IOT Based Smart Agricultural Monitoring System

Priyanka Makkar[1], Dr. Sunil Sikka[2]

[1]Assistant Professor, [2]Associate Professor, Department of CSE
Amity University Haryana, India

Abstract: - The automation and advanced machinery of farm activities can transform an agricultural domain from manual and old tradition to smart, innovative and dynamic leading to higher production with lesser human supervision and lesser resources. This paper proposes an automated irrigation system which helps in monitoring and maintaining the desired soil moisture, temperature and humidity of the soil. Arduino uno platform is used to implement the control unit and can be said as controller. The setup uses soil moisture sensors which measure the moisture content level in soil. This value enables the system to use appropriate quantity of water which avoids over or under irrigation. IOT is used to keep the farmers updated about the status of water pump. Information from the sensors is regularly updated on a webpage. Through which a farmer can check whether the water pump is ON/OFF at a particular time. Also, the sensor readings are transmitted to a database to provide the better result.

Keywords: IoT, Sensors, GPS, Microcontroller, Wi-Fi

1. INTRODUCTION

Agriculture have had and still have a biggest role in the history of life. It helps human beings grow the most ideal food crops and raise the right animals with accordance to environmental factors. Agriculture plays a vital role in India's economy. Over half part of the rural households depend on agriculture as their means of livelihood. Currently, agriculture accounts 83% of the total water consumption in India. Unplanned use of water accidently results in wastage of water. This suggests that there is an urgent need to develop systems that prevent water wastage without imposing pressure on farmers. So the farmer's and even the nation's economy will be ruined if there are no proper yields due to lack of knowledge of the soil nature, timely unavailability of water. Thus there is an importance for taking steps for a better and profitable irrigation. It is a smart farming based on IOT (Internet of things) technology which has brought revolution to each and every field of farmers' life by making agriculture method improved and smart. With the help of open source Arduino boards and different sensors (Temperature, soil moisture, smoke detection), farmers in getting live data for efficient soil monitoring according to the location, climatic conditions and need for the water resources to increase the overall yield and quality of crops which help the farmers by making work much easier and they can concentrate on other farm activities.

LITERATURE SURVEY

The older method and one of the oldest ways in agriculture is the manual method of checking the parameters. In this method the farmers only by themselves verify all the parameters and calculate the readings that's why to overcome this stress and relief from stress, It focuses on developing devices and tools to manage, display and alert the users using the advantages of a wireless sensor network method. It aims at making agriculture smart and modern using automation and IoT technologies. It provides a low cost and effective wireless sensor network technique to acquire the soil moisture and temperature from various location of farm and as per the need of crop controller to take the decision whether the irrigation is enabled or not. It proposes an idea about how automated irrigation system was developed to optimize water use for agricultural crops. In addition, a gateway unit handles sensor information. The atmospheric conditions are monitored and controlled online by using Ethernet IEEE 802.3.It is designed for IoT based monitoring system to analyze crop environment and the method to improve the efficiency of decision making by analyzing harvest statistics. Various companies in INDIA and globally have been proposed in using micro controller based controllers for various have come with novel solutions using automated systems for various application with specific individually (www.smartagriculture.com). Most work carried out in literature and organizations have their inherent advantages and disadvantages. These manufacturers do not have multiple agricultural applications integrated in a single hardware. To eradicate such errors or disadvantages we are introducing a multi function design using wireless sensor networks. The system was based upon an automated irrigation system by using mainly a soil moisture sensor. With this system, people can have a better control on their irrigation time and can also save water. In this prototype, different soil samples and crops for calibration at various moisture levels was tested. However, to improve this analysis, various soil samples from different places could have been tested and also during different weather conditions. Apart from soil moisture, other factors of the soil could have also been monitored. The cloud computing that could improve the advanced technologies using big data collection through the fast updates of data's through online entries. In an updated wireless network sensor system, the data that could be updated through faster applications.

2. PROPOSED WORK

In the field section, various sensors are deployed in the field like DHT sensor, moisture sensor and smoke sensor. The sensors are attached to the Arduino uno and the data received by the sensors is collected to database through WIFI module.

In control section, the received data is verified with the threshold values. If the data exceeds the threshold value the buzzer is switched ON. This alarm is sent as a message to the farmer and automatically the power is switched OFF after sensing. The values are generated in the web page and the farmer gets the detailed description of the values.

In automatic mode, the microcontroller gets switched ON and OFF automatically if the value exceeds the threshold point. Soon after the microcontroller is started, automatically an alert must be sent to the user. This is achieved by sending a message to the user through the GSM module.

Other parameters like the temperature, humidity, moisture and the water level sensor is used just to indicate the level of water inside a tank or the water resource.

3. HARDWARE USED

Arduino UNO

The UNO is an open-source microcontroller board which is based on the Microchip ATmega328P microcontroller and is developed by Arduino.cc. The board consists of sets of digital and analog input/output (I/O) pins that can be interfaced to various expansion boards and other circuits. The UNO board has 14 Digital pins, 6 Analog pins, and programmable with the Arduino IDE (Integrated Development Environment) via a type B USB cable. Arduino UNO can be powered using a USB cable or an external 9-volt battery, though it accepts voltages between 7 and 20 volts only. The communication is done using the original STK500 protocol. The UNO is the best board if you are just getting started with electronics and coding, the UNO is the most robust board you can start playing with. The Arduino UNO is the most used and documented board of the whole Arduino family.

Input and Output

Each of the 14 digital pins on the Arduino Uno can be used as an input or output, using pinMode(), digitalWrite(), and digitalRead() functions. They operate at 5 volts. Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20-50 kOhms.

Ethernet Shield

The Arduino Ethernet Shield connects your Arduino to the internet in mere minutes. Just plug this module onto your Arduino Board, connect it to your network with an RJ45 cable (not included) and follow a few simple steps to start controlling your world through the internet. As always with Arduino, every element of the platform – hardware, software and documentation – is freely available and open-source. This means you can learn exactly how it's made and use its design as the starting point for your own circuits. Hundreds of thousands of Arduino Boards are already fueling people's creativity all over the world every day. The transistor is the fundamental building block of modern electronic devices, and its presence is ubiquitous in modern electronic systems.

Soil Moisture Sensor

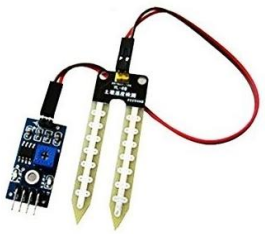

Fig 3.1 Soil Moisture Sensor

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. The relation between the measured property and soil moisture must be calibrated and may vary depending on environmental factors such as soil type, temperature, or electric conductivity. Reflected microwave radiation is affected by the soil moisture and is used for remote sensing in hydrology and agriculture. Portable probe instruments can be used by farmers or gardeners.

LCD

Fig 3.2 Line LCD

- A breadboard is a solderless device for temporary prototype with electronics and test circuit designs. Most electronic components in electronic circuits can be interconnected by inserting their leads or terminals into the holes and then making connections through wires where appropriate.
- Connection Concept
- The top and bottom rows (the rows indicated by the blue) and are usually the (+) and (-) power supply holes and these move horizontally across the breadboard, while the holes for the components move vertically Each hole is connected to the many metal strips that are running underneath. Each wire forms a node.

Table 3.1 Pin Description

Pin No	Function	Name
1	Ground (0V)	Ground
2	Supply voltage; 5V (4.7V – 5.3V)	Vcc
3	Contrast adjustment; through a variable resistor	V_{EE}
4	Selects command register when low; and data register when high	Register Select
5	Low to write to the register; High to read from the register	Read/write
6	Sends data to data pins when a high to low pulse is given	Enable
7	8-bit data pins	DB0
8		DB1
9		DB2
10		DB3
11		DB4
12		DB5
13		DB6
14		DB7
15	Backlight V_{CC} (5V)	Led+
16	Backlight Ground (0V)	Led-

Gas Sensor (MQ-6)

Fig 3.3 Gas Sensor

MQ-6 gas sensor modules are used in gas leakage detecting equipment in family and industry, are suitable for detecting of LPG, iso-butane, propane, LNG, avoid the noise of alcohol and cooking fumes and cigarette smoke. It also help in detecting gas around the field , which may be harmful to the crops.

Relay

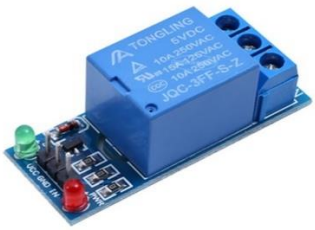

Fig 3.4 Relay

A relay is an electrically operated device. It has a control system and (also called input circuit or input contactor) and controlled system (also called output circuit or output contactor). It is frequently used in automatic control circuit. To put it simply, it is an automatic switch to controlling a high-current circuit with a low-current signal.

Temperature Humidity Sensor

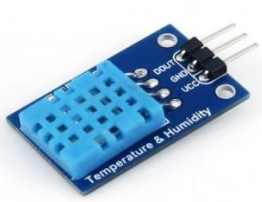

Fig 3.5 Temperature Humidity Sensor

DHT11 is a Humidity and Temperature Sensor, which generates calibrated digital output. DHT11 can be interface with any microcontroller like Arduino, Raspberry Pi, etc. and get instantaneous results. DHT11 is a low cost humidity and temperature sensor which provides high reliability and long term stability.

It is digital temperature and humidity sensor is a composite Sensor contains a calibrated digital signal output of the temperature and humidity. Application of a dedicated digital modules collection technology and the temperature and humidity sensing technology to ensure that the product has high reliability and excellent long-term stability. The sensor includes a resistive sense of wet components and an NTC temperature measurement devices[8].

4. SOFTWARE USED

SQL (Structured Query Language) is a domain-specific language used in programming and designed for managing data held in a relational database management system (RDBMS), or for stream processing in a relational data stream management system (RDSMS). In comparison to older read/write APIs like ISAM or VSAM, SQL offers two main advantages: First, it introduced the concept of accessing many records with one single command, and second, it eliminates the need to specify how to reach a record, e.g.: with or without an index.
Embedded C is a set of language extensions for the C programming language by the C Standards Committee to address commonality issues that exist between C extensions for different embedded systems. Historically, embedded C programming requires nonstandard extensions to the C language in order to support exotic features such as fixed-point arithmetic, multiple distinct memory banks, and basic I/O operations.

5. RESULTS

When the moisture sensor value goes below 50 then water pump will automatically pumps water into field and DHT11 sensor values shows the climate condition of the field and when smoke goes above 200 then buzzer will start beeping so that the farmer will be alert.

Database Structure
Table 5.1 shows the database structure used to store sensor values.

Table 5.1 Database Structure

#	Name	Type	Collation	Attributes	Null	Default	Comments	Extra
1	**Id**	int(255)			No	*None*		AUTO_INCREMENT
2	**MOISTURE**	float			No	*None*		
3	**Temp**	int(100)			No	*None*		
4	**Humidity**	int(100)			No	*None*		
5	**Smoke**	int(100)			No	*None*		
6	**DATE AND TIME**	datetime(6)			No	*None*		

6. Conclusion and future work

There is an urgent need for a system that makes the agricultural process easier and burden free from the farmer's side. With the recent advancement of technology, it has become necessary to increase the annual crop production output of our country India, an entirely agro centric economy. The ability to conserve the natural resources as well as giving a splendid boost to the production of the crops is one of the main aims of incorporating such technology into the agricultural domain of the country. To save farmer's effort, water and time has been the most important consideration.

This project has enormous potential and the following additional features can be introduced:

- Remotely perform the whole system through a mobile application.
- Use a float switch in a tank, so that the system automatically shuts the pump down, once the reservoir is full.
- Use it in conjunction with a solar panel, so that the entire system is eco-friendly.

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