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Smart Polyhouse using Internet of Things

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Abstract:- Currently, Internet of Things technology (IoT) is playing a crucial role in system automation and reducing human effort and intervention in maintaining them. IoT finds applications numerously in different fields like health, smart cities, agriculture etc.,. In this paper, IoT based smart polyhouse is proposed and a prototype is designed as a proof of concept (PoC). The system monitors the inside polyhouse conditions for effective plant growth using various sensors and control the operations of watering, lighting and temperature maintaining systems. Also farmer is informed about the operating conditions in the polyhouse through a message.

Keywords:- *Poly house, Internet of Things, Arduino uno, GSM modem, DHT11.*

I. INTRODUCTION

Farming is one of the important occupation of world population. One of the latest methods of farming technology includes usage of polyhouse to increase productivity and in turn profits [1]. The productivity of certain crops can be increased by optimizing the growing conditions as required. The usage of fertilizers for such crops under normal conditions can be optimized by using polyhouse structure. Agriculture and its allied sectors contribute around 24% of total GDP of India [1]. Conventional methods of agriculture grow crops open to atmospheric conditions in which crops may be subjected sudden changes in the climate. This will affect the growth of crops and finally the yield [1].

Green house or poly house is the latest methods being followed to grow certain types of vegetables, fruits and flowers to increase quality and productivity [2]. Poly house being broader term of green house is a place provided under glass or polythene to provide controlled conditions of temperature, humidity, light etc., for growing various plants [3, 4]. However with the lack of awareness about conditions to be maintained or due to human errors sometimes the productivity gets affected. To overcome this, the authors proposed a solution of an automated system using Internet of Things (IoT).

In this paper IoT solution for monitoring and maintaining required conditions in a polyhouse is developed. IoT connects sensors, actuators and control them over internet [5]. The different conditions that are monitored in this paper include temperature, moisture content in the soil, humidity and light. Using various sensors the conditions are monitored and appropriate actions are taken accordingly. The system is automated and it sends message to the concerned personnel regarding operation in the house.

II. MATERIALS AND METHODS

A. Materials

Different modules used to accomplish the solution are explained in the following section:

❖ *Arduino Uno*

Arduino uno is a microcontroller board based on ATmega 328 micro controller. It contains 14 digital I/O pins and 6 analog input pins. It can be powered using an USB cable or a power jack. It has a crystal oscillator of 16MHz. In this work various sensor data is being sensed by Arduino uno board with the code being uploaded using Arduino IDE.

➢ *GSM Modem*

GSM is a modem developed by bell laboratories for mobile communications. It is used to transmit mobile voice and data services at different frequency bands. The modem used in this paper operates in 900MHz band [6].

➢ *DHT11 Sensor*

DHT 11 is a digital temperature Humidity sensor whose operating voltage is between 3.3v to 5v. Its range of measuring temperature lies between 0 to 50 degrees and humidity ranges from 20% to 90%. It has three pins like Vcc, GND and data pin [7].

Fig 1:- Arduino UNO

Fig 2:- GSM Modem

Fig 3:- DHT 11 Sensor

➢ *Soil Moisture Sensor*

Moisture content in the soil plays an important role in the plant growth. In this paper soil moisture sensor (Fig.4) is used to measure the volumetric water content in the soil. These sensors are generally called as soil water potential sensors that include tension meter and gypsum blocks. The sensor contains Vcc, GND, analog and digital output pins [8].

➢ *LDR (Light sensor)*

LDR(Light Dependent Resistor) is a sensor module whose resistance varies depending on the light intensity received on its surface [9]. This property makes the sensor to be used in light sensing applications. In this paper LDR is used to sense the required light intensity. LDR is shown in Fig.5.

➢ *Relay*

It is a switch which is operated electronically and lets the current to go through or not. Relay module (Fig.6) can be controlled with low voltages of 5v using microcontrollers like Arduino Uno [10].

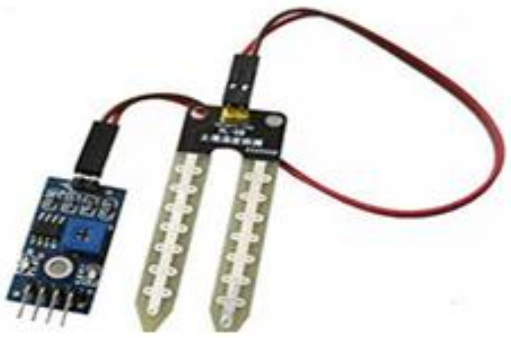

Fig 4:- Soil Moisture sensor

Fig 5:- LDR (Light sensor)

B. Technology Used

To implement the idea of making smart polyhouse, Internet of Things technology is used. IoT is the concept of connecting devices and exchange data among them [11].

III. BLOCK DIAGRAM AND HARDWARE

Fig.7 shows the block diagram of the proposed system. The target is to sense parameters like temperature, humidity, light and soil moisture using sensors and to take required actions to maintain controlled conditions in the poly house. To attain this, the authors developed a prototype for proof of concept. Arduino Uno is the microcontroller board used in the prototype developed to read the data sensed by various sensors.

Fig.8 shows the hardware setup developed to realize the smart polyhouse using IoT. Whenever there is any deviation in the predefined parameter limits, the controller will automatically operates the system to adjust the conditions to required level. If the moisture content in the soil is less, then the pump is turned on to supply the required level of water to plants. Similarly the light requirement sensed by LDR is less than the defined value then the roof shutters will be opened to provide the necessary light levels. Servo motors are used to operate roof shutters in the prototype. In the same way, temperature and humidity conditions are monitored by DHT 11 sensor and coolers are operated accordingly. DC motor is considered as a cooler/fan in the prototype. Whenever the system is operated to maintain the defined level of conditions the farmer is informed through a message using GSM modem.

Fig 6:- Relay module

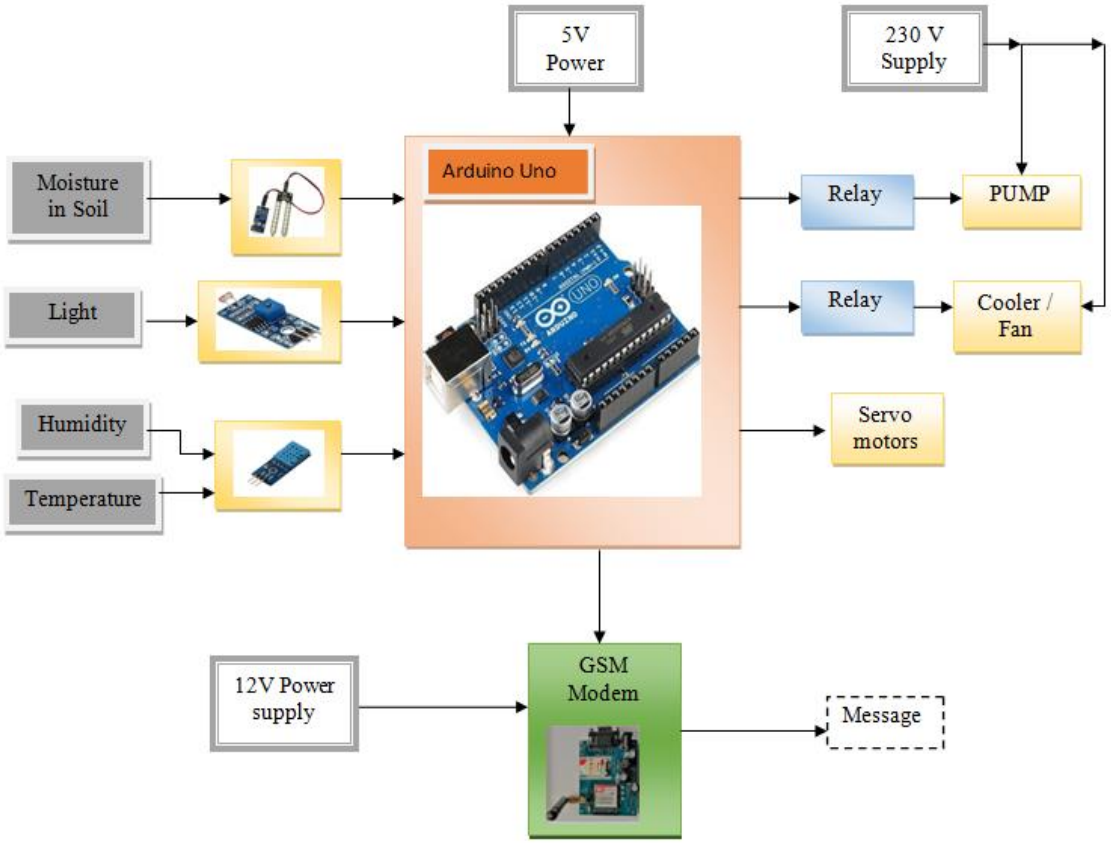

Fig 7:- Block Diagram

Fig 8:- Prototype Model

IV. RESULTS AND DISCUSSION

The system developed produces optimal results for effective maintenance of controlled conditions in the polyhouse. Pump is turned on automatically when the moisture content in the soil is less than the predefined value and simultaneously the farmer received message related to it. Fig.9 and Fig.10 shows the message received for water pump operation. Similarly farmer received messages about the working status of cooler and roof openers.

Fig 9:- Figure showing message received during pump ON condition

Fig 10:- Figure showing message received during Pump off condition

V. CONCLUSION

With the developed system using IoT, polyhouse is made smarter that takes care of controlled conditions automatically without any manual intervention. With this manual errors can be reduced in monitoring polyhouse conditions and also farmers can achieve high productivity. IoT being the latest emerging technology helps to improve quality and quantity of polyhouse yield.

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