Iot Based Smart Agriculture System

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Abstract- *Smart agriculture is an ordinary concept, because IOT sensors are capable of providing information about agriculture fields and then act upon based on the user input. In this Paper, it is proposed to develop a Smart agriculture System that uses advantages of cutting edge technologies such as Arduino, IOT and Wireless Sensor Network. The paper aims at making use of evolving technology i.e. IOT and smart agriculture using automation. Monitoring environmental conditions is the major factor to improve yield of the efficient crops. The feature of this paper includes development of a system which can monitor temperature, humidity, moisture and even the movement of animals which may destroy the crops in agricultural field through sensors using Arduino board and in case of any discrepancy send a SMS notification as well as a notification on the application developed for the same to the farmer's smartphone using Wi-Fi/3G/4G. The system has a duplex communication link based on a cellular Internet interface that allows for data inspection and irrigation scheduling to be programmed through an android application. Because of its energy autonomy and low cost, the system has the potential to be useful in water limited geographically isolated area.*

I. INTRODUCTION

Agriculture is the main backbone of Indian economical growth. The most important barrier that arises in traditional farming is climate change. The number of effects of climate change includes heavy rainfall most intense storm and heat waves, less rainfall etc. due to these the productivity decrease to the major extent. Climate change also raises the environmental consequences such as the seasonal change in the life cycle of the plant. To boost the productivity and minimize the barrier in agriculture field there is need to use innovative technology and technique called Internet of things. The technological advances in their areas gather increasing momentum and this means that maintaining as the overview. The most important things of smart farming are environmental measurement and water management. The reason is that the environmental and water management affect plant growth [6].The paper aims at making agriculture smart using automation and IOT technologies. The highlighting features of this paper include smart irrigation with smart control based on real time field data. Secondly temperature maintenance, humidity maintenance and other environmental parameters. And finally the recommendation to farmer for smart agriculture This calls for planning and strategies to use water sensibly by utilizing the advancements in science and technology. There are many systems to achieve water savings in various crops, from basic ones to more technologically advanced ones. One of the existing systems use thermal imaging to monitor the plant water status and irrigation scheduling. Automation of irrigation systems is also possible by measuring the water level in the soil and control actuators to irrigate as and when needed instead of predefining the irrigation schedule, thus saving and hence utilizing the water in a more sensible manner. An irrigation controller is used to open a solenoid valve and apply watering to bedding plants (impatiens, petunia, salvia, and Vinca rossia) when the volumetric water content of the substrate drops below a set point. The emerging global water crisis: In addition to managing scarcity and conflict between water users, the available freshwater is further contaminated by the human and animal population and the pollution levels have increased at an alarming rate. This if continues, will be leading to limitation of food production which in turn will affect the human productivity and thus the entire ecosystem will be affected in the years to come. The primary and the most important reason for this problem is the tremendous increase in the population which has increased at a rate which is faster than the food production rate. This population growth especially in water short countries will directly have an impact on its growth on the world map. The food production needs to be increased by at least 50%for the projected population growth. Agriculture accounts for85% of freshwater consumption globally.

II. BENEFITS OF SMART AGRICULTURE

Smart agriculture with the help of automation and sensor technology, benefits the society in the following ways.

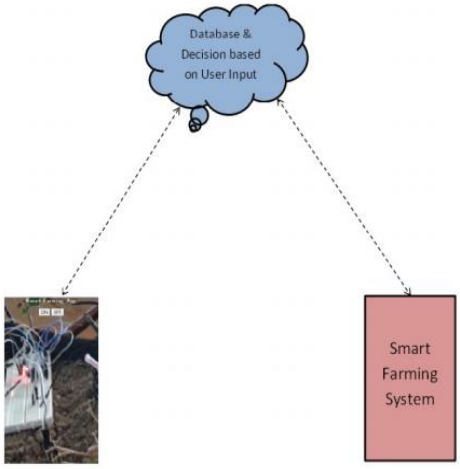
- Conservation of water
- Optimization of energy resources.
- Better crop yield
- Pollution prevention
- Eliminate human errors
- Time efficiency, accurate diagnosis of nutrient deficiency

- Automation with low power consumption components

On the whole smart farming refers to data gathering, data processing, analyzing and automatic control system.

III. PROPOSED SYSTEM

In the proposed system collecting all the data from various sensor like temperature, humidity, lux, moisture and other environmental factors and will do the analysis on the same. During analysis if gets better result of the combination of the data gathered from the various sensor then those data to all The development of a smart agriculture system using sensors, microcontroller within an IOT system is presented. The aim of the implementation is to demonstrate the smart and intelligent capabilities of the microcontroller to allow the decisions to be taken on watering the plants based on the continuous monitoring of the environmental conditions in the field. The system is as shown in Fig. 1. It also aims at a predefined irrigation schedule as per the farmers convenience, uploaded into the application developed for the same. The implementation is a photovoltaic powered automated irrigation system that consists of a distributed wireless network of soil moisture and temperature sensors deployed in plant root zones. These sensors continuously monitor the parameters and send it to the Arduino board for further processing which acts as an IOT gateway. This gateway has been given the wireless capability by installing a wifi module which will be updating the data to the cloud. The IOT gateway also has the GSM capability through the module connected. This receiver unit also has a duplex communication link based on a cellular-Internet interface, using general packet radio service (GPRS) protocol, which is a packet-oriented mobile data service used in 2G and 4G cellular global system for mobile communications (GSM).The data being uploaded to the cloud allows the user to continuously view the parameters from the comforts of his/her



home or wherever on the go. The system has the capacity to adapt based on the user input which the farmer can input through the smart agriculture application. The farmer can select a profile based on the season and the crop for irrigation and schedule and plan the water resource utilization sensibly as shown in Fig. 2. The volumetric water content in the soil is a primary factor which gives a suggestion that the water is required for the crops. In the absence of this system the farmer has to manually inspect these for all the crops by inspecting the soil in the fields which is tedious, time consuming and straining. This can be taken care by the intelligent system which informs the user whenever the water content goes below the threshold set by the farmer himself. Intrusion of animals especially cows, monkeys, dogs etc to the fields is a very common issue and one of the factors for disruption or disturbance to the yield. This requires one person to continuously guard the fields at all the times which will not be accurate and the productivity of one person is wasted. This can be overcome by this system which has a motion sensor to detect the presence of any animal in the fields and send notifications to the farmer in their presence. The distance range for which the farmer needs to detect the animals can be allowed to set by the farmer himself in the application in the beginning.

IV. SYSTEM DESIGN

The system architecture consists of a Arduino Uno R3microcontroller board, sensors like LM 35 temperature sensor, humidity, moisture and motion sensor, a Wi-Fi module i.e.ESP8266 and a GSM module as shown in Fig. 3. The software consists of an android application which includes setting up of the profile for predefined irrigation based on the seasons or on daily and weekly mode. The software has also been programmed to send a notification to the farmer whenever the physical parameters sensed are below the threshold value and based on the farmers input a control signal will be sent to the Arduino Uno to either switch ON/OFF the irrigation [9].

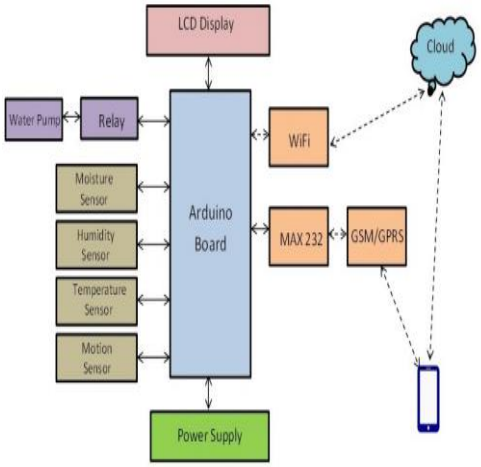


Fig block diagram of the system

The Arduino Uno board controls all the activities taking place on board and acts as the IoT gateway. Sensors sense all the physical parameters and convert the analogue value to digital value. Temperature and humidity sensors are used to measure the temperature and humidity respectively on field. Soil Moisture Sensor are of capacitive type, and are used to measure the moisture of the soil. The yield of crops is affected by the speed with which the wind blows also. This is also measured in our developed system. For capturing data in real time from the sensors, a RTC module is also incorporated. This data is then transmitted to the IOT gateway. The IOT gateway then transmits the data to the cloud using the Wi-Fi module. The cloud in our system will include a Web Server, a database and a decision logic. The database will maintain the data received from the IOT gateway. The decision logic then decides whether the farmer action is needed to water the plants. For example, in the developed system a threshold for temperature is kept at 25 ◦C. Whenever the temperature goes above the threshold temperature, the database will trigger an action to the decision logic which then sends a notification to the developed Smart Farming Android application. The farmer will also get notified by a SMS to his registered mobile phone. Based on the farmers action whether to turn ON/OFF the watering, a signal will be sent to the cloud and from the cloud to the gateway which will then send a signal to trigger the relay and turn on the water pump.

V.TECHNOLOGY REQUIREMENTS

To make the system one micro-controller which will process the data coming from the various sensor? Off-course sensors are the heart of the system and in this system use LM35 temperature sensor because this sensor gives the output in degree Celsius and also easy to interface.

A. Temperature Sensor

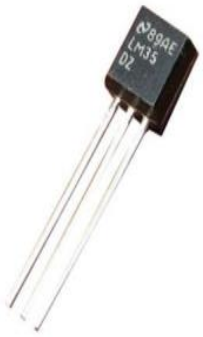


Figure.1 Temperature sensor LM35

Figure 1 Shows Photograph of a LM-35 Temperature Sensor. The change of soil temperature directly impact on soil nutrient absorption and soil moisture keep and sport. [5] The soil temperature plays a certain role on many of the physical processes of soil.

B. Moisture Sensor

Figure 2. Moisture Sensor

Figure 2 sensors are used to sense the moisture content in the soil. It works on the principal of electrical conductivity. Resistance of the sensor is inversely proportional to moisture content in the soil.[1] Moisture content of the soil is a major factor determining plant growth. The present work Comprises of development of a soil moisture sensor. Figure 2 shows the Photograph of a Soil Moisture Sensor. Moisture sensor used as soil sensor [4].

C. Pressure Sensor

Figure 3. Barometric Pressure Sensor

It is known that heavy showers can be expected when the atmospheric pressure is low and rainfall is less likely to occur when pressure is high. Rainfall is inversely proportional to atmospheric pressure. The pressure sensors connected to the micro controller also regulate the water flow by stopping the supply when the pressure is lower than a threshold value. (The threshold value depends on the amount of rainfall received in the area of cultivation). The plants are watered using sprinklers or small nozzles. To avoid errors in pressure values due to external factors like animals or flapping of wings of birds, etc., the pressure value is determined by an average of pressure values taken from a number of sensors installed at different points in the field

D. Humidity Sensor

Figure 4.Humidity Sensor

Humidity sensors senses, measure the relative humidity in the air, it therefore measure moisture and air temperature humidity is the ratio of actual moisture in air to the highest mount moisture that can be held at that air temperature. Humidity Directly influences the water relations of plant and indirectly affect leaf growth, photo synthesis, pollination and finally economical yield. Leaf growth not only depends on synthetic activities resulting from biochemical process but also upon the physical process of cell enlargement.

E. Microcontroller

Figure 5. Arduino Mini Pro Board

In our system Arduino Pro Mini used because Arduino Pro Mini is a micro controller board based on the ATmega328.It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, an on-board resonator, a reset button, and holes for mounting pin headers. A six pin header can be connected to an FTDI cable or Spark-fun breakout board to provide USB power and communication to the board. The Arduino Pro Mini is intended for semi-permanent installation in objects or exhibitions. The board comes without per-mounted headers, allowing the use of various types of connectors or direct soldering of wires. The pin layout is compatible with the Arduino Mini. There are two version of the Pro Mini. One runs at 3.3V and 8 MHz, the other at 5V and 16 MHz. The Arduino Pro Mini was designed and is manufactured by Spark-fun Electronics.[3] The strength of a plant is impacted by many factors, for example, stickiness, soild ampness content, supplement accessibility, measure of water/precipitation got, shade of the leaves, and so forth. The proposed framework goes for saving water and vitality by utilizing dribble water system technique and to screen the plants by keeping up the ideal temperature. Diverse sensors and actuators are being utilized to distinguish different parameters of the dirt like dampness, temperature, weight. At the point when any of the previously mentioned parameters cross a wellbeing edge which must be kept up to secure the plants, the sensors sense the change and the micro controller peruses this from the information at its information ports. On detecting the change, the micro controller at that point plays out the required activities by utilizing transfers until the strayed-out parameter has been taken back to its ideal level.

VI. IMPLEMENTATION

IOT based smart agriculture system is used to generate decisions regarding irrigation using real time data. First of all, farmer logs in to the system using his credentials such as username and password from an Android application.

He is then allowed to select the crop for that season. System is implemented in three phases.

• Sensing
• Processing
• Information distribution.

The sensing phase involves the sensing of the physical parameters which includes temperature, moisture, humidity and motion. All these sensors are attached to the Arduino Uno R3 microcontroller board. This board acts as the IOT gateway in the developed system as it has the capacity to transmit the data to the cloud. This transmission is done using Wi-Fi ESP8266 module. The processing phase takes place in the cloud. The cloud consists of a Web Server, a database where the sensed data is maintained and a decision logic which takes decisions based on the sensed data. In the information distribution phase, the output of the decision logic will be sent to the android application and then to the IOT gateway. The end-to-end algorithm of the smart farming system is given below

Start

- Continuously acquire sensor data
- A/D conversion of the sensed data on the Arduino Board
- Send the data to the cloud through the IOT Gateway
- If the data is above the threshold Send a notification to the Smart Farming Application If user selects Turn ON
- Send a control signal to the server i.e. cloud
- Control signal is then sent to the IOT gateway
- The IOT gateway triggers the relay and the water pump is turned ON

Else if user selects turn OFF
• Send a control signal to the server i.e. cloud
• Control signal is then sent to the IOT gateway
• The IOT gateway triggers the relay and the water pump is turned OFF
Endif
◦ Else
Continue checking for the threshold condition
◦ Endif
End

The Smart Farming Application is developed on Android. The features that are provided in this application are as follows

1. Selection to turn ON/OFF the water pump
2. Selection of an irrigation profile i.e. the farmer can choose a time on a particular day to start the irrigation and a time to stop the irrigation. This facilitates the farmer to invest his time in some other productive work. The application profile also allows the farmer to select the same schedule for a week or a month
3. Suggestion to the farmer to use a particular pesticide for their crop
4. Notify the farmer on the invasion of the field by animals.

VII. CONCLUSION

IOT based smart agriculture system can prove to be very helpful for farmers since over as well as less irrigation is not good for agriculture. 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 over come by extending the system to send suggestion via SMS to the farmer directly on his mobile using GSM module instead of mobile app.

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