The Seybold Report

ISSN 1533-9211

DOI 10.5281/zenodo.6697526

IOT BASED SMART AGRICULTURE MONITORING SYSTEM

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ABSTRACT

In every country agriculture is done from ages which are considered to be science and also art of cultivating plants. In day today life, technology is updating and it is also necessary to trend up agriculture too. IoT plays a key role in smart agriculture. Internets of Things (IoT) sensors are used to provide necessary information about agriculture fields. The main advantage of IoT is to monitor the agriculture by using the wireless sensor networks and collect the data from different sensors which are deployed at various no des and send by wireless protocol. By using IoT system the smart agriculture is powered by Node MCU. It includes the humidity sensor, temperature sensor, moisture sensor and DC motor. This system starts to check the humidity and moisture level. The sensors are used to sense the level of water and if the level is below the range, then the system automatically stars watering. According to the change in temperature level the sensor does its job. IoT also shows the information of humidity, moisture level by including date and time. The temperature level based on type of crops cultivated can also be adjusted.

1. INTRODUCTION

One of the largest livelihood providers in India is Agriculture. Agriculture plays an essential role in supporting human life. The rise in population is proportional to the increase in agriculture production. Basically, Agriculture production depends upon the seasonal situations which do not have enough water sources. To get beneficial results in agriculture and to overcome the problems, IoT based smart agriculture system is employed.

In IoT-based smart farming, a system is built for monitoring the crop field with the help of sensors like light, humidity, temperature, soil moisture, etc. The farmers can monitor the field conditions from anywhere. The proposed IoT based Irrigation System uses ESP8266 Node MCU Module and Sensor. It will not only automatically irrigate the water based on the moisture level in the soil but also send the Data to ThingSpeak Server to keep track of the land condition.

Due to the recent advances in sensors for the irrigation systems for agriculture and the evolution of WSN and IoT technologies, these can be applied in the development of automatic irrigation systems. The system will determine the parameters that are monitored in irrigation systems regarding water quantity and quality, soil characteristics, weather conditions, and fertilizer usage and provide an overview of the most utilized nodes and wireless technologies employed to implement WSN and IoT based smart irrigation systems.

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2. LITERATURE REVIEW

2.1 A Sustainable Agriculture System Using IOT

This work developed a system a system which will automatically monitor the agriculture fields. As well as performing live video streaming for monitoring the agriculture field from the server itself, through raspberry pi camera. The agriculture fields are monitored for environmental temperature, humidity at soil moisture sensor. IOT and wireless sensor node helps to decrease the efforts, for observing the agricultural fields. IOT also avoids the loss of agriculture parameters database and save in the storage device or cloud for long life. It also provides continuous monitoring in all places including the critical areas. Agriculture product rely on environment factory like relative humidity, PH of soil, temperature etc. The proposed system model is developed in order to get more yields by identifying the causes.

2.2 A Model for Smart agriculture using IOT

Climate changes and rainfall has been erratic over decade. Due to this, climate smart methods called smart agriculture is adopted by many farmers. In the existing system, village farmers may have planted the same crop for centuries, but over period, weather patterns and soil conditions and epidemics of pests and disease have been changed. By using the proposed system approach, which senses the local agricultural parameters, identify the location of sensor; transfer the data crop fields and crop monitoring. The Received updated information allows the farmers to cope with and even benefit from these changes. The Complete real-time and historical environmental information is expected to help to achieve efficient management/monitoring and utilization of resources.

2.3 Smart Agriculture System using IOT Technology

In the existing system agriculturists used to figure the ripeness of soil and presumptions to develop certain kind of products. They didn't think about the level of water, dampness and climatic conditions. The profitability relies totally upon the last phase of the harvest in which they depend. In this proposed system, they improved the efficiency of the product which appraises the nature of the harvest. To go up against the challenges in the field, IOT is used in providing accuracy and conservative cultivation. They also used wireless sensor networks in precision Agriculture by separating the solitary plants for checking in the tens or several square feet. Also used different kinds of sensors such as Temperature sensor, Humidity sensor, Soil moisture sensor, Water level sensor and ARM processor.

2.4 IOT Based Monitoring System in Smart Agriculture

The farmers are still using traditional methods for Agriculture, which results in low yielding of crops and fruits, so the crop yield can be improved by using automatic machineries. But by using IOT, we can expect the increase in production with low cost by monitoring the efficiency of the soil, temperature and humidity monitoring. In existing System, they used only the traditional methods for the crop yield. But in the proposed system, the combination of traditional methods with IOT and wireless sensor networks can lead to agriculture modernization. The developed System is more efficient and beneficial for farmers. The

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ISSN 1533-9211
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application of such system in the field can definitely help to advance the harvest of the crops and global Production.

2.5 Smart agriculture monitoring system using iot

The implemented framework comprises of different sensors and de-vices and they are interconnected by means of remote correspondence modules. The sensor data is been sent and received from client end utilizing Internet connectivity which was enabled in the Node MCU mo the same time. dule- an open source IOT platform. This system is used to

maintain the optimal conditions of the irrigation system effectively. The data can be viewed on the Thing Speak app or any web page. The farmer can go through each and every information regarding the levels, at what time it's been functioning, any fluctuations appearing or not, whether the operations are been performed in time. The foremost function is to monitor the crop growth using digital means. This will provide the accurate values of various parameters upon which growth depends. Besides, this model will help the farmer to monitor more than one land at the same time. Monitoring through this system requires less man power, people with physical disabilities can be employed for monitoring fields.

2.6 Smart farming using IOT

We aim to implement a smart GPS based remote controlled vehicle that performs various tasks like monitoring fields to prevent thefts, scaring birds and animals, sensing soil moisture content, spraying fertilizers and pesticides, weeding, sensing soil moisture, etc. Smart irrigation, by usage of optimum amounts of water, depending on the requirement of each crop type and the soil will be executed. Finally, we plan on enforcing smart warehouse management, with temperature and humidity sensing for the benefit of the products being stored, and detection of presence of any invader who tries to steal from the warehouse. Controlling and monitoring of all these operations will be through a remote smart device with Internet connectivity and the operations will be performed by interfacing sensors, ZigBee modules, with micro-controller.

2.7 IOT Based Agriculture Monitoring and Smart Irrigation System Using Raspberry Pi

Many researches are done in the field of agriculture and most of them signify the use of wireless sensor network that collect data from different sensors deployed at various nodes and send it through the wireless protocol. The collected data provide the information about the various environmental factors. Monitoring the environmental factors is not the complete solution to increase the yield of crops. There are number of other factors that decrease the productivity. Hence, automation must be implemented in agriculture to overcome these problems. In order to provide solution to such problems, it is necessary to develop an integrated system which wills improve productivity in every stage. But, complete automation in agriculture is not achieved due to various issues. Though it is implemented in the research level, it is not given to the farmers as a product to get benefitted from the resources. Hence, this paper deals about developing smart agriculture using IOT and given to the farmers.

ISSN 1533-9211

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Implementation of such a system in the field can definitely help to improve the yield of the crops and aids to manage the water resources effectively reducing the wastage.

2.8 NPK Measurement in Soil and Automatic Soil Fertilizer Dispensing Robot

In 'NPK Measurement in Soil and Automatic Soil Fertilizer Dispensing Robot', Mr. Nishant singh and Dr. A. D. Shaligram has designed a bot for dispensing the fertilizers for the soil based on the nutrient amount present by measuring the soil nutrient by using color sensor. In that the soil has mixed with proper chemical solution and the RBG lights has sent through the soil solution and the reflected light has absorbed. Based on amount of light reflected from the solution the nutrient content has measured. But these method needs a different chemical solution for each nutrient content.

3. EXISTING SYSTEM

IOT based smart agriculture system proves to be very helpful for farmers. Indeed, even in the wake of reaping, ranchers additionally face issues away of gathered yield. In order to give answer for every issue, it is important to create coordinated framework which deals with all components influencing the profitability in each stage. Threshold values for climatic conditions like humidity, temperature, moisture can be fixed based on the environmental conditions of that particular region. The system also senses the invasion of animals which is a primary reason for reduction in crops. This system generates irrigation schedule based on the sensed real time data from field and data from the weather repository. This system can recommend farmer whether or not, is there a need for irrigation. Continuous internet connectivity is required. This can be overcome by extending the system to send suggestion via SMS to the farmer directly on his mobile using GSM module instead of mobile app.

3.1 Disadvantage

- Manual Monitoring and Controlling
- Lot of man power required
- Only any of the area can be monitored in the agriculture field
- Needs availability of Internet continuously
- Rural communities especially in the developing Countries where we have mass crop production, it is completely impossible to operate this farming method

4. PROPOSED SYSTEM

This project presents proposed model for Smart Agriculture to develop real time monitoring system for soil properties like Temperature, Humidity and moisture, crop yield identification using SMS based Alerts. It will also be possible to control various operations of the field remotely from anywhere, anytime by mobile as well as web application. The IOT based agricultural monitoring system has been used to maximize the yield of crop by monitoring the environmental parameters and thus providing the required information to farmer remotely. This system can be implemented in any type of agricultural field with varying soils. The use

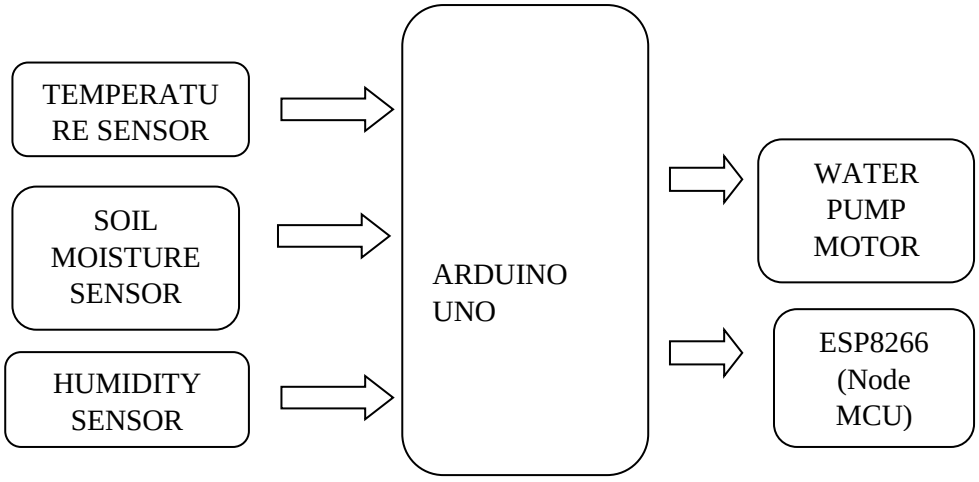
ISSN 1533-9211

DOI 10.5281/zenodo.6697526

of IOT over the other technology one aides for deploying it in any type of environment for monitoring, making it flexible and robust. The proposed system is developed for the goodwill of farmers. The system greatly reduces the human interaction, labor cost and wastage of water.

- The Smart Farm Monitoring System is a mixture of hardware and software additives. The hardware part includes embedded systems and software program is the Arduino IDE.
- The Arduino IDE displays readings from sensors are inserted using the hardware. The special sensors used are temperature and water level sensor and soil moisture sensor.
- The facts gathered with the aid of the sensors are sent to the Arduino UNO microcontroller ATmega328.The gathered information may be displayed in an Arduino screen. A GSM module is hooked up with the Arduino to facilitate messaging service which updates the farmers each 10 seconds approximately the climate conditions of the subject.

4.1 Block diagram



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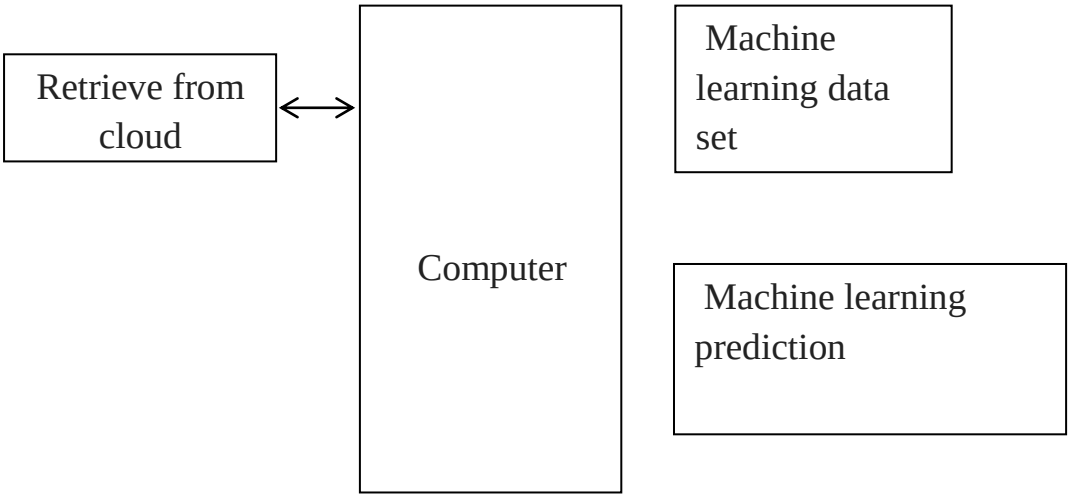

4.2 Advantages

- It allows farmers to maximize yields using minimum resources such as water, fertilizers, seeds etc. Mobile operated pumps save cost of electricity.
- Smart agriculture use robots which help in many ways. These improves data collection process and helps in IOT monitoring and control.
- It is cost effective method.
- It delivers high quality crop production.
- It is easy to maintain and cost is reasonable to purchase. The components which are used are easily available.
- It has advantage to observe the status on smartphone or laptop using internet. The information is up to date even in absence of farmer.
- The collected data is updated and the farmer is conscious about the status of the crop.

5. HARDWARE REQUIREMENTS

- Arduino Uno
- Water level sensor
- Temperature sensor
- Soil moisture sensor
- Relay
- Motor
- Node MCU

ISSN 1533-9211

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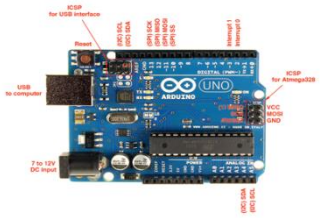
5.1 Hardware modules

Arduino UNO

Micro Controller

A micro-controller is a small computer on a single integrated circuit containing a processor core, memory, and programmable input/ output peripherals The important part for us is that a micro-controller contains the processor (which all computers have) and memory, and some input/output pins that you can control. (Often called GPIO - General Purpose Input Output Pins).



Temperature Sensor

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (centigrade) temperature. You can measure temperature more accurately than a using a thermistor. The sensor circuitry is sealed and not subject to oxidation, etc. The LM35 generates a higher output voltage than thermocouples and may not require that the output voltage be amplified.

Soil Moisture Sensor

Soil moisture sensors measure the volumetric water content in soil. Since the direct gravimetric measurement of free soil moisture requires removing, drying, and weighting of a sample, soil moisture sensors measure the volumetric water content indirectly by using some other property of the soil, such as electrical resistance, dielectric constant, or interaction with neutrons, as a proxy for the moisture content.

ISSN 1533-9211

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Water level sensor

A level sensor is a device for determining the level or number of fluids, liquids or other substances that flow in an open or closed system. There are two types of level measurements, namely, continuous and point level measurements.

Relay

A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions and they are double throw (changeover) switches.

Motor

A Stepper motor is a device which translates an electrical signal to a change in position of a shaft. They are driven by pulses. Stepper motor depend upon reluctance torque only. The stepper motor will move a load a discrete amount for each pulse and then stop and do nothing until another pulse is applied.

- Pole pieces are electromagnets, often with bifilar windings.
- By grounding a or b, the magnetic field can be reversed
- If neither a nor b is grounded, there is no magnetization A

6. SOFTWARE REQUIREMENTS

- Arduino IDE
- Embedded C Language
- Python
- Machine Learning

6.1 Software modules

Arduino IDE

The Arduino IDE (Integrated Development Environment) is a software to develop the coding in the environment. The coding is developed and then execute the process. These all modules are running in Embedded C software coding.

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Embedded C

Embedded C is most popular programming language in software field for developing electronic gadgets. Each processor used in electronic system is associated with embedded software. Embedded C programming plays a key role in performing specific function by the processor. In day-to-day life we used many electronic devices such as mobile phone, washing machine, digital camera, etc. These all-device working is based on microcontroller that are programmed by embedded C.

Python

Python is a general-purpose interpreted, interactive, object-oriented, and high-level programming language. It was created by Guido van Rossum during 1985- 1990. Python is designed to be highly readable.

Machine learning

Machine Learning is the scientific study of algorithms and statistical models that computer systems use to effectively perform a specific task without using explicit instructions, relying on models and inference instead. It is seen as a subset of artificial intelligence.

7. METHODOLOGIES

7.1 Smart crop monitoring system

Several related works have been found in literature. Ashif Uddin mondal and Rehena developed a system to monitor plants and control the water supply through a smartphone. The system integrates various sensors to measure the water content of soil and detect the temperature using soil moisture and temperature sensors respectively. This project makes used of Raspberry Pi to connect between the sensors and cloud server, and users can connect their smartphone to the raspberry pi using Bluetooth Module. A faster approach has been proposed by the authors using Wi-Fi to send sensors data to the cloud using Arduino. This can also connect to multiple devices at once. Next, an improvement has been done by Jindarat and Wuttidittachotti which has introduced a system that can track ambient of weather conditions including humidity, temperature, atmosphere performance and fan power control in chicken farm. Using this design, farmers can easily monitor and control their farm condition using their smartphone. Further improvement can be seen using Web Camera to monitor remote location of crop field by capturing time lapse images of the plant efficiently. The system used an IoT platform such as System Under Analysis based on Agro-Meteorology system for Viticulture Disease Warning. This system is used to monitor the vineyard using secure wireless or actuator sensor while server sub-system is used to transmit data to server.

7.2 Automated irrigation system

The article describes a system that is developed to manage water flow and power management for an irrigation system. In this design, the optimal water supply was calculated

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ISSN 1533-9211
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using the approximate information of an ambiguous expert method. This later system assessed an event-based irrigation system by utilizing tomato plants. This method is used to reduce water consumption to improve the efficiency of the system. Apart from that, a system proposed by authors make use of renewable source such as solar power to implement automatic irrigation system. The main goal of this method is to develop a low cost and time-based irrigation system. A similar approach to irrigation system has been proposed by which mainly centered on providing an active Modern Irrigation System (MIS) which depends on moisture control utilized by Arduino Nano with specific plantation modifications.

7.3 Smart crop monitoring and automated irrigation system

The article developed a system to monitor plants and control the water supply through a smartphone by integrating various sensors to detects soil moisture and temperature of the crop. This system uses wireless transmission such as Wi-Fi to send data to the cloud using Arduino and Ethernet connection. This improves the speed of data transmission and can also connect to multiple devices at once.An infrared sensor is used to detect intruders (human or animal) at surrounding area. Upon detection, data will be sent to the cloud to alert farmers. Apart from that, the maximum distance that motion sensor can detect is longer compare to infrared sensor. The work proposed has used water level sensor to monitor the water level inside a tank. The system also uses two types of sprinklers: irrigation and overhead sprinkler. The overhead sprinkler will be activated if the surrounding temperature and water level of water is high. Otherwise, if the temperature is high and water level is low, the irrigation sprinkler will be turned on. A method implements Precision Agriculture with cloud computing that optimizes the usage of water fertilizer while maximizing the crops yields and help in analyzing the weather conditions in the field. The proposed system also reduces hardware complexity and improves the field of the crops and overall production.

7.4 Yield monitoring, forecasting and harvesting

The AWS IoT platform has been proposed for crop prediction using temperature and rainfall monitoring. The Raspberry Pi is utilized as a gateway for remote monitoring in this study. Raspberry Pi can connect with sensors to operate applications, such as the DHT11 Temperature Sensor and Soil Moisture Sensor, which forecasts temperature and rainfall ranges. The gateway is integrated with Amazon Web Services' (AWS) IoT platform. MQTT is a messaging protocol that allows for various messages across distant connections.Real-time data is collected using the light intensity sensor and the ambient temperature and humidity sensors. Additionally, the pH and temperature of the recirculating water are monitored. Suppose the data acquired is beyond the threshold range. In this case, the system quickly engages the correction devices, which comprise a peristaltic buffer device, an aerator, an evaporative cooler, and inlet and exhaust fans, and grow lights. The internet remote access function enables real-time data transmission and receipt through the android app amongst the smartphone and computer system. A tree topology was used for the WSN-enabled agricultural monitoring system to improve performance. A cheap sensor node like a commercial sensor or a NodeMCU module transmits data to the control unit over Wi-Fi. Fertilizer, fertigation improvement, and agricultural operations are monitored by data

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processing and thresholding. The incorporation of cost-effective ICT technology with traditional crop management or weather monitoring and sensor data created the agronomic model. Minimal environmental impact from crop growing was achieved as a consequence of large fertilizer and water savings.

7.5 Climate conditions monitoring

In farming, the weather is extremely important. Incorrect climate knowledge can have an impact on crop quality and quantity. On the other hand, farmers may use IoT solutions to put sensors in thefield, including humidity sensors, temperature sensors, rainfall sensors, and water level sensors, to collect real-time data from the environment. These sensors monitor the state of crops and the environment in which they grow. If a worrying environmental situation is discovered, it is either automatically corrected or a warning is sent to the farmer. Greenhouses created an Internet of Things-based weather station to address the cost and accuracy issues. The TI CC2650 Sensor Tag and IBM Cloud Platform continuously monitor weather and abiotic factors, transfer the detected values to the cloud, and send e-mail notifications when values deviate. As a result, this study may be expanded to include the use of ML model-based classification training to categorize a plant's health as excellent, moderate, or terrible based on the average temperature, humidity, light intensity, and air pressure. Arifin et al. used an autonomous temperature control system to address the drawbacks of traditional growing methods, which are expensive, have low yields, and need a lot of care. The suggested IoT-based architecture was evaluated in a real-world setting at the Bandar Puteri Centre of NASOM (National Autism Society of Malaysia). The ideal temperature for oyster mushrooms is between 20 and 30 ◦C, with a humidity level of 70 to 80%. Two sensors were installed in the mushroom house's center and corner to detect temperature and moisture, then communicated to a remote monitoring station through a microcontroller unit for further action. The results of the six-day experiment revealed that an effective automatic monitoring system, which can regulate the farm's home while reducing resources and human labor, was developed. The mushroom home, IoT control box, and Web Client interface were all designed within the system. As a result, the mushroom house provided a regulated environment for mushroom growing as well as protection from pests and insects. The climate control system, which automates controlling the ideal environment for oyster mushroom production, was housed in the IoT control box.

8. CONCLUSIONS

The agricultural sector is of vital importance for the region. It is undergoing a process of transition to a market economy, with substantial changes in the social, legal, structural, productive and supply set-ups, as is the case with all other sectors of the economy. These changes have been accompanied by a decline in agricultural production for most countries, and have affected also the national seed supply sectors of the region. The region has had to face problems of food insecurity and some countries have needed food aid for IDPs and refugees. Due to the relatively low demographic pressure projected for the future, the presence of some favorable types of climates and other positive factors, including a very wide

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formal seed supply sector, it should be possible to overcome problems of food insecurity in the region as a whole, and even to use this region to provide food to other food-deficient regions.

9. FUTURE ENHANCEMENT

The project has vast scope in developing the system and making it more users friendly and the additional features of the system like:

- By installing a webcam in the system, photos of the crops can be captured and the data can be sent to database.
- Speech based option can be implemented in the system for the people who are less literate.
- GPS (Global Positioning System) can be integrated to provide specific location of the farmer and more accurate weather reports of agriculture field and garden.
- Regional language feature can be implemented to make it easy for the farmers who are aware of only their regional language.

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