful information from the data. It derives the leaves based on leaf perimeter, shape, region edge, threshold, feature, and model. There are different types of segmentation techniques available here we use neural network-based segmentation.[1]

Feature extraction: CNN contains various layers which provide feature extraction and further classification of images. The key role of feature extraction in plant disease identification is to learn the features automatically. The basic geometrical features are derived in this step. Feature extracted based on the parameters like diameter, width, leaf area, leaf perimeter, morphological features, shape, texture, rectangular, etc.[1]
Classification: classification is a process of placing each of the images under specified classes. The classification is a step in which it compares various values received after the

feature extraction, and it classifies whether the input leaf as diseased or healthy, to establish efficient relation analysts use data. Here, we classify four categories as leaf images. If the resulting status of the leaf is diseased it provides the remedies for removing the deficiency.

4.3.3. Flowchart

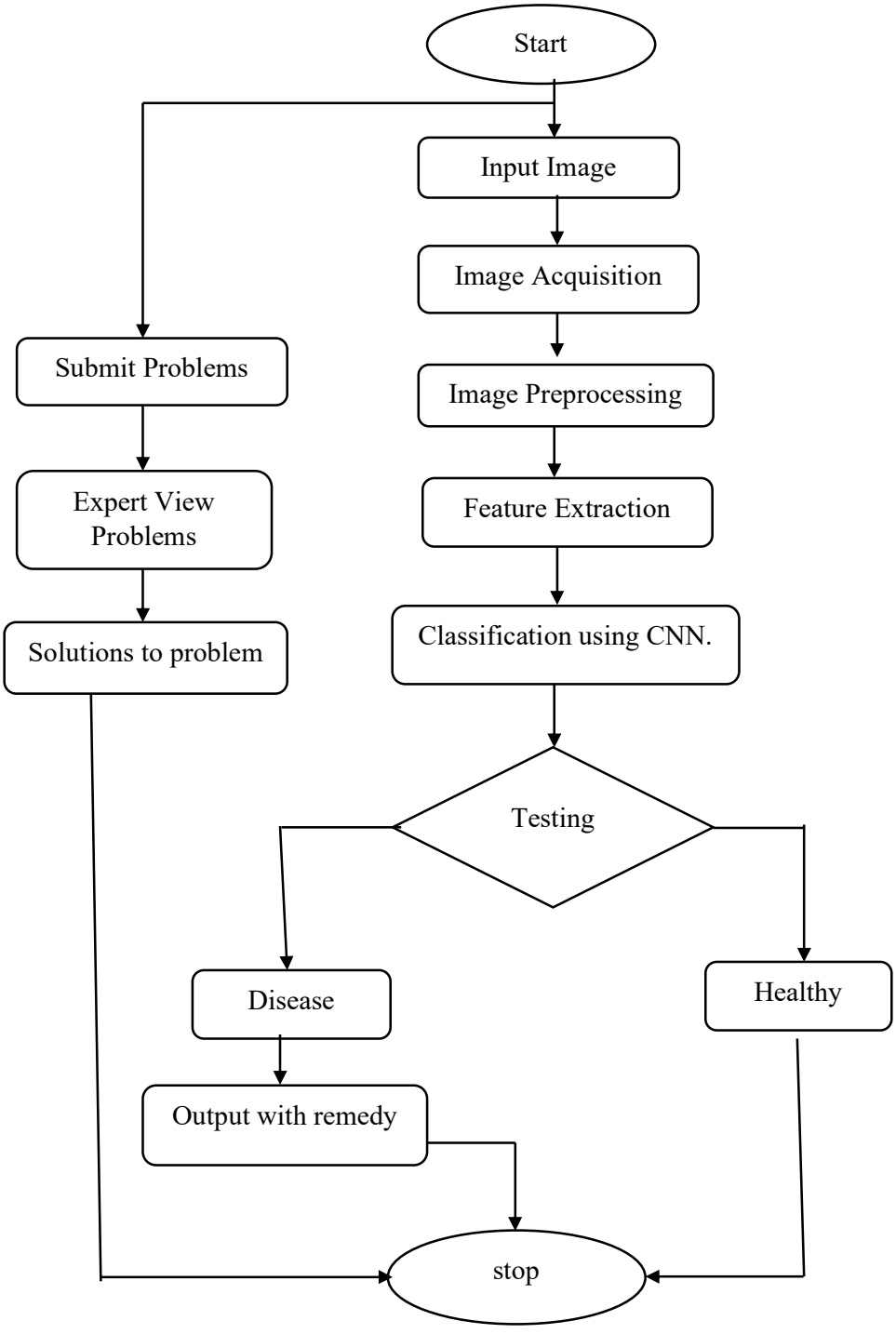


Figure 2: Flowchart

4.3.4. ER Diagram

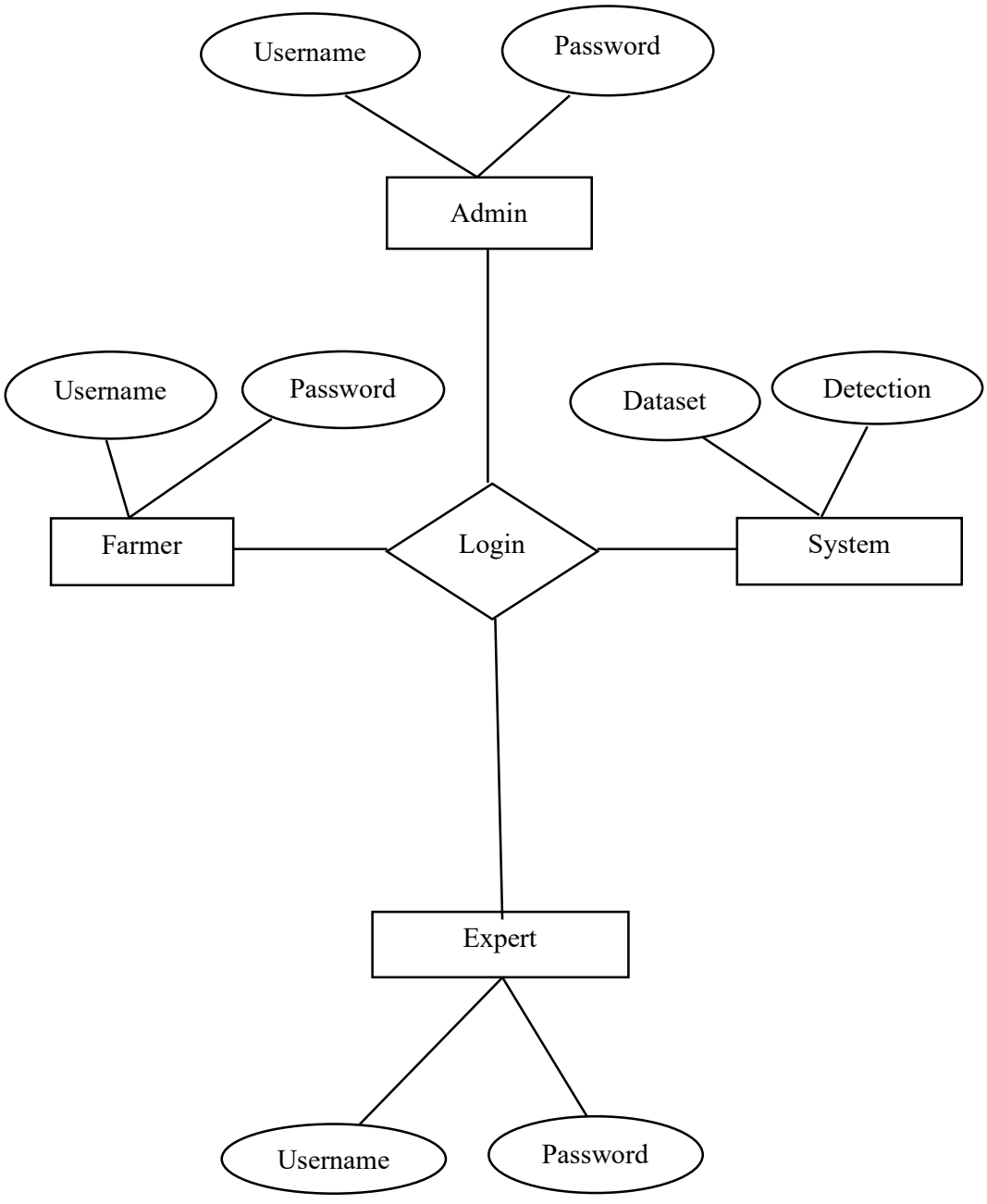


Figure 3: Entity-Relationship Diagram[7]

4.3.5. Use Case Diagram

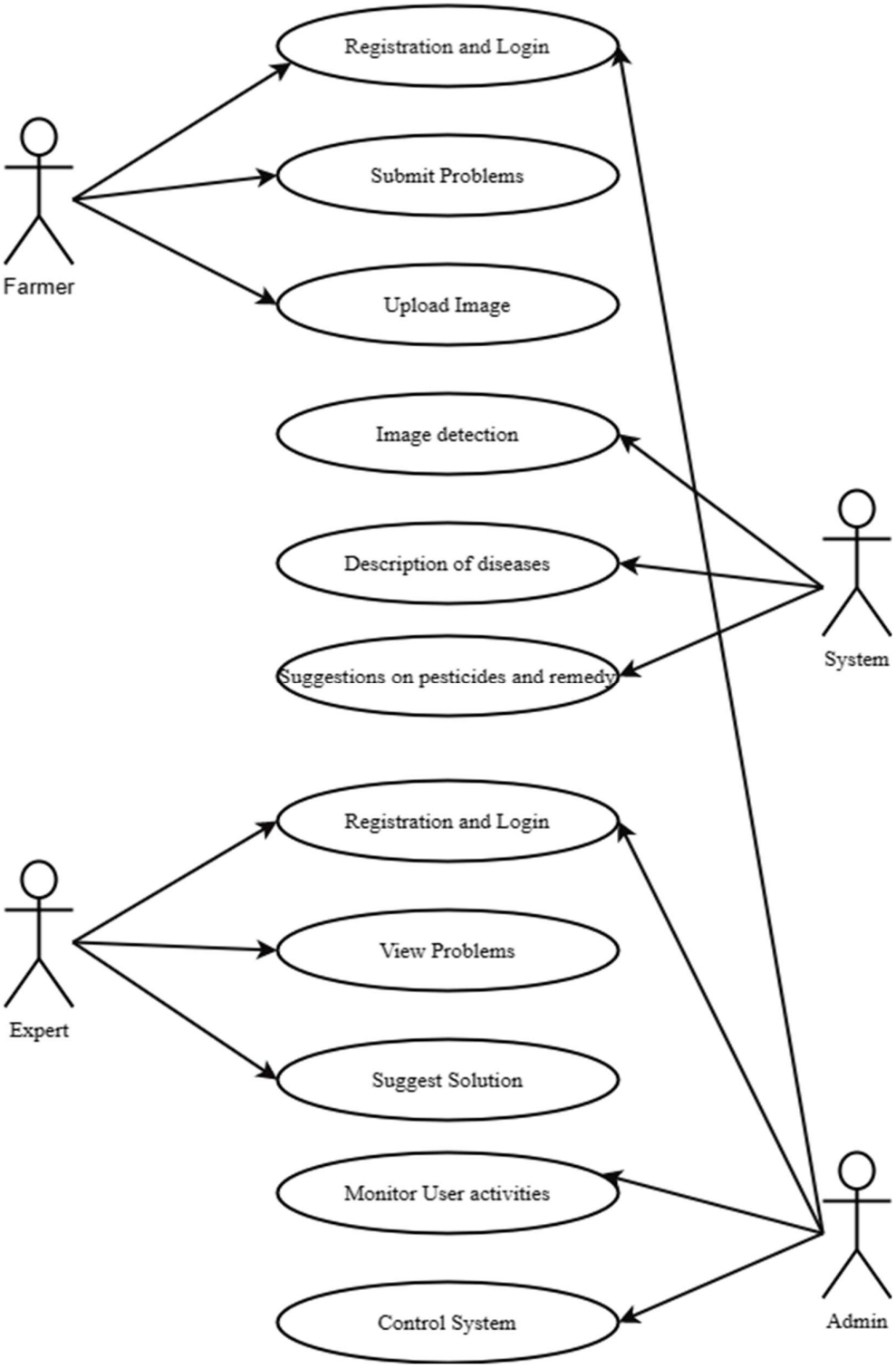


Figure 4: Use case Diagram[7]

4.3.6. Data Flow Diagram

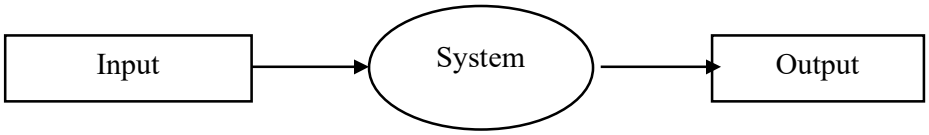


Figure 5:DFD Level 0, DFD Level 1[7]

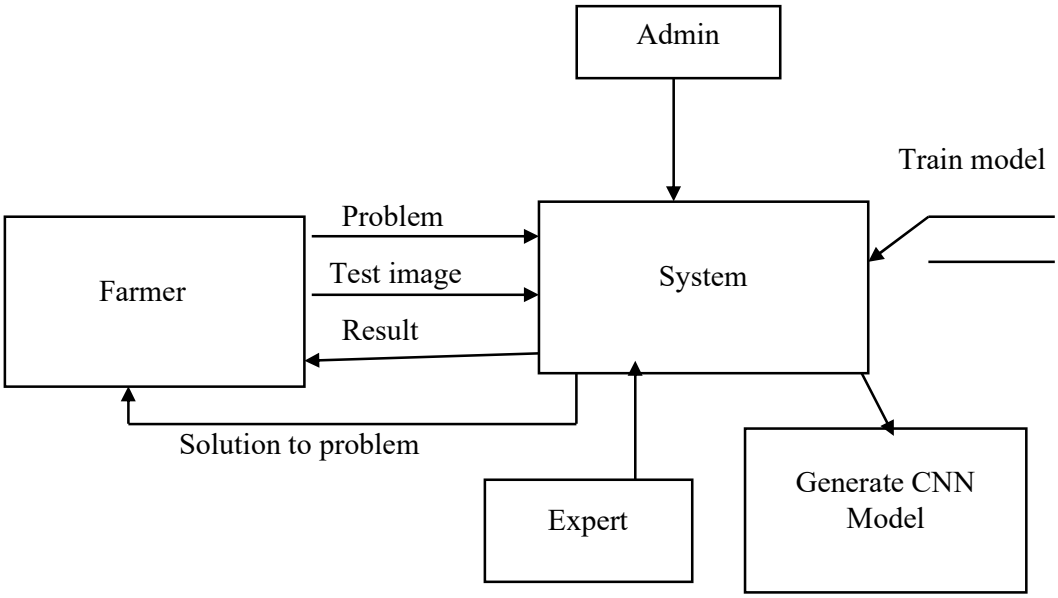


Figure 6: DFD Level 2[7]

4.3.7. Working Mechanism of Proposed System

The proposed system shall have four types of actors: Farmer, Expert, Admin and System.

i. **Farmer:** Farmer is anyone who can submit problems regarding farming and upload an image of crop's leaf like rice, maize, potato, and tomato to identify diseases.

ii. **Expert:** Expert is the one who views farmer's problems and suggest solutions.

iii. **Admin:** Admin is responsible for managing the whole system. Admin can monitor the overall system. Admin can check and monitor whether the user and the request made by the user is legit or not.

iv. **System:** System is responsible for detecting image uploaded by the farmer and provide description of diseases to farmers. System can suggest pesticides/insecticides and remedy to get rid of identified disease.

The user of this web-app can register and login with their mobile phone.

Step1: Farmers submit problems and image of crop's leaf in our application.

Step2: Experts view problems and suggest solutions.

Step3: System automatically detects image and identify diseases and suggest pesticides/insecticides and remedy.

4.3.8. Description of Algorithm

We are using CNN (Convolutional Neural Network) algorithm for our project. CNN is a type of artificial neural network used in image recognition and processing that is specially designed to process pixel data. CNN consists of a complex network chain that extracts the characters in the images and classifies them to get specified results related to the input. Neural networks build with many layers like the input layer, convolutional layer, output layer, and fully connected layer. The Convolutional layer can add more layers to it. Firstly, we load the input data and create the convolution layer. Each layer consists of an activation function. Together with the convolutional neural network, we add a pooling function. Here five convolutional layers build, with corresponding pooling added. At the end of each layer take the fully connected layer and give a Soft Max activation function. Finally, the regression layer is used for receiving the result and using the optimizer. Another important

parameter is the learning rate (LR) which represents the speed at which one learns the model. Here we set the learning rate as 1.e-3. After the model building, load the data in the model. Training data convert for x and y. x is the image and y defines the label. We use the variable for the model to represent healthy and unhealthy. Finally, give the data for the model and detect if it is healthy or diseased. CNN algorithm is more efficient for dividing a huge amount of data and it can be described as an efficient machine learning algorithm. As it is building on finding solutions to classification and identification tasks. It can be learning characters automatically on the dataset. This algorithm analyzes visual leaves more efficiently. The structures of this algorithm change dramatically. The quality and type of training data collectively impact the capabilities of the model. Classifier accuracy depended on the data. Classification is made with the nature of their primary causal agent, either infectious or healthy. [1]

Training and Testing Algorithm

Input: Provide an image of leaves localization.

Output: classification of a review into healthy or diseased, it is diseased provides the remedies for overcoming the deficiency.

Step1: Start

Step2: Prepare a dataset (healthy or diseased)

Step 3: Preprocessing normalization

Step4: Train CNN

Step5: Real images from Google or dataset

Step6: Preprocessing

Step7: Test network

Step 8: If the probability of healthy > probability of unhealthy display a healthy leaf, otherwise display a diseased leaf.

Step 9: Go to the fourth step.

Step10: Stop.[1]

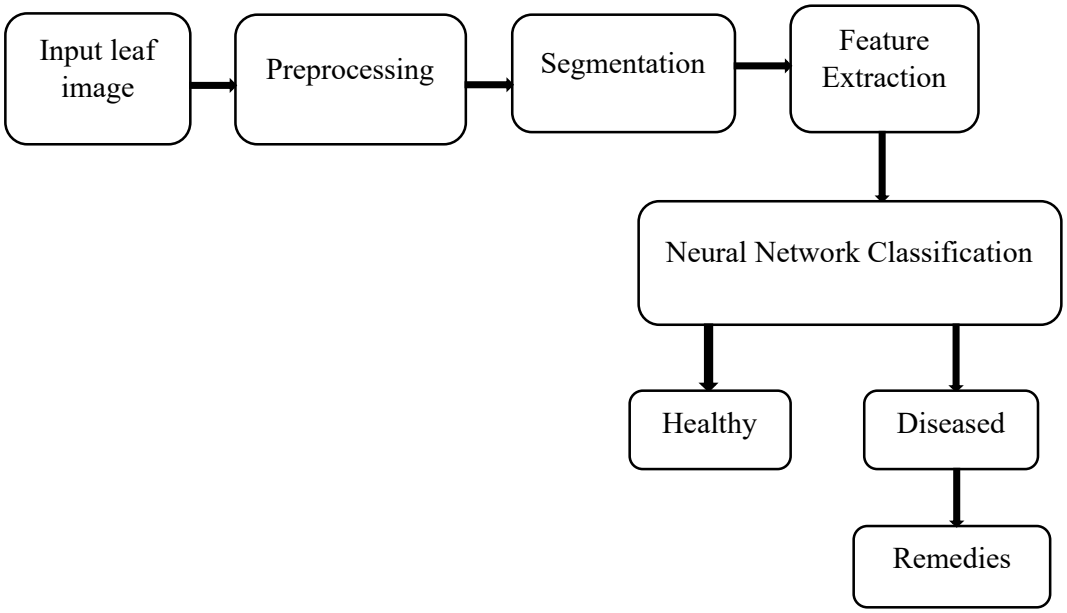


Figure 7:Block Diagram[1]

5. EXPECTED OUTCOME

- Farmers will be able to submit problems and reach solutions to their problems.
- Diseases of crops like rice, maize, potato and tomato plant will be identified automatically in a short time.

6. REFERENCES

[1] P. Prashidhan and M. S. Scholar, “Leaf disease detection using cnn 1 1,” vol. 10, no. 3, pp. 235–241, 2022.

[2] V. Nayak, P. R Nayak N, Sampoorna, Aishwarya, and N. H. Sowmya, “Agroxpert - Farmer assistant,” *Glob. Transitions Proc.*, vol. 2, no. 2, pp. 506–512, 2021, doi: 10.1016/j.gltp.2021.08.016.

[3] S. Gupta, A. Chopade, N. Jain, and A. Bhonde, “Farmer’s Assistant: A Machine Learning Based Application for Agricultural Solutions,” 2022, [Online]. Available: http://arxiv.org/abs/2204.11340

[4] B. Tugrul, E. Elfatimi, and R. Eryigit, “Convolutional Neural Networks in Detection of Plant Leaf Diseases: A Review,” *Agriculture*, vol. 12, no. 8, p. 1192, 2022, doi: 10.3390/agriculture12081192.

[5] R. R and M. S H, “Plant Disease Detection and Classification using CNN,” *Int. J. Recent Technol. Eng.*, vol. 10, no. 3, pp. 152–156, 2021, doi: 10.35940/ijrte.c6458.0910321.

[6] S. T. Santhanalakshmi, S. Rohini, and M. Padmashree, “PLANTS DISEASE DETECTION USING CNN,” vol. 8, no. 4, pp. 94–98, 2021.

[7] P. Deepalakshmi, K. T. Prudhvi, C. S. Siri, K. Lavanya, and P. N. Srinivasu, “Plant leaf disease detection using CNN algorithm,” *Int. J. Inf. Syst. Model. Des.*, vol. 12, no. 1, pp. 1–21, 2021, doi: 10.4018/IJISMD.2021010101.