

Smart Farmer System

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Abstract - India is a country largely dominated by the agricultural sector, and hence it is our duty to utilize our knowledge of easy and accurate analysis in time efficient manner to boost the agriculture to newer heights. Also, lately there have been innumerable changes in our environmental conditions and hence, the rate of crop failure has increased over time. This is resulting into the increased number of suicides of farmers. Thus, the focus of this paper is to implement a system that would help the farmers of our country to maximize their yields along with maximized profits. The system proposes to predict the accurate crop prediction based on the past and live data that is analyzed using supervised machine learning algorithm, SVM. Both the live data as well as the big data is stored and retrieved from cloud. Also, the system proposes to make use of soil moisture sensors along with the weather conditions to automate the process of irrigation, which is one of the most time-consuming activities in farming. All the notifications from the system and the queries of the farmer are interacted using an android application.

analytics, we can make accurate predictions of the type of crop to be sown to avoid its failure.

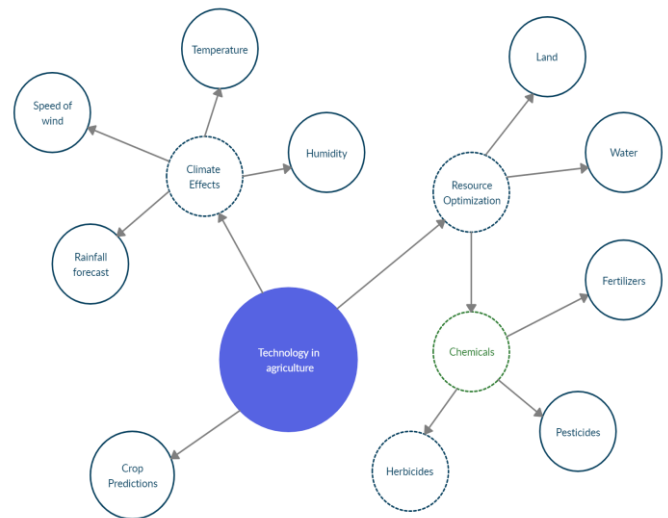


Fig -1: Technology in Agriculture

Key Words: IoT, Climate Smart Agriculture, Big Data Analytics, Classification (SVM), Cloud Computing, Android Application.

1. INTRODUCTION

Technology is booming at an exponential speed in India as well as globally. But what use is this technology if our highest rated sector, agriculture cannot benefit from it. Lately there have been innumerable cases in India about farmers committing suicides due to aftermaths of crop failure. Farmers have known their fields and environment from generations but lately, the environmental conditions are largely varying and hence the rate of crop failure is also increasing rapidly.

The various sectors of agriculture in which technology can be easily and efficiently used are climatic effects, quality of the land, amount of water used, chemicals used, along with the prediction of yielding the best crop to maximize produce and profits.

Climatic Effects have a large-scale impact on the yield. Weather forecasts can warn the farmers beforehand about any sudden changes in the environment and the farmer can take certain precautionary decisions. Temperature, speed of winds, humidity and rainfall forecast are some of the important weather forecasts.

Selection of crop for yielding is one of the most important decisions to be taken depending upon the weather, texture of soil and situation of water sources. Hence, using big data

Resources optimization is one of the key factors to obtain high yields. Farmers may have huge pieces of land and these can optimally yield more than one crop if arranged and managed properly. India almost has crisis of availability of water almost every year, and in such conditions if water is not used efficiently then the risk of crop failure increases. Technology can be efficiently used to avoid under or over irrigation.

The texture of the soil is an important aspect which contributes to the crop production. In order to maximize the yield, the soil must contain essential nutrients in the right amounts. Technology can be used to detect nutrients of soil and accordingly suggestions can be made for the usage of fertilizers. Also, technology can be used to detect any disease detection of the crops and suggestions can be made for the usage of pesticides.

2. LITERATURE SURVEY

Agriculture is considered as the backbone of India, is the major contributor to the country's economy. However, technology involvements and their usage have still not been incorporated in this sector. Some initiatives have been taken by the governments by providing mobile messaging and calling services to farmers' queries relating to sowing, harvesting and selling of crops, it provides static data related to quality of soil in each region. The system has not yet been implemented to completely automate the irrigation, accurate prediction of crops, suggestions of fertilizers depending

upon the real time data that is obtained from individual farmer. Soil quality, weather forecasts, required amount of fertilizers and the predicted profits form major pillars of decision of selection of crops to be yielded. Also, with depleting water tables and drying of natural sources of water like wells, we need to manage irrigation without wastage.

In [1], the authors have described that with the use of fog computing and WIFI-based long distance network in IoT, it is possible to connect the agriculture and farming bases situated in rural areas efficiently. Also, they analyzed the network structure based on coverage range, throughput, and latency. In [2], the authors have described several benefits and challenges of IoT have been identified. They also presented the IoT ecosystem and how the combination of IoT and DA can be enabled in smart agriculture. In [3], the authors have described an integrated framework system platform incorporating Internet of Things (IoT), cloud computing, data mining and other technologies and proposed a new model for its application in the field of modern agriculture. In [4], the authors have proposed the system which focuses on checking the soil quality to predict the crop suitable for cultivation according to their soil type. In [5], the authors have aimed in making a technology which is completely automated. The paper takes care of all major factors of agriculture i.e. monitoring, irrigation and security. The methodology used in this system can monitor the humidity, moisture level and can even detect motions. In [6], the authors have identified current and future trends of IoT in agriculture and highlight potential research challenges. In [7], the authors have introduced the latest technologies such as sensors, IOT to radically revise approaches to agriculture by collecting the data about the various parameters of soil, analyzing the data and performed the computations. In [8], the authors have suggested a low cost IoT enabled smart agricultural system which can evaluate the farmland and predict which type of crop is best for that land based on the data collected from local conditions of that land varying from humidity to soil moisture content. In [9], the authors have gathered continuous information of farming generation condition that gives simple access to horticultural offices, for example, alarms through Short Messaging Service (SMS) and advices on climate design and crops. In [10], the authors have proposed a sensor system which monitors and maintains the desired soil moisture content via automatic water supply.

3. CHALLENGES IN TECHNOLOGY IMPLEMENTATION

- Standards Infancy:

Literacy rate in rural India is very low, and hence the farmers are most likely to be hostile towards the use of new equipment or applications due lack of knowledge.

- Fragmented Market:

Each farmer is independent and have to make their own amends to sell their yield. However, the government is

proposing to replace existing fragmented and over-regulated markets for the yields and allow farmers to sell their produce beyond the local mandi or wholesale markets.

- Coverage and Connectivity:

Often, we find issues of network connectivity in the rural areas. The problem of coverage and connectivity is a huge problem in the smooth implementation of technology. However, now with the recent boom in the communication industry, we are able to establish good network connection in the rural areas as well.



Fig -2: Challenges to Technology Implementation

- High Initial Investment:

Well, as a matter of fact each and every sector has a high initial investment but in the near future, it gives tremendous revenues which overshadow the high initial cost of hardware and software integration in agriculture.

- Fear of Technology:

People have assumed notions about the use of technology and feel that the technology will kill them or harm their fields. This fear makes them hostile towards the use of technology.

- Untrained Manpower:

Any use of technology requires the much-needed basic training for its proper functioning. But it becomes even more difficult when the user does not have basic education and hence it poses as an extremely difficult challenge.

4. PROPOSED SYSTEM

An Android application is considered to manage the user interaction with the system. User needs to register himself to the application, initially required data needs to be submitted by the farmer and accordingly, the essential steps farmer

should take to increase his profit and future predictions will be notified.

Questions like which crop they should yield, real-time analysis of crop they have planted will be provided along with which pesticides and fertilizers they should use.

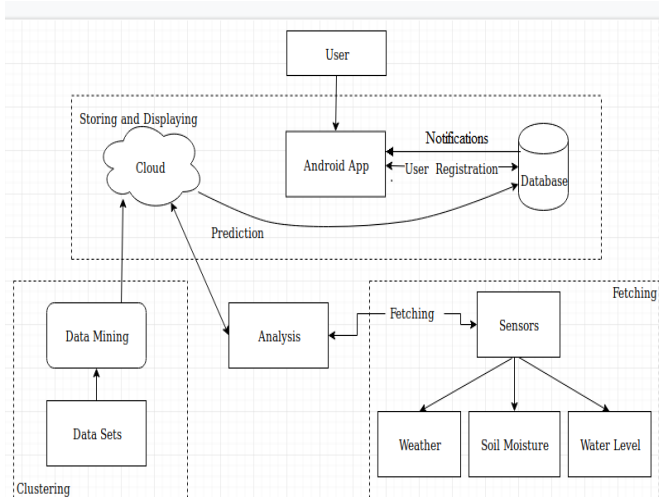


Fig -3: Architectural Diagram

Data will be stored in Cloud, whole system will be working in real-time. Clustering algorithms will be used for grouping similar data. Database will be mainly divided into three partitions, namely Datasets, Application data and Data for prediction:

- a) Datasets: The ideal Agricultural data like which crop should be yield in different surroundings (Weather, soil moisture and water required) and also, crop's quarterly profit in market. These datasets will go through data mining algorithm and only required data will be stored in System's database.
- b) Application data: Individual User's data for his piece of land, his surrounding's data fetched using sensors and predictions made accordingly.
- c) Data for prediction: Machine Learning algorithm will be used for predicting the crop farmer should yield and which pesticides and fertilizers they should use. Use of datasets and application data is considered for prediction.

Sensors and microcontroller: Soil moisture Sensors and Water level sensors are implanted in farmer's land along with microcontroller. Periodically, data will be fetched by these sensors and through controller this data will be stored in cloud.

5. COMPONENTS

1. Arduino Development Board:

Arduino is open-source electronics prototyping platform based on flexible, easy-to-use hardware and software. Arduino can sense the environment by receiving input from a variety of sensors and can affect its surroundings by controlling lights, motors, and other actuators. The

microcontroller on the board is programmed using the Arduino programming language (based on Wiring) and the Arduino development environment (based on Processing).

2. Depth Sensors

We have used metal pins for sensing depth of field.

3. Temperature Sensor (LM 35)

It has an output voltage that is proportional to the Celsius temperature. The scale factor is $.01V/^{\circ}C$. The LM35 does not require any external calibration or trimming and maintains an accuracy of $\pm 0.4^{\circ}C$ at room temperature and $\pm 0.8^{\circ}C$ over a range of $0^{\circ}C$ to $+100^{\circ}C$. Another important characteristic of the LM35DZ is that it draws only 60 micro amps from its supply and possesses a low self-heating capability. The sensor self-heating causes less than $0.1^{\circ}C$ temperature rise in still air.

4. L293D Motor Driving IC

L293D is a dual H-bridge motor driver integrated circuit (IC). Motor drivers act as current amplifiers since they take a low-current control signal and provide a higher-current signal. This higher current signal is used to drive the motors. L293D contains two inbuilt H-bridge driver circuits. In its common mode of operation, two DC motors can be driven simultaneously, both in forward and reverse direction. The motor operations of two motors can be controlled by input logic at pins 2 & 7 and 10 & 15. Input logic 00 or 11 will stop the corresponding motor. Logic 01 and 10 will rotate it in clockwise and anticlockwise directions, respectively. Enable pins 1 and 9 (corresponding to the two motors) must be high for motors to start operating. When an enable input is high, the associated driver gets enabled. As a result, the outputs become active and work in phase with their inputs. Similarly, when the enable input is low, that driver is disabled, and their outputs are off and in the high-impedance state.

5. Voltage regulator IC's 7805 and 7809

7805 and 7809 are the voltage regulator integrated circuit. It is a member of 78xx series of fixed linear voltage regulator ICs. The voltage source in a circuit may have fluctuations and would not give the fixed voltage output. The voltage regulator IC maintains the output voltage at a constant value. The xx in 78xx indicates the fixed output voltage it is designed to provide. 7805 provides +5V regulated power supply whereas 7809 provides +9V regulated power supply. Capacitors of suitable values can be connected at input and output pins depending upon the respective voltage levels.

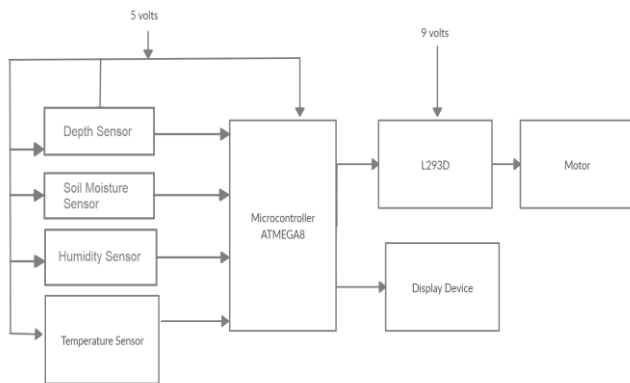


Fig -4: Hardware Block Diagram

Working:

The depth sensor will sense depth up to which water is present in the field, temperature sensor will sense temperature of the field, humidity sensor will sense humidity in the air and the soil moisture sensor will sense the moisture of soil. If moisture level in the field drops beyond certain level than the output of the sensor will go high. If temperature and humidity is in the proper range and suitable for irrigation, then microcontroller will provide high output to motor driving IC. Hence motor will start drawing water from the nearby source. When proper amount of water (as required for particular crop) is drawn by motor then automatically microcontroller will cut supply from the motor as the result proper amount of water will be given to the crop.

6. APKA-AGRO MOBILE APPLICATION

The APKA_AGRO Mobile Application will be the medium through which the system and the farmer will interact with each other.

The data processed by the system will be notified to the farmer using this application. The farmers will get an in-depth information about the weather, soil and chemicals along with the predicted crop. With the help of this data analysis, the farmers will be able to sow the best crop to maximize their yields and therefore the profits.

Each farmer will be able to directly access their account by logging in using their unique username and password. New farmers will be able to register themselves and their farm and its location by filling in the form in "Register".

The farmers will get dynamic readings from the sensors of the node that they have selected from their fields. Based on these readings the irrigation pump will switch on and off notifying the farmer.

Highlights of the application:

- **Weather Forecast:** The system continuously sends updates of the data collected from the sensors, which include temperature, and rainfall.

- **Fertilizers Suggestions:** Depending upon the pH of the soil, the system suggests the deficit nutrients of the soil and composition of fertilizers that can be used.
- **Water Pump Notification:** Depending upon the soil moisture levels, the water pump will automatically start and stop flow of water and this will be notified to the farmer via application.
- **Crops Prediction:** Depending upon the current and ideal situations of the fields, the farmers will be notified about the crop to maximize their yields.
- **Updates:** Regular updates of the application will be notified to the farmer.
- **Help Care:** Any queries about the use of the application or hardware installed can be communicated using this feature of the application.

7. CONCLUSIONS

The described system uses supervised machine learning algorithm to classify the crops into the various months in which they should be yielded based on their ideal requirements. The system uses information from soil moisture sensors to irrigate the soil to avoid the damage of crops due to over irrigation or under irrigation. The project provided us with an opportunity to study the existing systems, along with their features and drawbacks.

8. FUTURE SCOPE

Future work includes the usage of the application in the native languages. Also giving notifications in native audio format to assist the farmers.

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