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AGRI-CARE – One Stop Solution for Modern Farming and Agriculture

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Abstract: The objective of the project is to create a website called AGRI Care which aims in improving agriculture and also helps in sustainable development in terms of economy, moderanization and create technology ease to the farmeres and the frontline workers on the farms. Micro level planning is recommended for our country due to the fact that it has increased population. The AGRI-Care website is created using software components like HTML, CSS and Javascript in the front end. Here we propose solutions for Smart Irrigation System using the combination of technologies like Machine Learning and Internet of Things. Also the smart irrigation system is implemented along with fertilizer prediction, crop prediction and disease presiction upon the integration with IOT based cloud services. The website also contains and element called agrihub which makes the life of farmers easy by networking and exchange of knowledge and other professional services. The agri news section contains recent and updated information related to improvements in latest practices involved in agriculture.
Keywords: component, formatting, style, styling, insert (key words)

I. INTRODUCTION

A website made to modernize the old/traditional farming techniques. This website features ensure the great productivity growth without creating any threats to the nature. In recent times, it has become inevitable to use technology to create awareness about cultivation. The seasonal climatic conditions are also being changed against the fundamental assets like soil, water and air which lead to insecurity of food. In a scenario, crop yield rate is falling short of meeting the demand consistently and there is a need for a smart system which can solve the problem of decreasing crop yield. Therefore, to eliminate this problem, we propose a system which will provide crop selection based on economic and environmental factors to reap the maximum yield out of it for the farmers which will sequentially help meet the elevating demands for the food supplies in the country.

The proposed system uses machine learning to make the predictions. The system will provide crop yield and crop selection based on weather attributes suitable for the crop to get the maximum yield out of it for the farmers. The system makes predictions of the productions of crops by studying the factors such as rainfall, temperature, area (in hectares), etc.

This forecast structure is used to predict the market costs of different yields. By implementing demand grade for each crop, the real downside of this framework is destroyed i.e., price of the crops will not be stable all the times. One of the useful support systems in Bangladesh focuses on helping the poor farmers by assisting the demands about the crop through website. The drawback in the system is that the uneducated farmers were not able to use the system, even if the farmer knows about the system, they could not able to operate the model. In this model the data will be sent by means of SMS voice message in regional language.

The procedure of crop yield prediction is done by using Data Mining approach which results in prediction of analysed soil dataset. The interest existing in the rural economy is not considered by the system. This system overcomes the drawback by considering the demands based on the market price crops and it is suggested to the farmers for better growth. To improvise the value and gain of farming area, data mining techniques are made used which selects the appropriate crops for cultivation and predicting the crop yield. A novel system known as extensible Crop Yield prediction framework is built for precision agriculture using data mining techniques. In this paper there is an investigation of requirement for crop yield prediction and different systems have been utilized and finally it results in a framework which is flexible for prediction accuracy. The results in-turn will help in predicting the crop yield. Agriculture is one of the tedious processes which involve numerous estimations and effecting factors. Representing the knowledge more visually, effectively, simple and structural makes this technique more advantageous and thus a convenient approach for predicting and improving cotton yield prediction. To make the sustainable irrigation system and old monitoring system for getting better crops growth as well as best production, this IOT based Automatic irrigation system is proposed. In this system IOT and WSN are used to control and monitor the irrigation system.

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IOT is used to obtain stored data monitoring and real time monitoring of various contents of soil. WSN is used to make a fully wireless system to make a user-friendly system to cultivate and irrigate water properly to the eld. Different kinds of sensors are used. This report presents a fully automated irrigation system which is controlled and monitored by using “Thing speak Cloud Server”. Temperature and the humidity content of the soil are frequently monitored.

II. CROP PREDICTION, AND FERTILIZER PREDICTION

The crop prediction element helps the farmers to choose what kind of seeds can be sown depending upon the parameters like nitrogen content, phosphorus, potassium, pH , rainfall and temperature. These parameters serve as inputs to the developed logistic regression model. The inputs to the model are arranged as shown:

[C0, C1, C2, C3, C4, C5] = [Nitrogen, Phosphorous, Potassium, pH, Rainfall, Temperature]

In fertilizer prediction process , similar to the above approach we have the model to the inputs from Phosphorous , Potassium , Nitrogen and type of the crop under consideration. The inputs are represented as shown:

[F0, F1, F2, F3] = [Potassium , Nitrogen, Phosphorous , Crop type]

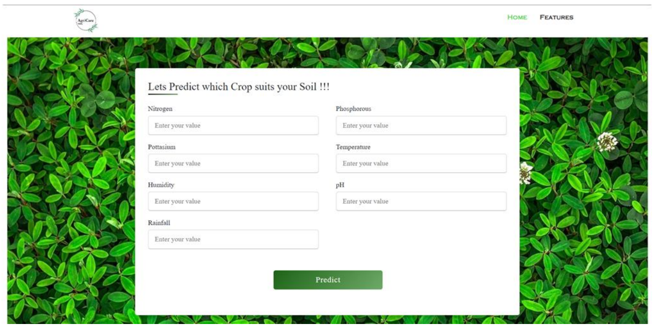

Figure 2.1: User interface of crop prediction

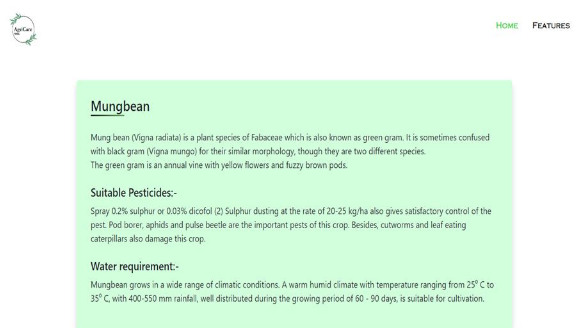

Figure 2.2: Result of crop prediction

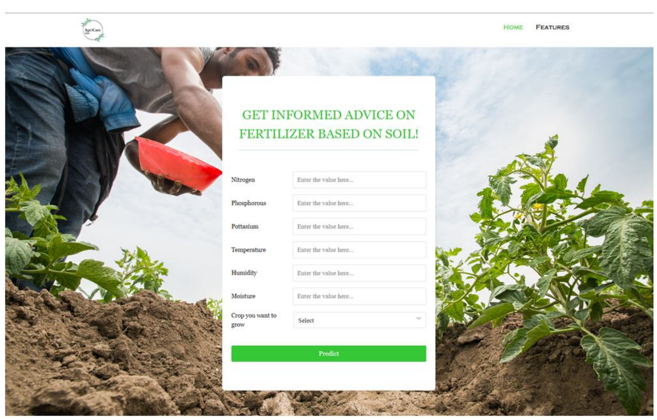

Figure 2.3: User interface of fertilizer prediction

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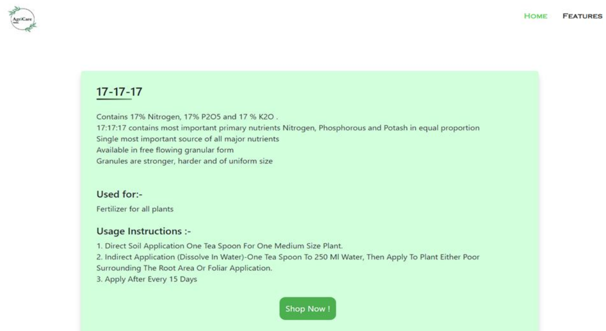


Figure 2.4: Result of fertilizer prediction

III. LOGISTIC REGRESSION MODEL

Let us assume that there are three possible outcomes (three possible type of crops (for example)) needs to be predicted of type Class A, B and C respectively. Here we use multinomial logistic regression method in solving simultaneous models. The block diagram for all the three predictions is generalized here in the block diagram.

Figure 3.1: Block Diagram for Logistic Regression Implementation

For K classes/possible outcomes, we will develop K-1 models as a set of independent binary regressions, in which one outcome/class is chosen as “Reference/Pivot” class and all the other K-1 outcomes/classes are separately regressed against the pivot outcome. Here as we have three outcomes i.e. crops belonging to Class A or Class B or Class C we develop two models in order to predict the type of the crop. Here we take class C as pivot class and perform the calculation. This is explained as below.

$$\ln\left(\left(\frac{p(A)}{p(C)}\right)\right) = a1 + b1x1 + \cdots \ldots \ldots \ldots + bnxn$$

$$\left(\frac{p(A)}{p(C)}\right) = \exp\ (a1 + b1x1 + \cdots \ldots \ldots \ldots + bnxn)$$

$$p(A) = p(C) * \exp\ (a1 + b1x1 + \cdots \ldots \ldots \ldots + bnxn)$$

Develop second logistic regression model for class B with class C as reference class, then the probability equation is as follows:

$$\ln\left(\left(\frac{p(B)}{p(C)}\right)\right) = a2 + b1x1 + \cdots \ldots \ldots \ldots + bnxn$$

$$\left(\frac{p(B)}{p(C)}\right) = \exp\ (a2 + b1x1 + \cdots \ldots \ldots \ldots + bnxn)$$

$$p(B) = p(C) * \exp\ (a2 + b1x1 + \cdots \ldots \ldots \ldots + bnxn)$$

$$p(A) + p(B) + p(C) = 1$$

$$(p(C) * \exp(a1 + b1x1 + \cdots \ldots \ldots \ldots + bnxn)) + (p(B) = p(C) * \exp(a2 + b1x1 + \cdots \ldots \ldots \ldots + bnxn)) + p(c) = 1$$

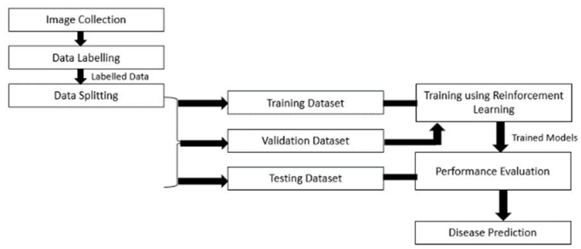
$$p(C) = 1/(1 + (\exp(a1 + b1x1 + \cdots \ldots \ldots \ldots + bnxn)) + (\exp\ (a2 + b1x1 + \cdots \ldots \ldots \ldots + bnxn))$$

Where
P(A) is the probability of A
P(B) is the probability of B
P(C) is the probability of C
a1, a2 are constants
b1, b2…………...bn are the coefficient constants for the inputs

Once probability of class C is calculated, probabilities of class A and class B can be calculated using the earlier equations. Same logic can be applied to k classes where k-1 logistic regression models should be developed. Similar logics are applied for both fertilizer and disease prediction.

IV. DISEASE PREDICTION

Disease prediction has its primary importance as this concept detects and upfronts the health of the crop. This as a result helps in solving the issue for value of money and time invested on the plant growth thereby helping to achieve better yields of the crops planted. In the proposed implementation, image processing techniques are incorporated with the help of Scikit, TensorFlow and Keras packages from python programming language. The steps involved in the disease prediction could be realized as an outline in the block diagram (figure 3) below.



The sample images are collected as an initial step followed by which data labelling is performed based on the disease detected. Hence the output samples are of labelled type. Further the labelled data are split into three forms which are training data, validation data and test data. Depending upon the labels from the training and validation data the test data output could be determined. To accurately detect disease samples, it is further sent for analysis using reinforcement learning model through which performance evaluation is performed. As a resultant of this final step, we could predict the type of disease affected the crop or specific parts of the plant under consideration.

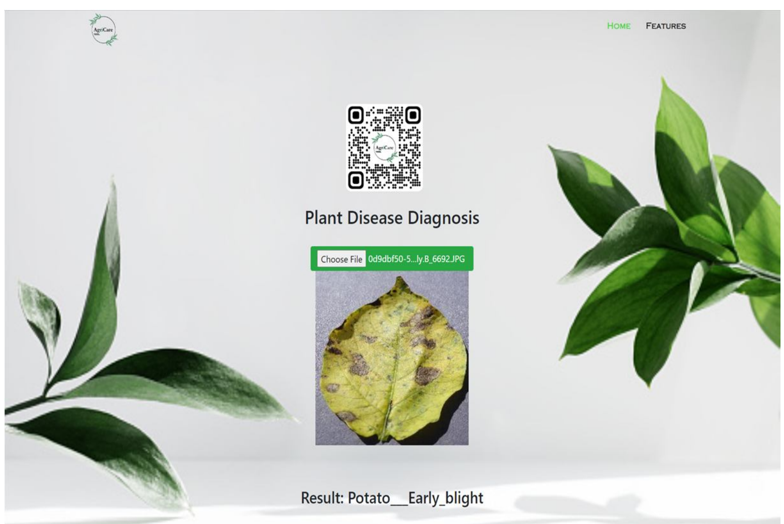


Figure 4.1: Result of disease prediction

V. SMART IRRIGATION SYSTEM

Just from the description we could understand the fact that irrigation system we propose is made smart by incorporating IoT and IoT based cloud services like AWS-IoT. Here the output from the sensor is driven to the Node MCU based microcontroller and the output is fed into the cloud platform form to perform smart operations instructing the farmers to control the water flow for the crops planted. The straight forward description of the above process could be seen in the figures 2(a) and 2(b). The individual components for practical implementation of the smart irrigation system is described as in below.

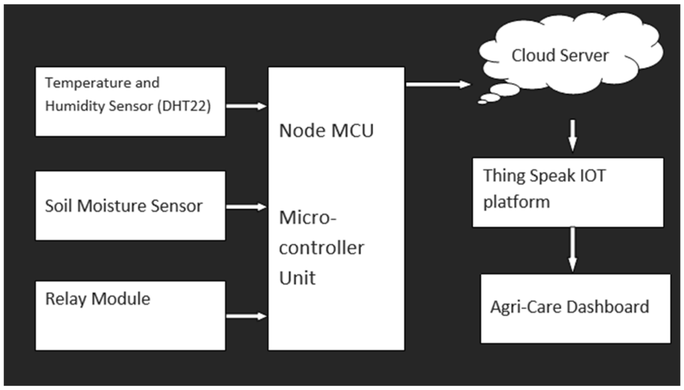


Figure 5.1: Block Diagram on Smart Irrigation System Implementation

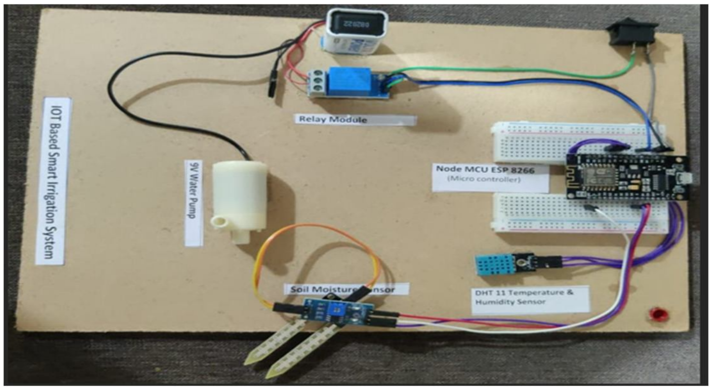


Figure 5.2: Hardware setup for Practical Implementation

Temperature Sensor (DHT 22): The DHT 22 or RHT 03 temperature and humidity sensor is a low -cost digital sensor and hence the analog inputs to them are unnecessary. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and spits out a digital signal on the data pin. It is fairly simple to use, but requires careful timing to grab data.

1) *Soil Moisture Sensor:* The fork-shaped probe with two exposed conductors acts as a variable resistor (similar to a potentiometer) whose resistance varies with the soil's moisture content. This resistance varies inversely with soil moisture. The sensor produces an output voltage according to the resistance, which by measuring we can determine the soil moisture level.
2) *Relay Module:* The relay module performs the operation of a switch which changes from on to off mode and off to on mode automatically to fill in the water in the tank.
3) *Node MCU:* The Node MCU integrates the micro controller low-cost platform via the ESP 32 SoC Wi-Fi, which with the help of cloud services pushes the process data to the cloud.
4) *Cloud Server Platform:* The cloud services chosen are AWS-IoT based services. AWS-IoT Core platform would be suitable as an intermediate to perform other IoT services like Thing-Speak services.
5) *Thing-Speak IoT Services:* The Thing- Speak IoT services are enabled via WSN or the Wireless Sensor Network services, integrating the cloud services with the Node or the hardware. This service is the novelty proposed upon designing the overall platform or the framework.
6) *Dashboard:* The dashboard displays the information in the form of UI or User Interface such that it displays the Crop Prediction, Fertilizer Prediction, Disease Prediction and display the required information for the Smart Irigation System.

VI. CONCLUSION

In short to explain the efforts taken on completion of the project, a website is designed to help farmers to perform smart farming by using technologies like IoT and Machine Learning. Crop Prediction, disease prediction and fertilizer prediction is determined along with techniques for smart irrigation system. The website as a result of deployment of the above techniques would serve as a potential resource and help get accustom with latest techniques thereby contributing to the economic growth in the agriculture sector.

VII. APPENDIX

The following table gives the overview of the list of sensors used upon the implementation of this project.

Serial Number	Purpose	List of Sensors
1	Crop Prediction	pH Sensor
		Temperature Sensor
		Moisture Sensor
2	Smart Irrigation	pH Sensor
		Temperature Sensor
		Water Level Sensor
		Soil Moisture Sensor

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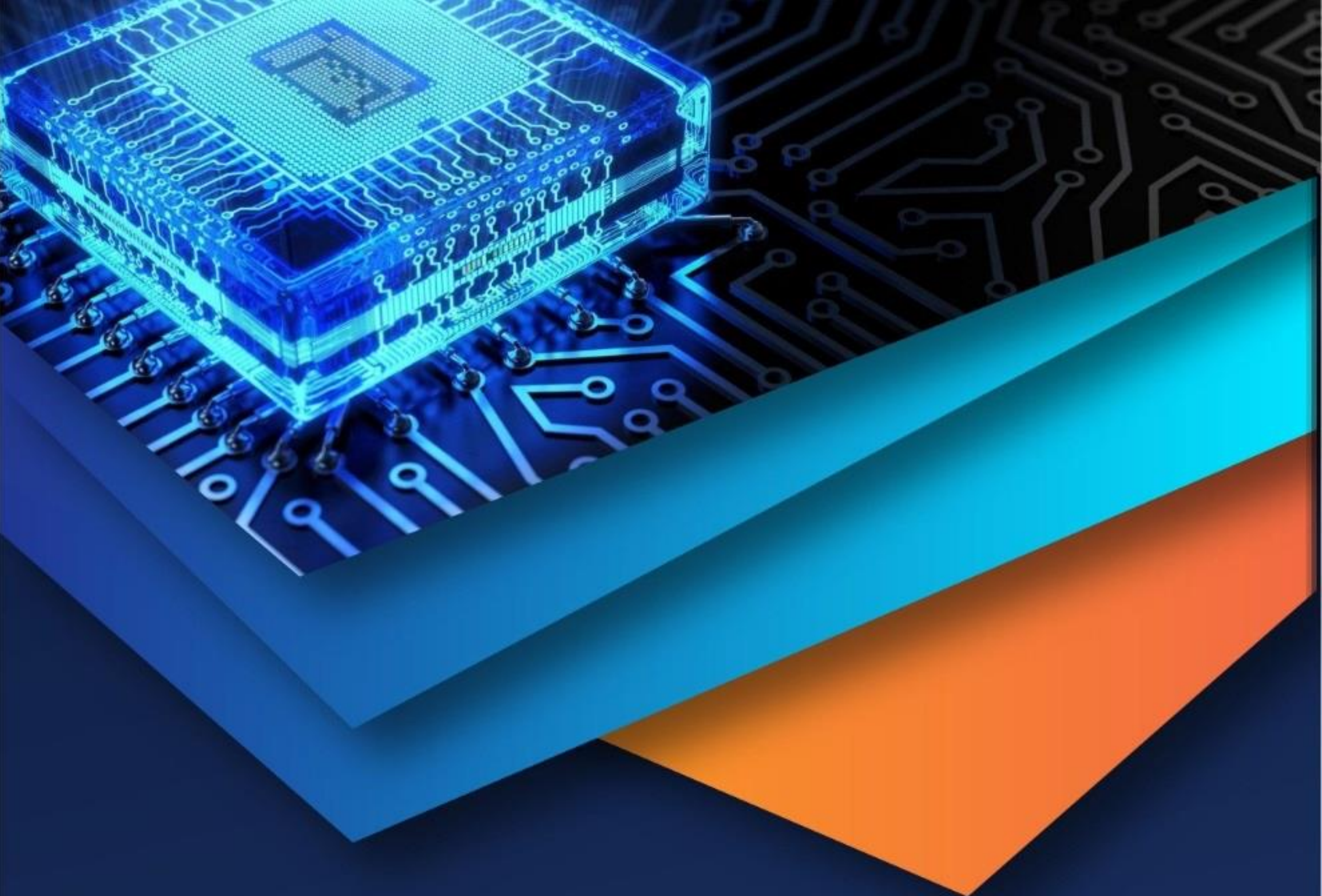

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