IOT Based Greenhouse Automation

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Abstract - *In a major agricultural country like India, greenhouses form an important part of agricultural and horticulture sectors. Greenhouse Automation System is the technical approach in farming by which the farmers will be benefitted by automatic monitoring and control of greenhouse environment. Greenhouse is a building where plants are grown in a controlled fashion. Nowadays due to urbanization and lack of land availability there is a great need to construct such greenhouses which will be reserved mainly for growing crops which can be automatically maintained with this system. A greenhouse is a closed area where plants grow and cultivate. There are some important parameters to be monitored inside the greenhouse required for the growth of the flora inside. The aim of the project is to achieve complete automation of the greenhouse by using the many resources available.*

***Key Words*: IoT, Automation, Greenhouse, Arduino, Sensor, Monitoring, Microcontroller, Agriculture**

1. INTRODUCTION

The primary occupation of India is agriculture and there is a great need for efficient methods of growing crops. In the recent days due to global warming and drastic climatic changes modern agricultural system needs to be implemented for the better yield. Greenhouse plays a very important role in this aspect. But sometimes either the plants consume more water or the water reaches late up to the plants. This ultimately affects the plant growth. Also, there are many such problems associated with it. Due to lack of rainfall and unavailability of natural water reservoirs, crops cannot be grown throughout the year. Similarly, many of the other environmental parameters like soil moisture, temperature, humidity and availability of CO2 also pose challenge for modern day farmers. Earlier the monitoring of the mentioned parameters was controlled by human intervention. Our project aims to replace manual supervision with atmospheric sensors and actuators. It also prevents unauthorized entry inside the greenhouse. Due to automated technology, it reduces manpower and provides better performance and accuracy. Greenhouse will give a better yield per square metre than traditional farming because the environmental conditions are monitored continuously with a higher precision.

The microcontroller constantly monitors the digitalized parameter of various sensors and verify them with the predefined threshold values under check if any corrective action to be taken for certain at that instant in case such situation should arise then it activates the actuators to perform a controlled operation as needed. An array of actuators can be used in the system such as relays etc. they are used to turn on AC devices such as water pump and light panel.

1.1 Existing System

The recent scenario of decreasing water tables, drying up of rivers and tanks, unpredictable environment presents an urgent need for proper and efficient utilization of water. We also visited greenhouses and recorded the working methods of the framers, which provided us a very clear idea of how the maintenance and monitoring activities take in a greenhouse. We were introduced with the techniques for selection hardware, provided basics and reference models on which an IoT system can be based and developed. Comparative study of some existing systems provided us insights and our first node to start research on the matter.

Although India receives ample amount of precipitation, only one third of the total agricultural land is connected via canal irrigation system. Places with excess water faces downside of land fertility because of over irrigation and water work. Alternatively, places with limited supply of water cannot do irrigation throughout. Relative Humidity (RH) affects leaf growth, photosynthesis, pollination rate and ultimately crop yield. Prolonged dry setting or heat will create the fragile sepals dry quickly and lead to the death of flower before maturity. Hence it is very crucial to control air humidity and temperature

Relying on the manpower to supervise the greenhouse and monitor it constantly increases the capital for the farmer. There also exists a great margin of error with humans and such misshapen might cause the temporary death of the plants as most of the crops grown in greenhouse are of sensitive nature and require a great deal of undivided attention. Due to all these shortcomings, a severe need for a more efficient and cost-effective method presents itself.

1.2 Proposed System

Very often agriculturists rely upon their knowledge to figure out the vital operations which can have an adverse effect on their production, but here sensor data in in the greenhouse can help farmers plan an optimum time to carry out the harvesting and would then ensure that the crop is ready and the value is maximized. Thus, agriculture is one of the largest use cases of IOT, besides this selective irrigation, remote equipment operation, livestock monitoring, and monitoring, etc. are other use-cases where IoT is most helpful.

Our proposed system is a microcontroller-based design which uses low power and also is cost efficient. The microcontroller used is ATMEGA328P which serves as a main processing unit and processes various inputs from the atmospheric sensors like temperature sensor, humidity sensor, soil moisture sensor, rainfall sensor, light sensor (LDR) and gas sensor. The program controls the actuators like water pump and LED light system based on the recorded inputs. There is also a keypad sensor attached to the microcontroller which is involved to prevent unauthorized access to the greenhouse which controls the door with the help of a swerve motor. This particular design replaces the direct supervision of the human.

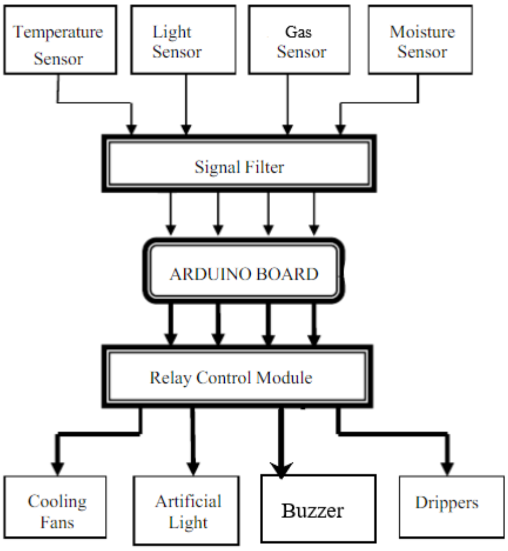

Fig -1: Block diagram of the proposed system

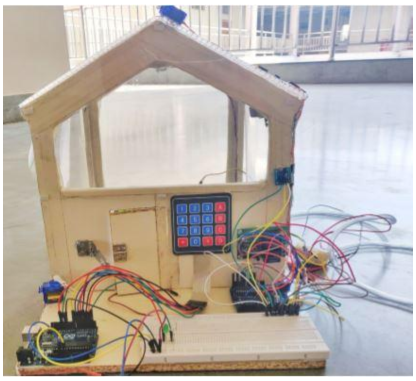

Fig -2: Front view of the model design

Fig -3: Side view of the model design

2. SYSTEM DESIGN

2.1 Arduino Uno

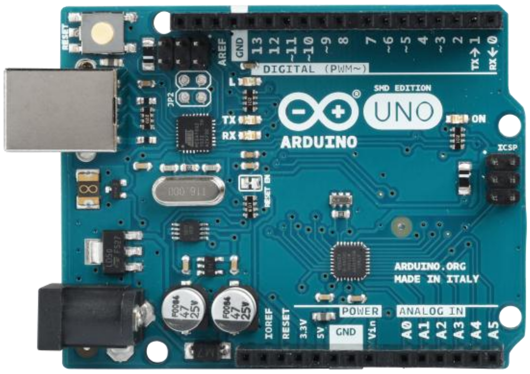

Fig 4: Arduino Uno

The Arduino Uno is an opensource microcontroller board based on the ATmega328P microcontroller. The board has 14 digital input/output pins (of which 6 provide PWM outputs), 6 analog input pins, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller since it can be programmed with Arduino IDE (Integrated Development Environment) via a type B USB cable. It accepts an input voltage within the range of 7 to 20 volts and is usually operated at the voltage of 9V.

The ATmega328 on the Arduino Uno is preprogrammed with a bootloader through which a new code is uploaded to it without the use of an external hardware programmer. It has 32 KB of Flash Memory out of which 5KB is used by bootloader. Communication is made using the original STK500 protocol.

The Arduino Software (IDE) includes a serial monitor through which simple textual data is sent to and from the board. When the data is transmitted via the USB-to-serial chip and USB connection to the computer, the RX and TX LEDs on the board flash. Serial communication on any of the Uno's digital pins is provided by a SoftwareSerial library.

2.2 Sensors

Soil Moisture Sensor:

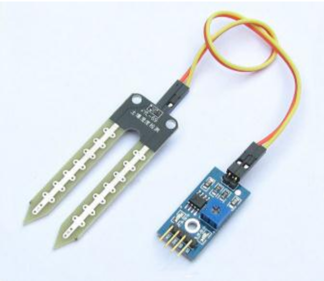

Fig -5: Soil moisture sensor

It is very essential for the crops to have sufficient soil moisture content to thrive to their full potential. A farmer can increase the yield of the crop by knowing the exact moisture content in the soil and monitoring it. We use a basic soil moisture sensor containing two probes which measures the volumetric content of water. When the sensor is immersed in soil, soil acts as hygroscopic dielectric material. The moisture content is sensed based on the capacitance effect. Current passes through the two probes and then soil to measure its moisture level.

When the moisture content is below the threshold value, Arduino turns on the relay which in turn switches on the sprinkler system and irrigates the land, thereby maintaining the optimum soil moisture content required for the crop.

Rainfall detection sensor:

Fig -6: Rainfall detection sensor

It is used to measure rainfall intensity. Rainfall Detection sensor is basically a printed circuit board on which nickel is coated in the form of parallel lines. This module is based on the LM393 op amp and works on the principle of resistance. When the water droplets are collected on the board, they offer lower resistance and hence lower the voltage output. When there are just few water droplets or when the board is completely dry, greater voltage is output on the analog pin.

Analog pin measures the output voltage and it provides a digital output when a threshold of moisture is exceeded.

Light sensor:

Fig -7: Light dependent resistor

We use a Light dependent resistor (LDR) in this project to measure the intensity of light in the greenhouse. Higher the intensity, higher the voltage. LDR is connected to the analog input pin on Arduino. The Arduino being an analog to digital converter, it converts the analog voltage (0-5V) into a digital value (0-1023). Furthermore, the Arduino is programmed to turn on the relay which in turn turns on an appliance (LED bulbs) when the light intensity is low.

Temperature and Humidity Sensor:

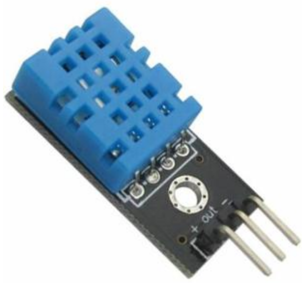

Fig -8: Temperature and humidity sensor

DHT11 is used to measure temperature and relative humidity in the atmosphere. Temperature is expressed in Celsius and Humidity is expressed in %. Condensation occurs at 100% RH and the air is completely dry at 0% RH.

DHT11 can measure humidity within the range of 20-90% with 5% accuracy. It can measure temperature within the range of 0-50°C with an accuracy of 2%.

Gas Sensor:

Fig -9: Gas sensor

We use MQ-2 smoke sensor to detect the presence of gases as a part of safety system. It is sensitive to smoke and flammable gases such as LPG, Hydrogen, Methane.

It has a built-in potentiometer to adjust the sensor sensitivity as required. It outputs analog/digital voltage depending on the gas concentration in the atmosphere. Higher the concentration, higher the voltage. The Arduino is programmed to turn on the relay which in turn triggers the buzzer when the smoke level becomes higher than the threshold value as specified in the code.

Keypad component:

Fig -10: Keypad

A matrix keypad is used to unlock the password protected door and thereby preventing unauthorized entry.

For this project we have used 4 x 4 matrix membrane keypad. There is a membrane switch beneath each key. The Arduino detects which button is pressed by detecting the row and column pin the button connects to. We have used 12C enabled LCD to display the button pressed on the screen.

3. CONCLUSIONS

The proposed system we have here is implemented on a small scale with limited resources. With the usage of more sophisticated devices it is possible to develop this idea on a large scale which may include the raising of the roof if the sunlight is not enough or alerting the owner of the property about the intrusion etc.

IoT is playing a major role in the everyday life in the recent days with applications in numerous fields, this system helps the farmers to create a cost-effective automatic system to maximize the efficiency.

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