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Remote Monitoring for Crop Security and Smart Irrigation using GSM Module

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Abstract--*In India, agriculture comes under the primary sector which demonstrates most of the nation's economy is depending on agriculture. Farmland depends on the several factors such as water, temperature, humidity, security from intrusions, soil quality, disease identification etc. Among several factors, water system is one such factors where human consideration must be given more. Olden method plant watering to field is of two types, that is when to water the plants and how much water will be adequate for the plant. The proposed paper is mainly focused on three factors in agriculture. Firstly, smart irrigation system, real time sensor data sent from the farm land and based on the data control of irrigation motor smartly using android application. Secondly, to provide security for the crops PIR (Passive infrared) sensor is used to detect the intrusions like animals, birds and immediately turn ON the buzzer as well as message sent to user. Finally, remotely monitoring data like temperature, humidity, soil moisture and PIR information is sent to farmer based on his request. Now here comes the job of GSM (Global System Mobile) to send data to user from the farm land. User can see the information about farm land as a message in android application. As a result, user presence can be reduced and precise measure of water given to the field, provides security and monitor the field data. The proposed system is applicable to large farm lands and easily integrate with the conventional agriculture system.*

Keywords-- *smart irrigation, crop security, remote monitoring, GSM module, android application, large farm lands, conventional system.*

I INTRODUCTION

Farming is considered as the premise life for the human beings. Agriculture utilizes 85% of new water assets around the world and this extent will keep on taking water due to population development and greater food demand request. There is an essential need to deliver plans dependent on science and innovation for endurable utilization of water, involving specialized, agronomic, authoritative, and institutional enhancements. Water system assumes a noteworthy job in agriculture and farmlands are the biggest user of water on the planet [1].

A smart irrigation system is define as the control activities of the system remotely by reducing the human effort, time and workload. All farmlands can be programmed with the assistance of sensors, timers, relays, and modern controller chips. The computerized procedure makes the water system more powerful and productive. Hence by helping the farmers to concentrate on other cultivating exercises. The benefits of these computerized smart irrigation system is manually turn ON and OFF the motor when needed. There are various ways for building a

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smart irrigation system using microcontrollers, irrigation system based on solar power, IOT-based water system, and soil dampness based water system, but the primary issue of these water system is that they focus particular crop at a time, however when the farmer needs to plant another yield or crop in a same area, these water systems won't be effective [2].

Security for the food is a significant issue which will turn to be progressively and critically in the following years because of the population growth and the developing welfare in rising economies. Nowadays agriculture deals with various factors to achieve food harvest increment such as humidity, soil moisture, air temperature, rainfalls, predict diseases, pesticide usages, fertilizers etc. By collecting and analyzing huge data, early warning systems is to be expected. Due to that factors which are in critical and non-critical, analyzes the risk of crop failures in early [3].

This paper proposed to monitor the crop factors like temperature, air humidity and soil moisture. PIR (Passive Infrared) sensor is used for security purpose to detect the intrusion objects in farmland. Smart irrigation is presented to operate the water motor manually based on the real time sensor data. GSM technology is used to send the information of farmland to user when he request the proposed module.

II RELATED WORK

Author proposed an idea of automatic irrigation system based on detection of soil moisture sensor. The tube light is connected between the pump motor and the sensor for understanding the farmer. The temperature and IR (Infrared) sensor used for security purpose in the farmland and the technology used here is IOT (Internet of Things). Farmer can see the information in webpage server [4]. The intention of the author here is reduce the excess usage of water in farmland. Author proposed the MIS (Modern Irrigation System) which helps to perform multiple operations in field and it is a fully automated process doesn't need farmer intervention [2]. Author used the Things Speak module which is connect to the WI-FI module. Program is developed to get Information from the sensor and act on farmland automatically [5].

WSN (Wireless Sensor Network) in Precision agriculture is explained by the author. IoT technology is used to get the information from the sensors [6]. Author explains about the smart irrigation system for better growth of crop production. The proposed model is helpful to multi crop in small area and status of soil moisture information is send to web page via IoT technology. Author developed a program that helps to farmer to set the time for watering the field [7]. Author explains the irrigation system of farmland depends on the solar energy. The microcontroller will control the flow of water to farm and thereby reduce the usage of current, short circuits due to wires etc in farmland [8].

Interface the sensors and galileo board, and these modules are connected as a wireless sensor network structure. Authors mainly focused on the soil moisture for crop growth and development. The sensor information is stored in the cloud using IoT module [9]. Author combines the IoT and cloud computing. Variables used in the farm is pH, soil type and soil moisture and information is stored in Things Speak. Author also uses the GSM module to send the data to user [10]. A Raspberry pi based automatic irrigation using IOT to modernization and better growth

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of crop. Soil moisture data is compare with the weather forecast data and this will be useful to precision agriculture with cloud computing [11].

A new design of embedded web server making use of raspberry pi technology and internet of things. Author place a water motor in the field, if any excess of water farm then it sends water to outside area. Using color sensor to scan the leaf and identify the colorless leaf and it also helps to identify diseases based on color [12]. Author proposed an idea to determine the usage of fertilizers in the farm land. Monitors the soil moisture data for crop production and intension to find type of crop is suitable to particular farmland [13]. Author aims to find the pH level of the soil and with the other parameters in the farm land. An application is developed to know the pH level nutrients of the soil and all the information is stored and updated in the cloud. Author conclude that pH not only determine the type of the harvest but also reduces the usage of fertilizers [14].

Arduino based plant watering system is developed. Here the proposed model is used to detect the moisture content of each plant. Based on the detection, water is transferred using sprinkles. The function of the entire system is done automatically [15]. Author mainly focused on the protection of crop from natural disasters or unavoid the disasters. Explains problems about rains or floods, heavy watering and animal distractions. Using GSM and DTMF, all sensors in farm land is activated and information sent to farmer. Author developed module such that decision will be taken by farmers not by automatically [16]. Author used mainly two nodes, coordinate node as raspberry pi and Arduino UNO as end node. All the Arduino nodes are connected to the single raspberry pi node through wireless transceiver. The coordinate node send the data to webpage where farmer can see [17].

III RESEARCH METHODOLOGY

In the proposed methodology, the research issue is to create the crop security, smart irrigation and monitoring the system with capable of analyzing and transmitting data from the farmland to remote location. Literary survey gives the idea of current work done in the farmland using IOT, raspberry pi, Wi-Fi etc. This can be upgraded by incorporating new advances with present plan. Module which is designed with help of IOT, WSN, Raspberry, WI-FI etc., for monitoring the farmland has doesn't have ability to convey the information in understandable way to farmer. In proposed, essential sensors and electronic gadgets are used. The information from the sensors is analyzed by the Arduino with the help of decision tables and GSM module act as transceiver between farmer and module. It conveys the simple text information of farmland to farmer in understandable way [18].

Components used here:

1) Soil Moisture sensor,
2) Dht11 sensor,
3) PIR sensor,
4) Arduino Uno,
5) Buzzer
6) Motor drive,
7) Water motor,
8) GSM module

Software used here:

1) Arduino IDE

IV WORKING

The block diagram of the proposed system is shown in fig-1. At first sensor like PIR (Passive Infrared) sensor is activated based on the intrusion detection like animals, birds in the farm land immediately PIR activates the buzzers or alarms. Side by information is sent to the farmer using GSM module automatically. In second, sensor like temperature, humidity, soil moisture is monitored the crop based on the user request to GSM module. Once, farmer request the module by pressing key in android application the farm land information is sent to android. The proposed module programmed in such a way that received information of soil moisture sensor is compare with the temperature and humidity for irrigation system to fields. Water motor status will be decided based on the comparison decision table. At last, smart motor operation is presented. Based on the result, farmer can turn ON and OFF the motor from anywhere by pressing key in android application.

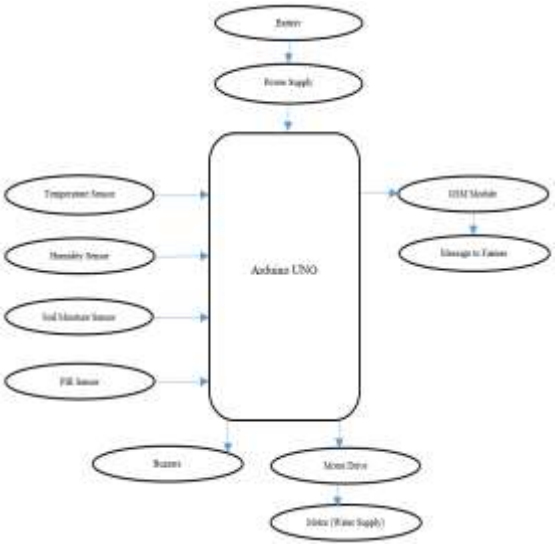

Figure 1: Block diagram of proposed system

V COMPONENT DESCRIPTION

Soil Moisture sensor:

Soil Moisture Sensor can be utilized to distinguish the dampness content in soil by analyzing the volumetric water content. It is required to expel the dirt and weigh of the sample soil for the measurement of soil moisture. The mechanisms used to estimating data are electrical obstruction, cooperation with the neutrons or dielectric consistent. Various technologies are used to estimate the moisture content in soil are frequency domain, time domain and neutron moisture gauge. Calibrating is used to distinguish between measured data and standard data. Sensor consists of two plates, anode and cathode that is used to estimate the water content in the soil. Analog to digital converter is used to convert data in digital format and set the threshold values.

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Figure 2: Soil moisture sensor [19]

PIR sensor:

PIR stands for passive infrared. It consists of two slots and made up of special material which is sensitive to IR. When intrusion body crosses the sensor, first slot detects the body and generates the positive differential change and when body leaves away from sensor second slot generates negative differential. Thus, due to change in pulses the PIR sensor is detected and active buzzers. The range of this sensor is 10 to 15m with an angle of 120 degree.

Figure 3: PIR sensor [20]

DHT11 sensor:

The DHT11 sensor is used to find the temperature and humidity values. The sensor has a thermistor to measure the temperature and capacitive humidity to measure the humidity in surroundings. The proposed sensor is very good for 20 to 80 percent of accuracy in measuring humidity and 0 to 50 degrees in measuring temperature accuracy.

Figure 4: DHT11 sensor [21]

Arduino Uno:

Arduino Uno board comprises of ATmega328P microcontroller. It has an 8-bit RISC (Reduced Instruction Set Computer) processor and is manufactured as a 28 pin PDIP. It has 14 advanced input/output pins with 2KB of SRAM and 6 simple pins which has a resolution of 10 bits. Arduino Uno board comprises a 16MHz frequency resonator, a USB association, and power jack of 5V [17].

Figure 5: Arduino Uno[22]

GSM Module:

The GSM stands for Global System Mobile. The proposed module GSM sim900 is a complete Quad band. The sim900 delivers 850/900/1800/1900 MHz performance for SMS, data, voice and Fax in small form factor with low power consumption. It consist of 12 GPIOS, 2 PWMs and built in A/D converter. The SIM900A is a dual-band GSM/GPRS solution. SIM900A delivers GSM/GPRS 900/1800MHz [25] performance for SMS and Data in a small form factor with Low power consumptions. It controlled via AT commands.

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Figure 6: GSM Module[23]

Arduino IDE:

The IDE stands for Integrated Development Environment. Arduino IDE is an open source software tool. The language used in the software is similar to C/C++ and Arduino code can upload in the Arduino board. These software works on various operating systems like Linux, Mac OS, windows etc., and these files are saved with .ino extension.

VI DATA PROCESSING AND DECISION MAKING

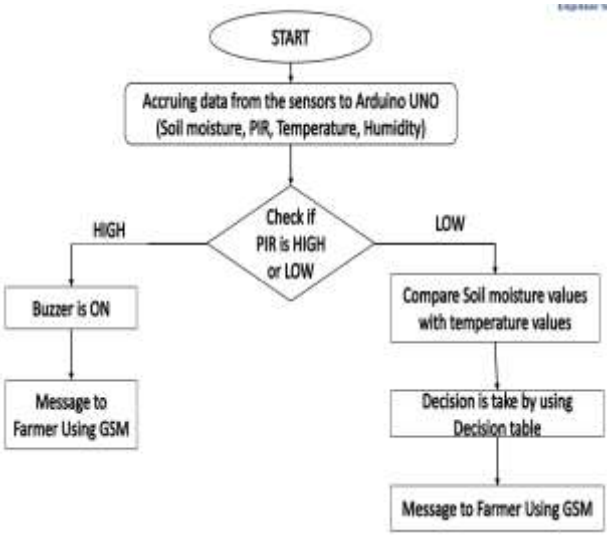

Figure 7: Flow chart of the proposed model

The fig-7 explains the working flow of proposed model. After initialize the components and apply the power supply to the module. All sensors starts to collect data from the farmland and send to Arduino UNO. In Arduino board, the pre-programmed software analysis the received data based on the given threshold values. For crop security purpose, program first checks PIR status based on the PIR data decision is taken. If PIR status is HIGH, then automatically buzzers, alarms turn ON for particular time as well as automatically message sent to the farmer. If PIR status is LOW then soil moisture data compares with the temperature and humidity data of farmland. The comparison result should consists indication or information give to farmer to turn ON or OFF the water motors. Here comes the role of GSM, to send and receive text messages from farmland to farmer or vice versa.

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As we said earlier decision table is created and applied in the Arduino programming. The following table is used to analysis the sensor values with weather forecast values and takes decision for the irrigation to crop.

Table 1: Decision rules for Making Decisions

Result from weather forecast	Result from sensed data	Decision to do
No Rain	Humidity ≥ 60%	No watering
No Rain	Humidity ≤ 30%	Watering
Rain or Strom	Humidity ≈ 60%	Wait for rain

In farmland humidity is greater than threshold value then module suggest to the farmer to turn OFF the motor when result from weather forecast is No Rain. If it is less than threshold value and no rain from forecast then water supply is given to crop making turn ON the motor. If sensed values is approximately to the pre-determine values then suggest to farmer to wait for rain.

Following flow chart represents to convey and request for the information in simple, easy, understandable way.

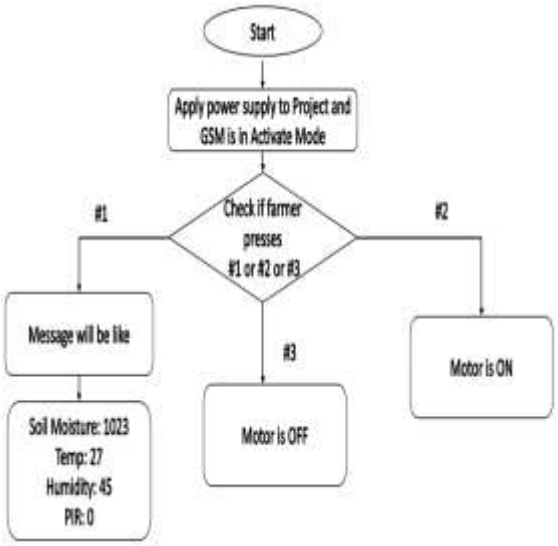

Figure 8: Proposed flow chart for farmer

After successful activation of module, if farmer wants to know information of the farmland then request to press #1 key to get information from the sensors. This indicates smart agriculture monitoring using GSM module. If farmer is in some other location and he need to turn ON or OFF the water motor the following keys are used to operate #2 or #3. This indicates the smart irrigation system using android application.

VII RESULT ANALYSIS

The We can comprehend the activity of the remote monitoring system from the experiment results as explained below:

Table 2: Data from the sensors

Temperature	Soil moisture	Humidity	PIR	Water Motor	Buzzer
28.2℃	13.70 %	64. 40%	Not detected	OFF	OFF
28.8℃	33.80 %	66. 70%	Not detected	OFF	ON
29.5℃	18.85 %	64. 40%	Detected	OFF	OFF
32.4℃	29.80 %	39. 30%	Not detected	ON	OFF
32.8℃	15.65 %	35. 70%	Not detected	ON	OFF
33.2℃	49.20 %	64. 90%	Not detected	OFF	OFF
29.5℃	28.78 %	64. 90%	Detected	ON	ON

The proposed system collects the values from four sensors and these values are sent to farmer's android and stored as messages in android application. Arduino controller and related information was found from four sensors to test the threshold sensors values at every time. The status of the device can be viewed and tracked remotely in real time. Lastly, the communication between GSM and android was successfully created and data is transferred.

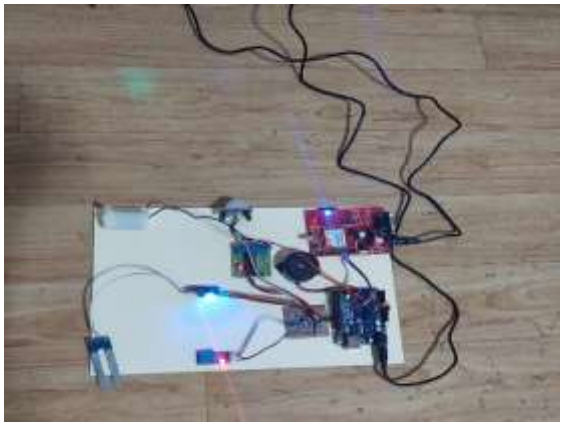

Figure 9: proposed system hardware

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Figure 10: snapshot of the sensor results

Approximately 84.8% of accuracy data was collected in existing system [24]. User can visualize the accuracy data from sensors and decisions based on sensor readings is proposed. In existing system, for every 5 minutes during irrigation and 30 minutes in normal time data can be collected whereas proposed system collects readings only when farmer request the GSM module.

VIII CONCLUSION

The implementation of remote monitoring for crop security and smart irrigation using GSM module is presented. Using this type of module helps to farmer in monitoring the farmland parameters and control the water motor from anywhere using GSM text messages. Temperature is displayed accurately in degree/Celsius and humidity is displayed in percentage successfully without any errors. The PIR sensor used for security purpose is given immediate alarm and sent message to farmer when detection of intrusion. The proposed system is cost effective and efficient. Hence, to prevent the usage of water and improve the plant growth and maintain the required moisture level, suggested method is must applied in the farmland. For future up gradation, device used for pattern recognition techniques to categorize the humans, animals and birds. By using sensors measure the nutrients content in the soil and quality of soil. Identify the type of the diseases while monitoring the crop in early stages and indicate to farmer.

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