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AUTOMATIC DISEASE PREDICTION SYSTEM FOR VARIOUS CROPS BY USING THE INTERNET OF THINGS AND DEEP LEARNING TECHNOLOGIES

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Abstract:

Internet of things (IoT) is an emerging technology where the data can be collected from everything at every place and at every time. The machine learning/deep learning is a advent technology which is used to extract the knowledge from the data. In the combination of these two technologies has vast applications almost in every field. Agricultural field is the major in India. This paper proposes a system to automatically classify the healthy and diseased crops and predicts the name of the disease along with the solution to cure that disease with the help of the IoT and deep learning technologies. The proposed system is simultaneously applied in the chilles, mango and maize crops and the results were obtained. The results were shown effectiveness in terms of the accuracy and the prediction rate of the crops disease.

Keywords: IoT, Deep Learning, crop, agriculture, and disease.

I. INTRODUCTION

Agriculture is the major field in india. To improve the quality of the crops various technologies has been contributed. To face the challenges in this particular field required an advanced technologies [7-8]. To solve this kind of challenges the agriculture farming needs to be converted into the smart agriculture farming [9], this can be done by using the internet of things technologies. With this technology the agricultural fields have vast applications for equal distribution of the water, classifying the healthy and diseased crops and fruits and prediction of the same in early stages. To increase the nutrients of the plant also a major challenge [10], the correct fertilization, with the nitrogen and potassium also a matter a lot to increase the crop yield. For these the deep learning technologies are used. The deep learning is a technology which is used to prepare a model for automatic analysis of the data. The deep learning as well has many applications related to the agricultural field.

The various diseases of the chilies crop are shown in figure 1.1, in figure 1.2 the mango diseases crop and the figure 1.3 shows the maize diseases.

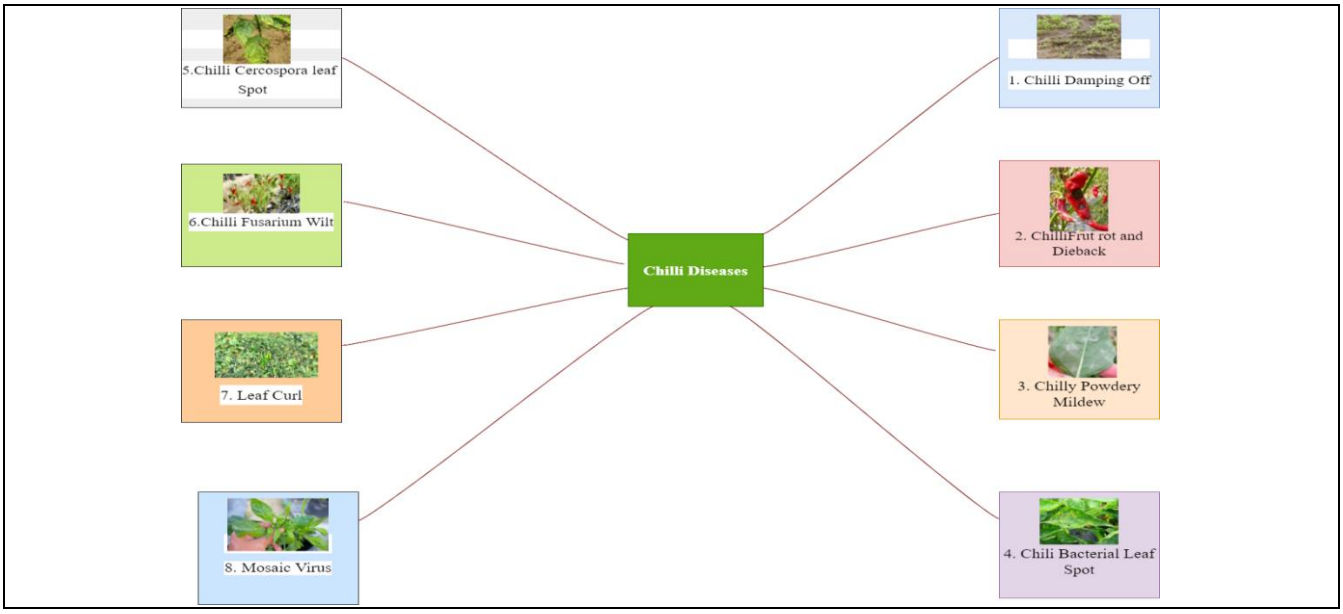

Figure 1.1: chiles diseases

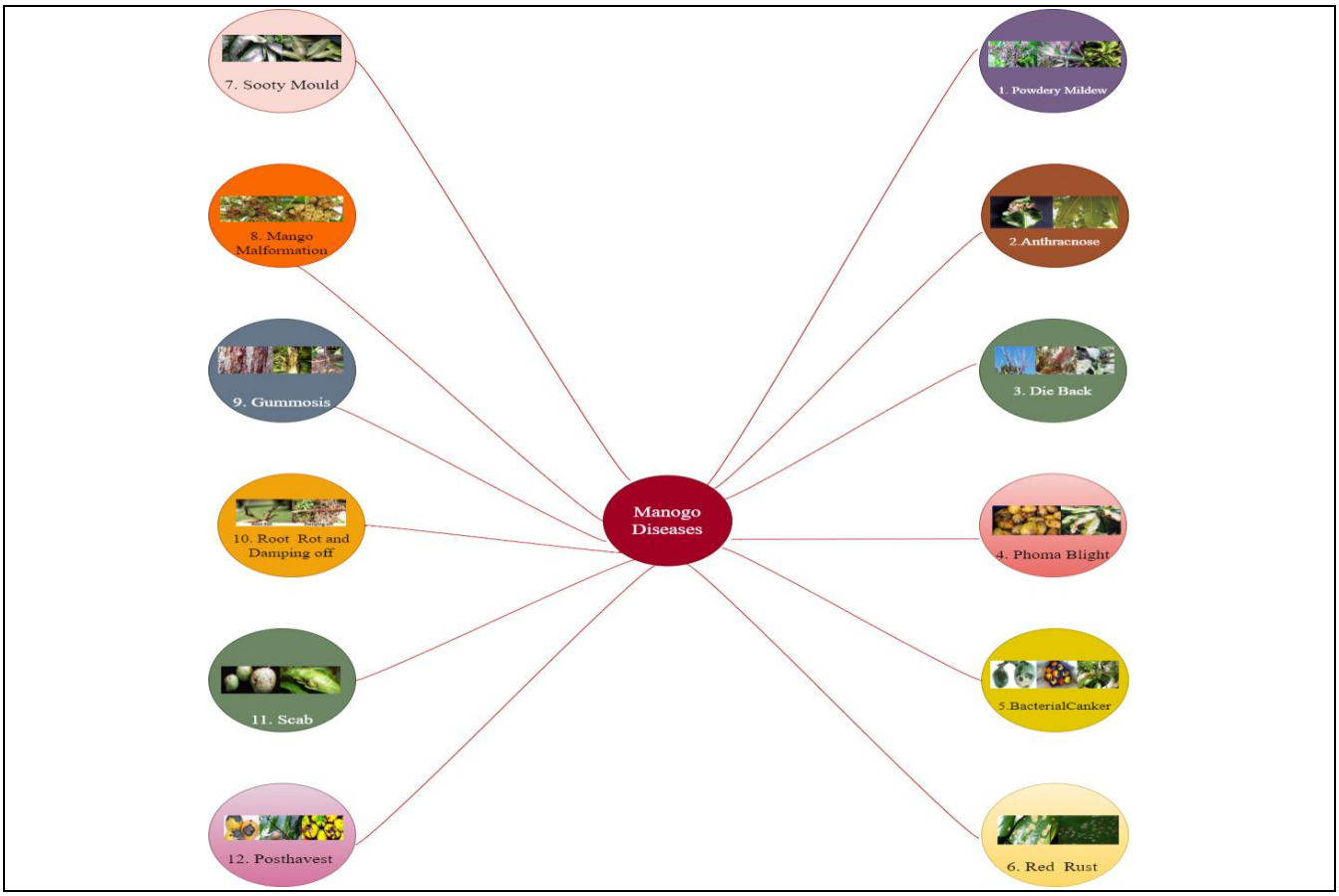

Figure 1.2: Mango diseases

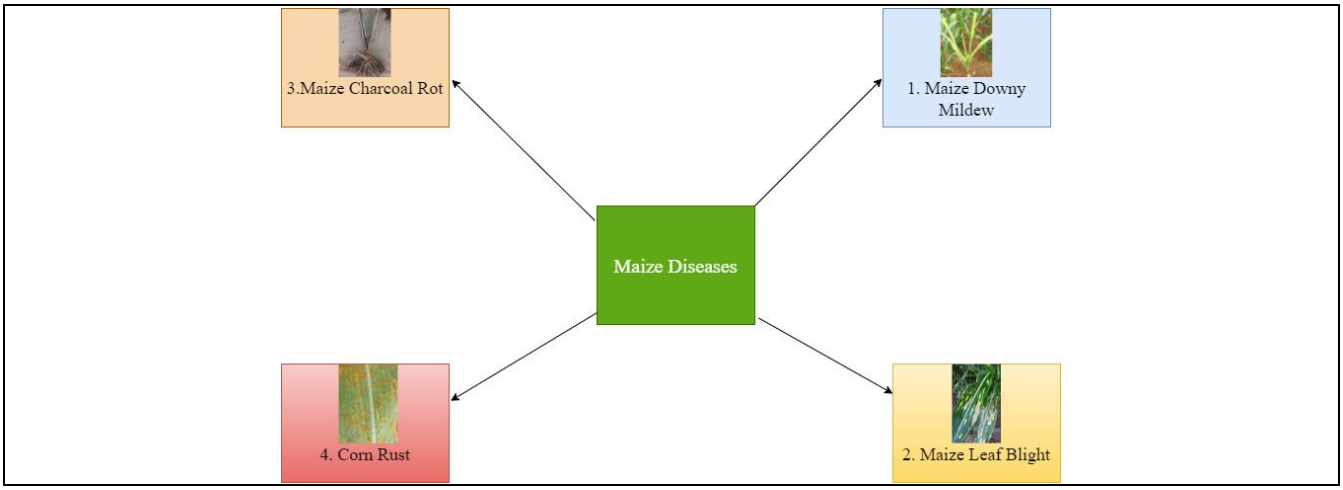

Figure 1.3: Maize diseases

Here proposed a system which is used to predicted and classify the diseases of the various crops with the remedy for the diseased crop. In the next section discussed about the related work, in section III discussed about the proposed system, in section IV discussed about the implementation, in section V discussed about the results and discussion and finally in section VI discussed about the conclusion and the future work.

II. RELATED WORK

To improve the quality of the crops various technologies has been contributed. Among them the image processing is used by using the color transformation technique [1] for detecting the quality of the crop in various levels, for the classification of the chilies pepper the fuzzy based K-nearest neighbor algorithm were used with the HSV features [2], the CNN [3-4] and ANN [5] has been used for the classification and predictions of the quality of the chilies crop. The deep learning approach is used [6] that is the YoLo based architecture for classifying the crops to predict the dieses of the chilies.

The smart agriculture [9] is used here to saw the chilies seeds and developed the analyzer android app, for remote monitoring the crops based on the environmental factors. And the based on this the alerts will be given to the famers via the app. The support vector machines, neural networks and other models are used to classify the diseases [10-16].

III. PROPOSED SYSTEM

Here proposed a system that is used to automatically predict the disease names of the crops by taking the live data from the crops by using the IoT based Agri electronic device and deep learning approach. The VGG-16 and Dense Net is used for analysis of the data. The Agri electronic device is used to collect the data from the crops. It consists of the camera sensor and other sensors like the temperature, humidity, soil moisture and water level sensor. With the help of this sensors the data is collected from the crops and stored in the centralized systems or cloud. These devices are placed in the crops accordingly to cover all the area of the crop. So that for every second the data will be collected from the crop at all places and stored in the cloud or centralized server. In the cloud or centralized server, the deep learning algorithms will be applied. With this algorithm the model is developed and with this model the crops will classify and predict the disease name along with the remedy to cure the predicted disease. The process of proposed system is shown in the figure 3.1.

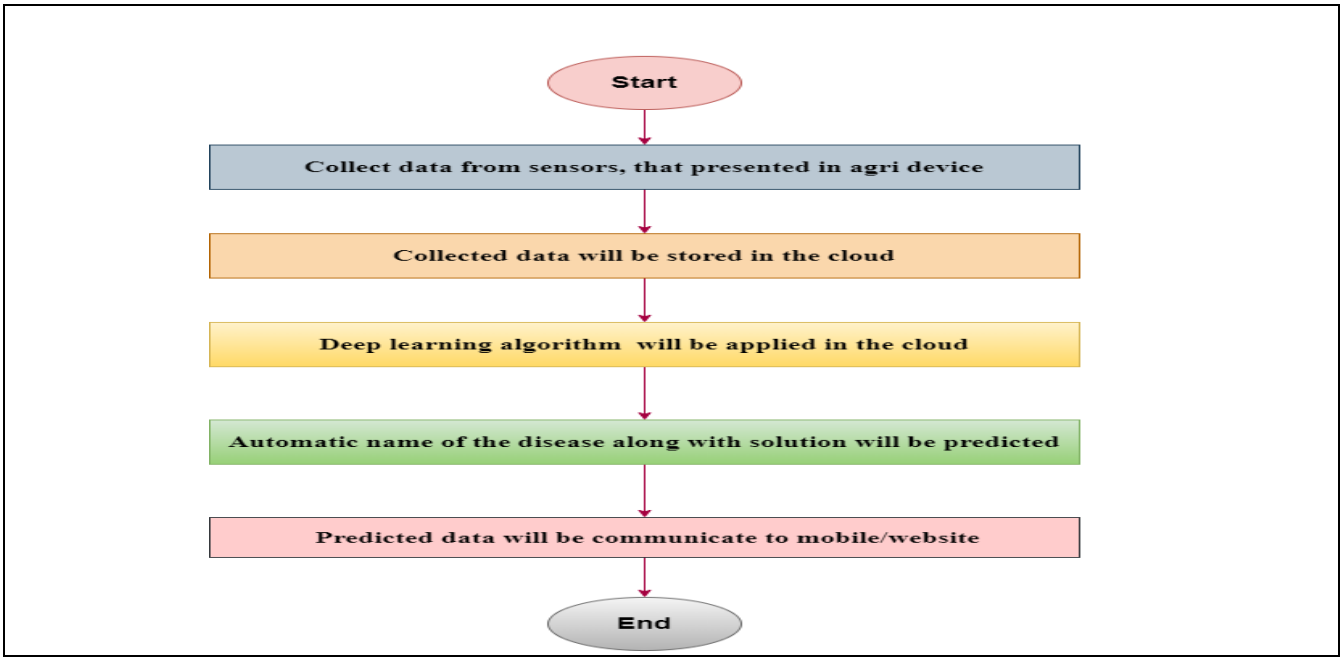

Figure 3.1: The process of the proposed system

IV. IMPLEMENTATION

The proposed system is implemented in the Andhra Pradesh state on chilli, maize and mango crops simultaneously. The implementation of the Agri electronic device along with the deep learning approaches were shown here. The figure 4.1 shows the implementation of the proposed system in the chilli crop, the figure 4.2 shows the implementation of the proposed system in the mango crop, the figure 4.3 shows the implementation of the proposed system in the maize crop, the figure 4.4 shows the Agri electronic device and the figure 4.5 shows the proposed deep learning approaches. Here the Agri device are used to collect the data from the crops, in the current work the device has been installed in various crops in different locations simultaneously and the data is collected at a same time and stored in the cloud or corresponding centralized devices. The data is collected and stored in the cloud and centralized servers. Each crop has a separated channel ID for storing the data in the cloud, from that cloud the data can be download in CSV/any required format to analyze the data. The device will collect the data as it has sensors installed in it. This device can be customized based on the customer needs. By using the deep learning approach, the model is prepared in a way that can apply for various crop at a same time that which can classify and predict the disease for different crops at a time. The implemented results were shown in the next section.

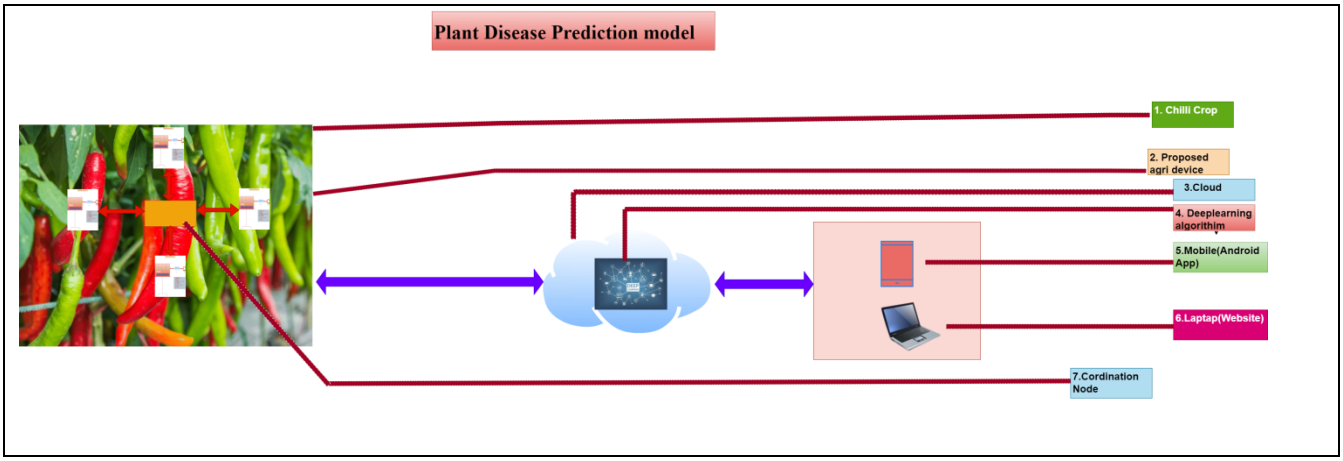

Figure 4.1: Implementation of proposed system in chilly crop.

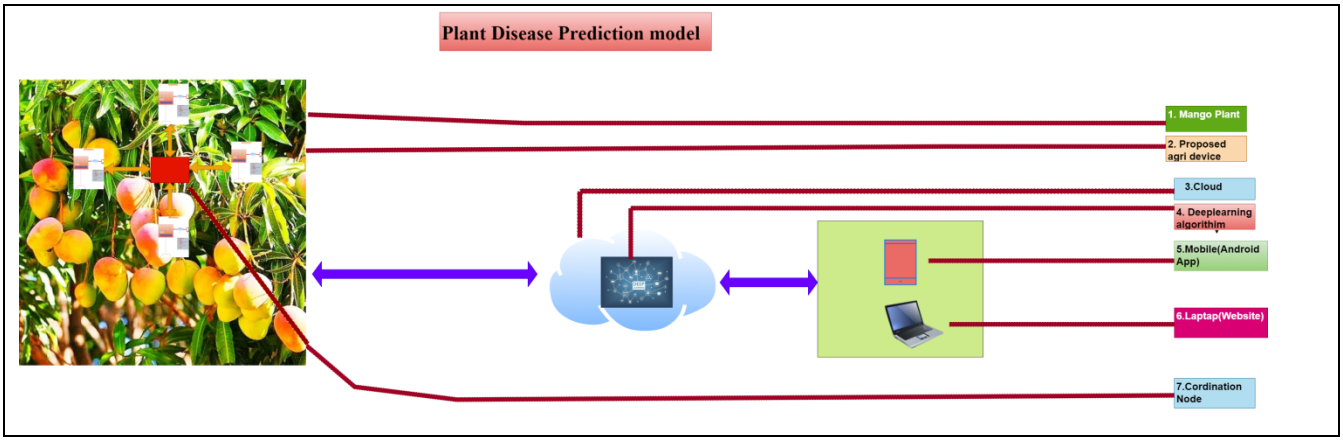

Figure 4.2: Implementation of proposed system in Mango crop.

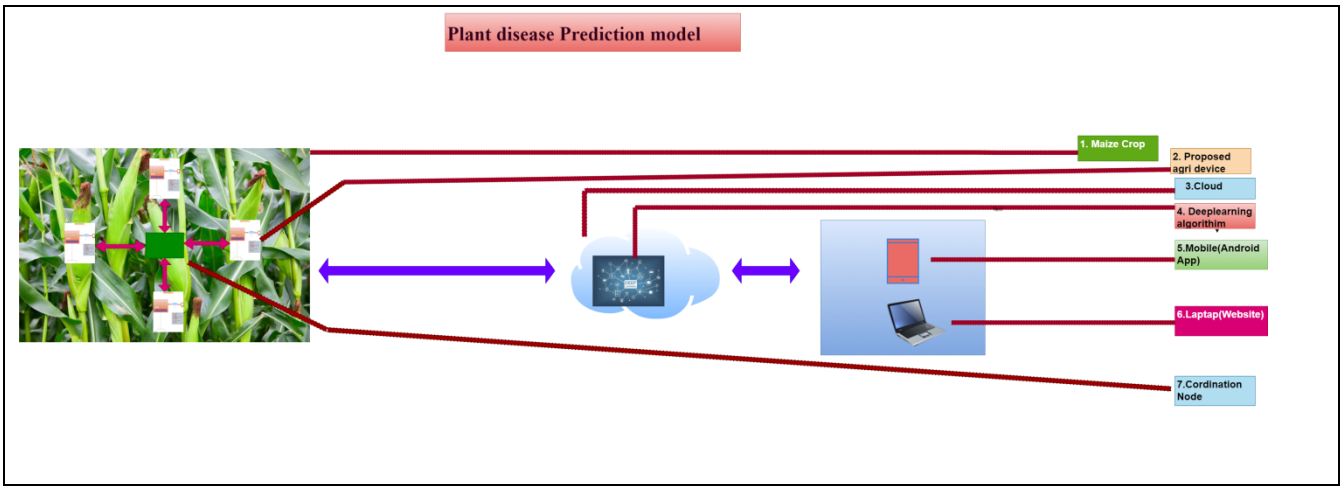

Figure 4.3: Implementation of proposed system in maize crop.

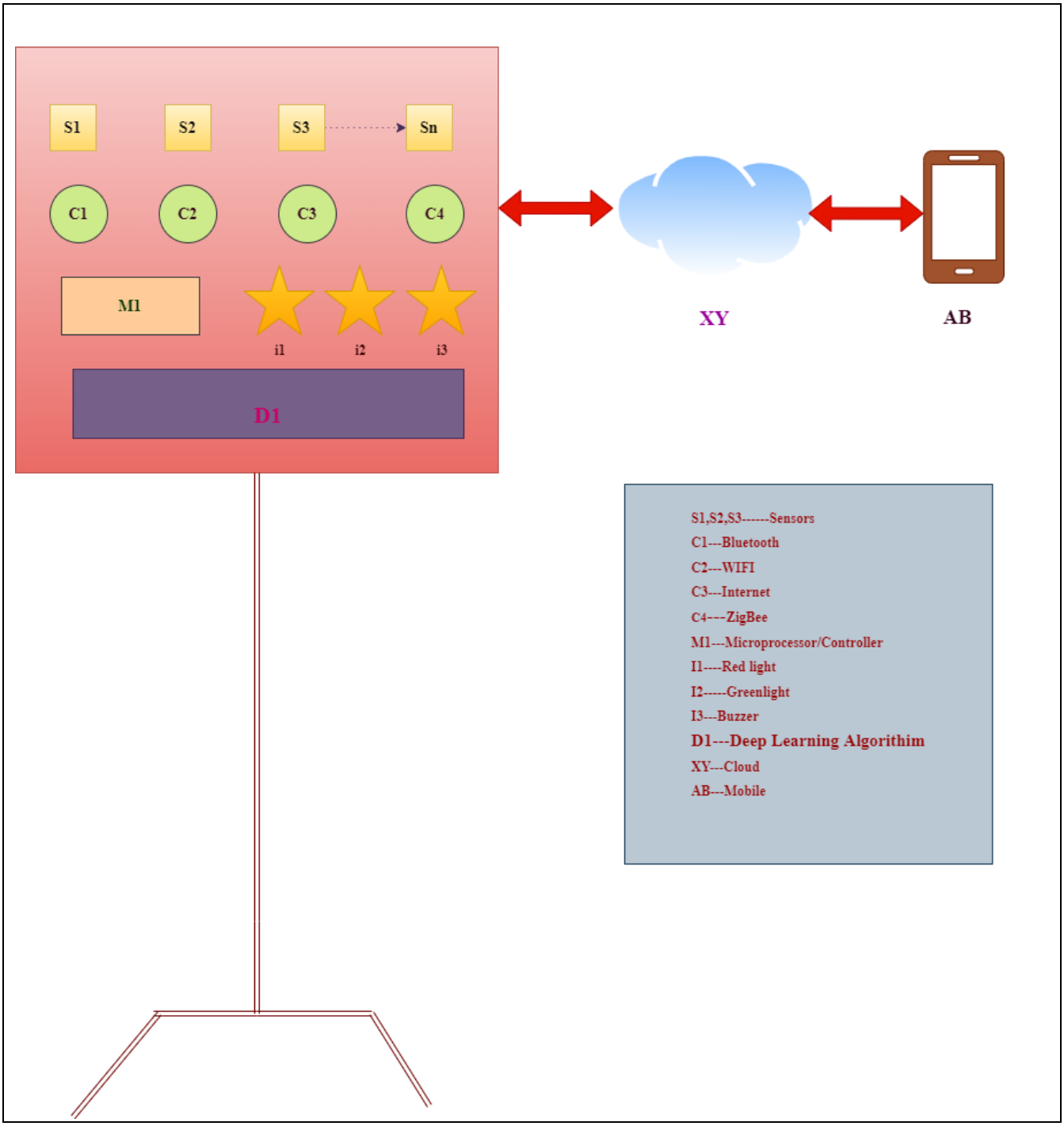

Figure 4.4: The Agri electronic device.

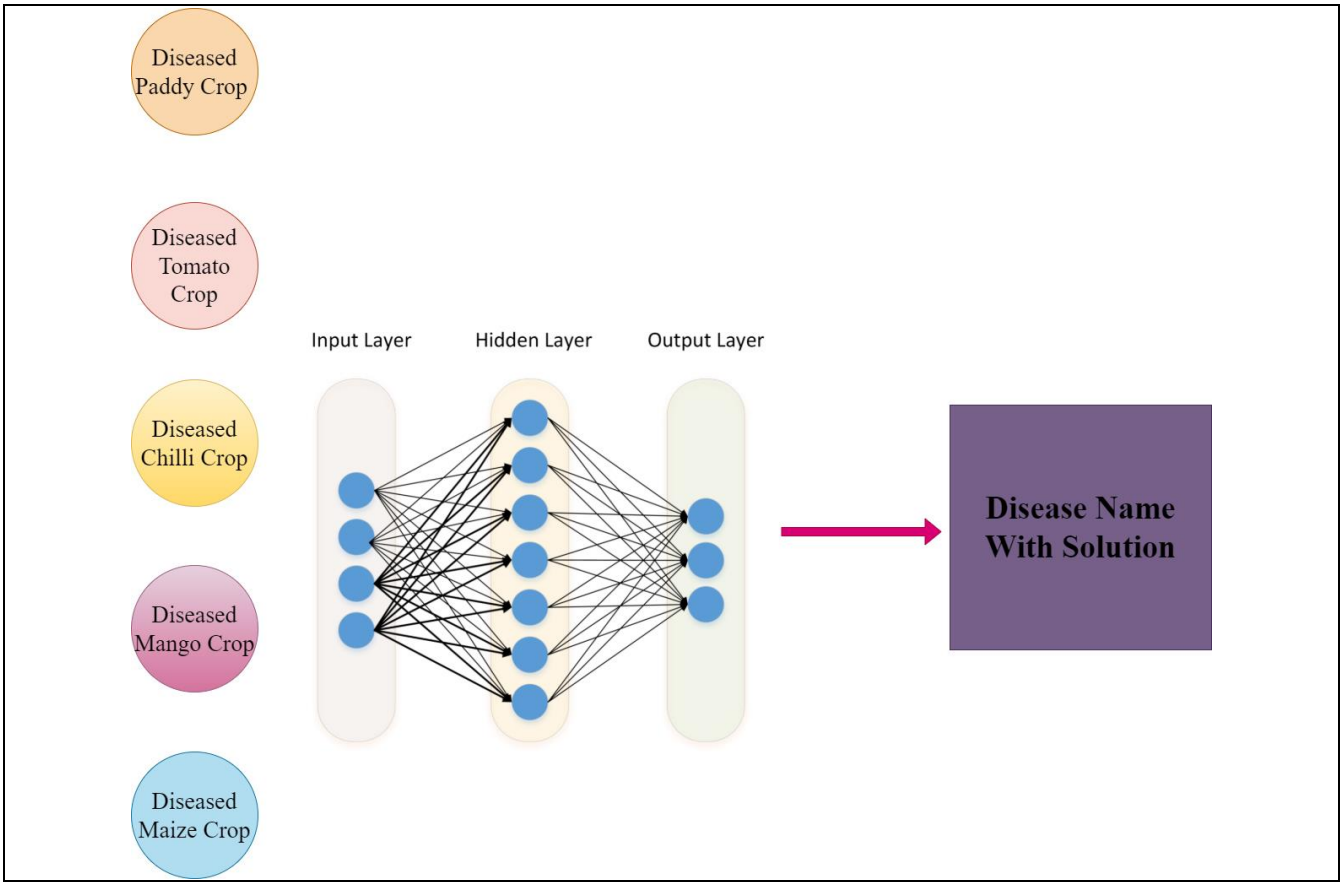

Figure 4.5: The deep learning approach

V. RESULTS AND DISCUSSION

The implemented results and discussion were done in this section. In figure 5.1 the accuracy rate for various crops by using the proposed system with respect to time, in figure 5.2 and figure 5.3 the true positive and false positive rate for classification and prediction of the crops with respect to time for various crops at a time, and in figure 5.4 the disease prediction rate has been shown respectively. After clear observing the results, it shows the from time to time and crop to crop, the results are fluctuating, because here the crop is not a single type and as time is increase the data collected will be increase. But results shows effectiveness for the paddy crop when compare with the other crop.

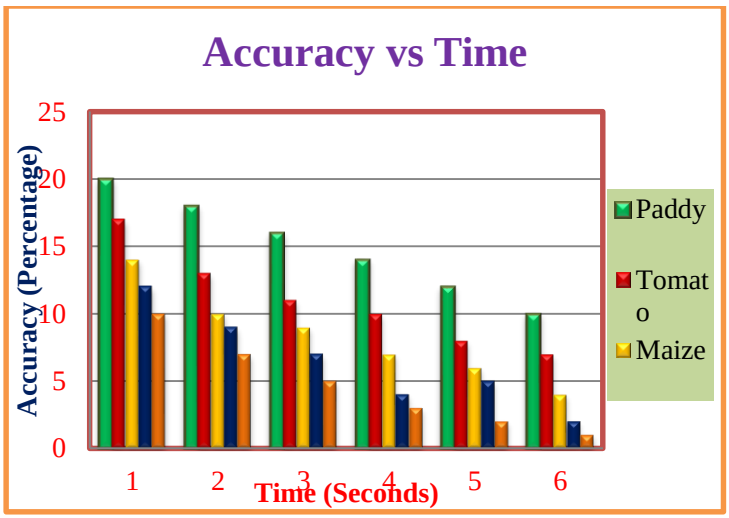

Figure 5.1: Accuracy with respect to the time for various crops.

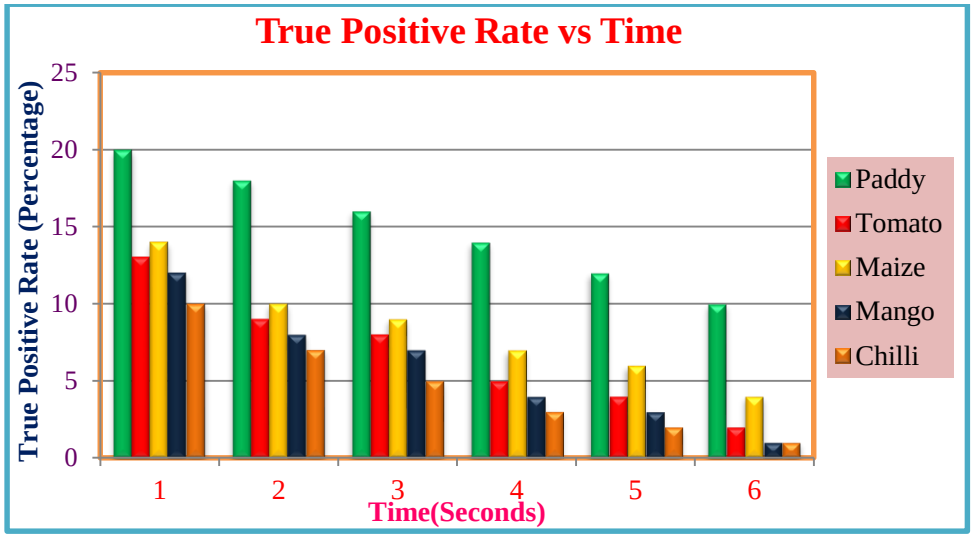

Figure 5.2: True Positive Rate with respect to the time for various crops.

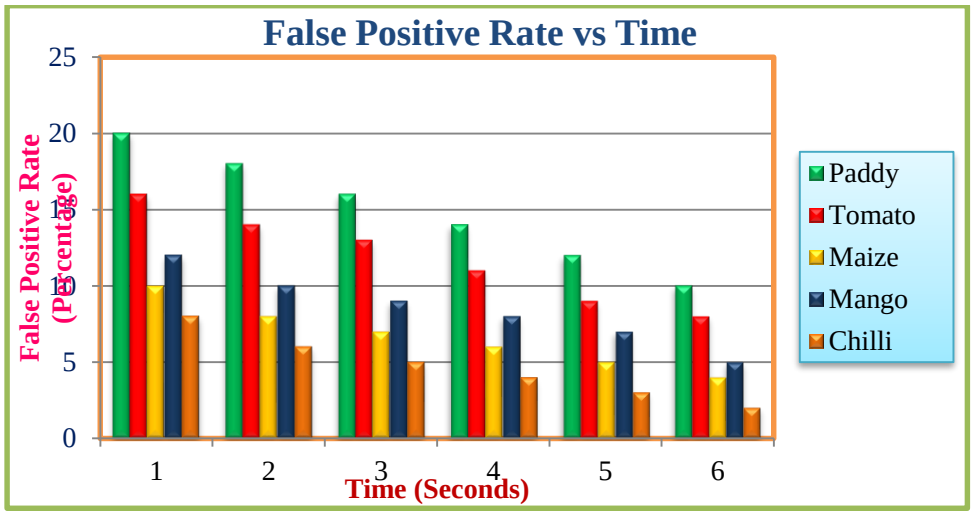

Figure 5.3: False Positive Rate with respect to the time for various crops.

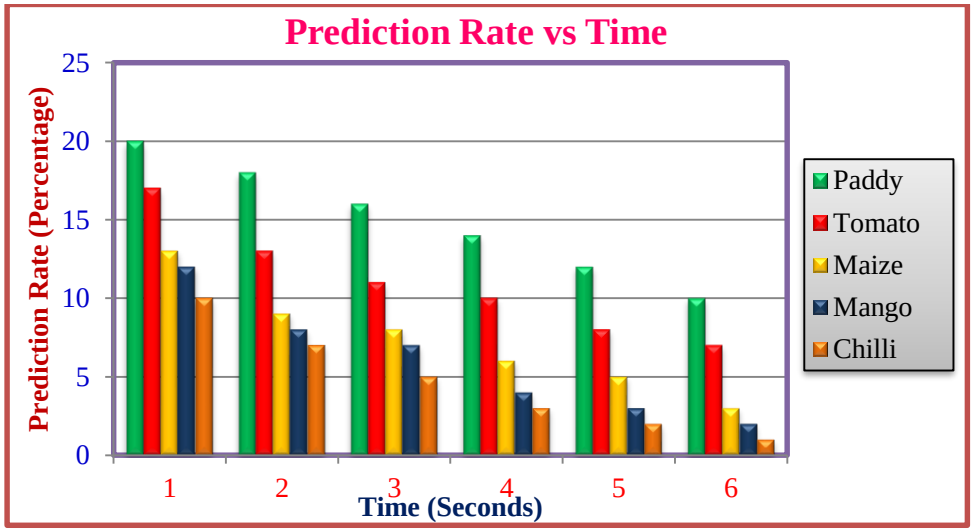

Figure 5.4: Disease prediction Rate with respect to the time for various crops.

VI. CONCLUSION AND FUTURE WORK

Here proposed a system to automatically predict the diseases names of the maize, mango and the chilles by using the internet of things and deep learning approaches. And it is implemented in the Andhra Pradesh state in India and results were obtained. The results were shown effective in terms of the accuracy and the disease prediction rate. This system can be applied by various other crops simultaneously, and this has a capable of working with other crops at a same time. In future work, the deep learning algorithms and the Agri electronic devices can be improved by adding more sensors and more other parameters.

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