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GREENHOUSE AUTOMATION USING GSM AND ARDUINO WITH SOLAR POWER SUPPLY

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Abstract: Food security is one of the major rising issues as the human population is larger and the land available for cultivation is smaller, as well unassured affairs happened often in society especially in the current CoVID-19 rapidly spread days. To mitigate this condition, further improve the yields and quality of food, this paper proposed a smart and low-cost greenhouse monitoring and control system, which mainly consists of sensors, actuators, LCD display and microcontrollers. DHT11 sensor is used to get the surrounding temperature and humidity in the greenhouse, and Arduino UNO is used as the main microcontroller. Some other facilities such as fan and heater are used to adjust the inside environment. The system could monitor the growth environment continuously with Internet-connected, the monitoring data is transmitted and stored in the ThingSpeak cloud, the users can visualize the live data through a webpage or phone APP in real-time. If the environment condition is out of the predefined level, the environment is monitored continuously, and the system can be adjusted automatically. This system can be deployed in the greenhouse simply and maintain the greenhouse environment in a normal range dynamically and continuously.

***Index Terms*: IoT, Sensors, Smart Farming, Greenhouse Farming, Agriculture.**

I INTRODUCTION

As urbanization is continuously expanding, resulting in a huge decrease in arable land, the rapid growth of human population has increased the demand for food as well. The traditional agriculture method is not satisfied with current demands [1]. The problem of food for humans is becoming more and more serious. Food security is still a main issue in current days, it is an integrated and long-term task to deal with not only for agriculture but also for political will [2]. Climate change has resulted in severely damaging agroecosystems of the Loess Plateau in China, further aggravating the loss of soil and crop yields [3]. The living standards of people are greatly affected. The traditional farming model requires more land and manpower to manage, so traditional farming along could not be sufficient and resolve food security problems, it requires to apply of modern technology especially the Internet of Things (IoT) to improve it in this digital age.

In nowadays, the greenhouse is applied widely in the countryside to plant crops or vegetables for the whole year regardless of the seasons. It has heat-keeping, anti-coldness, and transparency characteristics. The main significance of greenhouse is the climate inside can be controlled at a suitable level constantly of the specific plant favorable. Some important nursery factors such as temperature, humidity, soil moisture, pH, light intensity et al [4]. Along with the yield prediction character, the most efficient production of the greenhouse could be possible with the help of advanced technology. Researchers and Engineers use Internet of Things (IoT) and other modern technologies to make it realize. With the popularity of smartphones, farmers could use phone to monitor and control the greenhouse in real-time without extra human intervention [5]. IoT technology applied in agriculture is a developing trend, the potential benefits not only expand the yields and quality of the planting crops but also reduce farmers' burden and improve income

It is important to apply smart greenhouse technology in urban areas. An Arduino uno based smart greenhouse prototype was designed and implemented, the greenhouse environment is monitored in real-time and can be accessed through an Android application. The user also could use the Android phone to manually control the inside environment remotely. The prototype was examined and highlighted that it could improve the yields of plants [6]. An STM32-based temperature monitoring and control system was developed; this development proved that smart agriculture could ease the management burden and increase the yields of crops [7]. Artificial intelligence (AI) technology is playing an important role in the smart greenhouse as well. An improved fuzzy neural network algorithm was designed to fit the intelligent greenhouse development. It is a trend that different technologies such as 5G, AI, NB-IoT, and Cloud should be applied to make the greenhouse more sustainable and smarter [8]. The greenhouse can be designed and implemented in a modern way by using different kinds of technologies. The rest of this paper is divided into sections mentioned below: Section II is about the literature review, it summarizes the corresponding works of the smart greenhouse. In Section III, the proposed system and experimental setup are presented in detail. In Section IV, the results of this research project are described. Finally, the conclusion is summarized in Section V.

II. LITERATURE REVIEW

Though IoT technology is widely used in different fields, such as smart parking systems, smart healthcare and so on, it still does not apply in large-scale agriculture in many countries especially developing countries. A Lora-based small-scale smart greenhouse was developed; the system could monitor soil moisture, light strength and temperature; the data was transmitted to the Tata server; and the data could be retrieved from Microsoft Azure Cloud and displayed on the developed webpage through the network [9]. In order to further efficient management of farming, a camera was deployed not only to monitor the growth conditions of plants, but also to check which disease the crops have by using image processing technology [10]. An Esp8266-based smart and automated controlling agriculture system was designed, four parameters: temperature, humidity, light and soil moisture were monitored in real-time, the data was transferred to the customized webpage through a wireless network, the system also could adjust its environment conditions automatically if one factor was out of the predefined threshold so that it could maintain the optimum environment for the crops to grow rapidly [11]. A data analysis platform based on docker technology was designed and implemented; this platform was deployed simply regardless of the underlying operating system [12]. Data analysis is an important process after data gathering in IoT technology.

III. EXISTING SYSTEM

In previous system they were using temperature sensor so by this system we can't monitor all other parameter like if it is dark or not, if soil is dry or wet and we never store the data. So that's why we are using this greenhouse monitoring system and controlling system. Here we are using LDR for light detection, soil moisture sensor for monitoring moisture in soil, DHT11 for temperature and humidity and GPRS and GSM for sending SMS and uploading data on cloud

IV. PROPOSED SYSTEM

Internet of things (IoT)-based technology applications are a tendency to make everything intelligent and facilitate. In this project, a low-cost and sustainable smart greenhouse monitoring and controlling system for agriculture is designed and developed. The architecture and experimental prototype setup of this research project are presented in this section

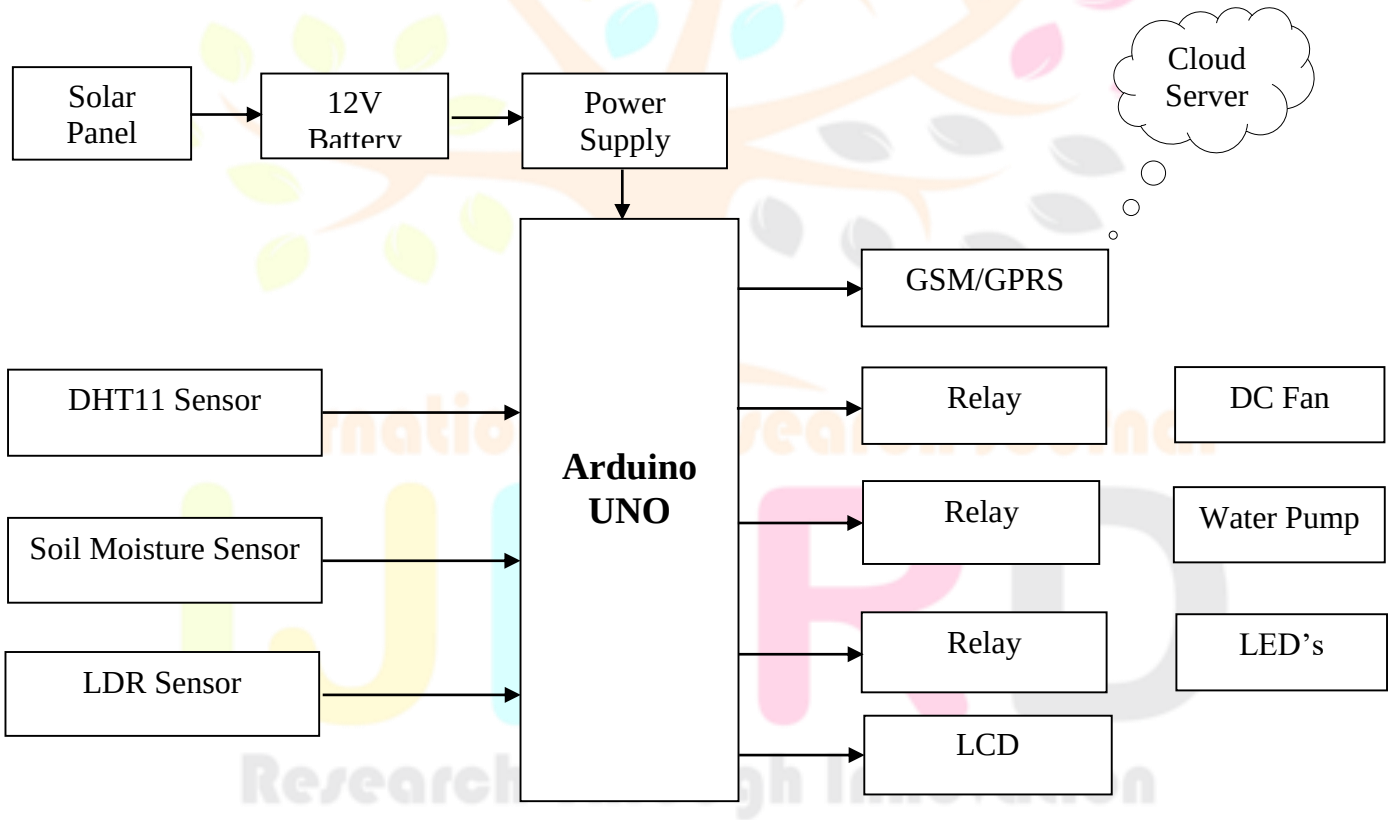
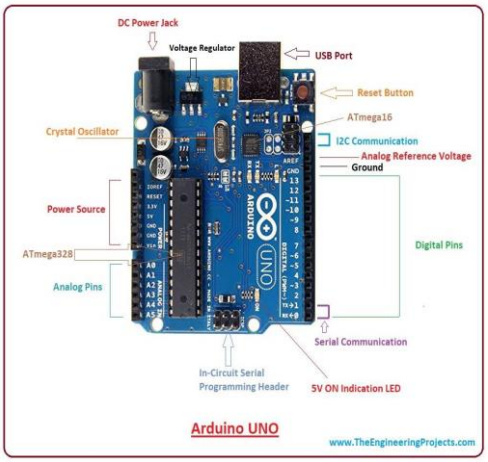


Fig: Block Diagram

Arduino Uno is a microcontroller board developed by Arduino.cc which is an open-source electronics platform mainly based on AVR microcontroller Atmega328.The current version of Arduino Uno comes with USB interface, 6 analog input pins, 14 I/O digital ports that are used to connect with external electronic circuits. Out of 14 I/O ports, 6 pins can be used for PWM output.



In this project, the greenhouse environment not only can be monitored in real-time, but also it can adjust the environment conditions: temperature and humidity at a suitable level automatically and continually. If the temperature is lower than the predefined threshold, the heater would turn on, if the temperature is higher than the preset temperature or the humidity is outside the threshold, the fan would turn on, otherwise, the fan and heater are turned off. Users can remotely access the monitoring data by phone or webpage through the network wherever the users are. The proposed architecture of the smart greenhouse system is illustrated in Fig. 1

Soil Moisture Sensor

- The soil moisture sensor is one kind of sensor used to gauge the volumetric content of water within the soil. As the straight gravimetric dimension of soil moisture needs eliminating, drying, as well as sample weighting. These sensors measure the volumetric water content not directly with the help of some other rules of soil like dielectric constant, electrical resistance, otherwise interaction with neutrons, and replacement of the moisture content.

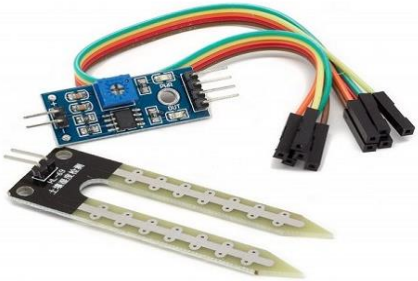


Fig: Soil Moisture Sensor

DHT11 SENSOR

The DHT11 is a basic, low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and spits out a digital signal on the data pin (no analog input pins needed). It's fairly simple to use, but requires careful timing to grab data. The only real downside of this sensor is you can only get new data from it once every 2 seconds.

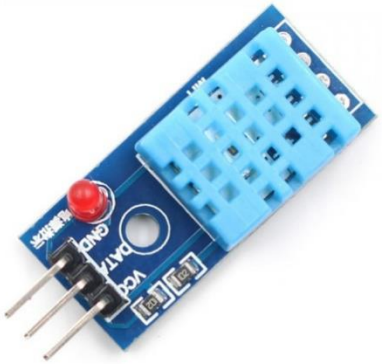


Fig: DHT11 SENSOR

LDR Sensor

A Light Dependent Resistor (also known as a photoresistor or LDR) is a device whose resistivity is a function of the incident electromagnetic radiation. Hence, they are light-sensitive devices. They are also called as photoconductors, photoconductive cells or simply photocells. They are made up of semiconductor materials that have high resistance. There are many different symbols used to indicate a photoresistor or LDR, one of the most commonly used Symbol is shown in the figure below. The arrow indicates light falling on it.

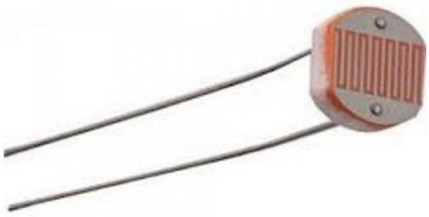


Fig: **LDR Sensor**

RELAY

A relay is an electromagnetic switch that is used to turn on and turn off a circuit by a low power signal, or where several circuits must be controlled by one signal.

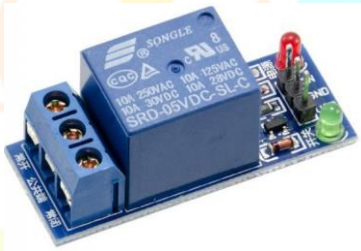


Fig: Relay

DC WATER PUMP

A High Performance non submersible dc water pump is a device which has a hermetically sealed motor close-coupled to the pump body. Some part of assembly is submerged in the fluid to be pumped. The main advantage of this type of pump is that it prevents pump cavitations a problem associated with a high elevation difference between pump and the fluid surface.

Fig: DC WATER PUMP

16*2 LCD

The term LCD stands for liquid crystal display. It is one kind of electronic display module used in an extensive range of applications like various circuits & devices like mobile phones, calculators, computers, TV sets, etc. These displays are mainly preferred for multi-segment light emitting diode and seven segments. The main benefits of using this module are inexpensive; simply programmable, animations, and there are no limitations for displaying custom characters, special and even animations, etc.

Fig: 16*2 LCD

GSM(Global System For Mobile Communication):

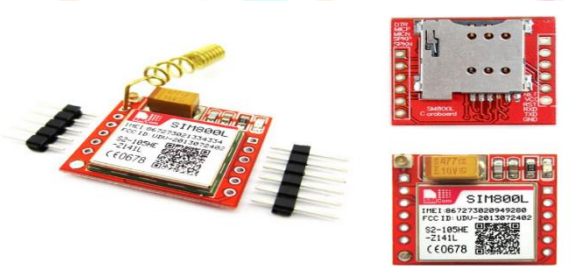


Fig: Global System for Mobile Communication

A GSM modem is a device which can be either a mobile phone or a modem device which can be used to make a computer or any other processor communicate over a network. A GSM modem requires a SIM card to be operated and operates over a network range subscribed by the network operator. It can be connected to a computer through serial, USB or Bluetooth connection.

12V battery

- A rechargeable battery is an energy storage device that can be charged again after being discharged by applying DC current to its terminals.
- Rechargeable batteries allow for multiple usages from a cell, reducing waste and generally providing a better long-term investment in terms of dollars spent for usable device time. This is true even factoring in the higher purchase price of rechargeable and the requirement for a charger.A rechargeable battery is generally a more sensible and sustainable replacement to one-time use batteries, which generate current through a chemical reaction in which a reactive anode is consumed. The anode in a rechargeable battery gets consumed as well but at a slower rate, allowing for many charges and discharges.

Fig: 12V battery

Solar panels

Solar panels are those devices which are used to absorb the sun's rays and convert them into electricity or heat. Description: A solar panel is actually a collection of solar (or photovoltaic) cells, which can be used to generate electricity through photovoltaic effect.

Fig: Solar Panels

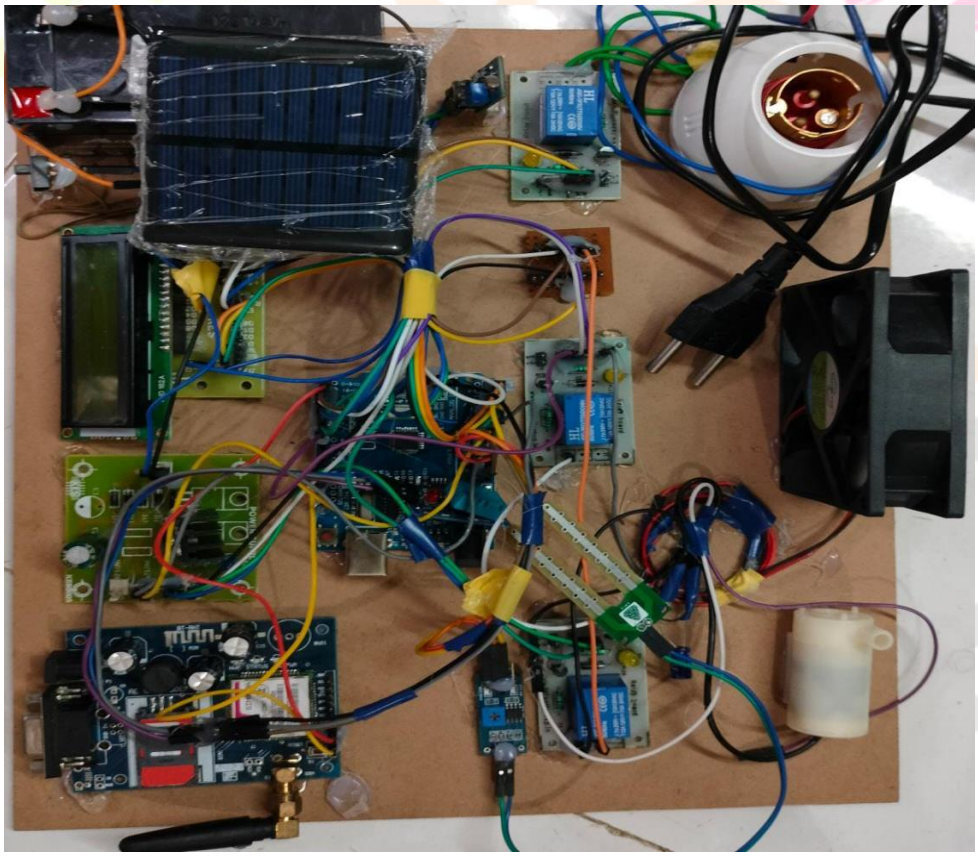
Advantages of Proposed method:

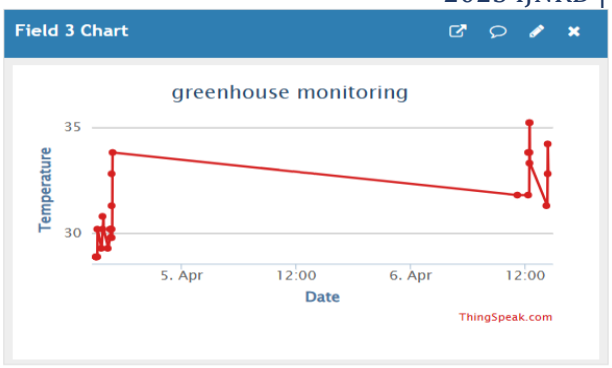
We can measure Temperature value and Humidity value and Moisture value in lands . Controlling all the high temperature. For good for farming.

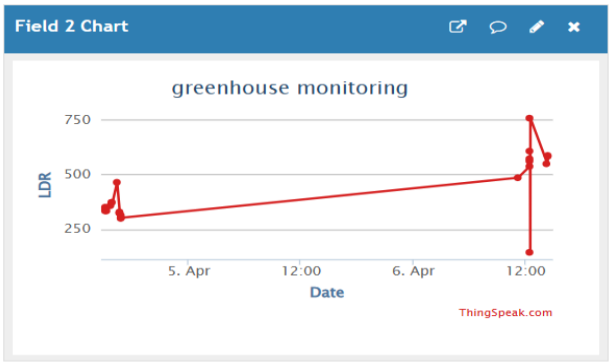
Applications:

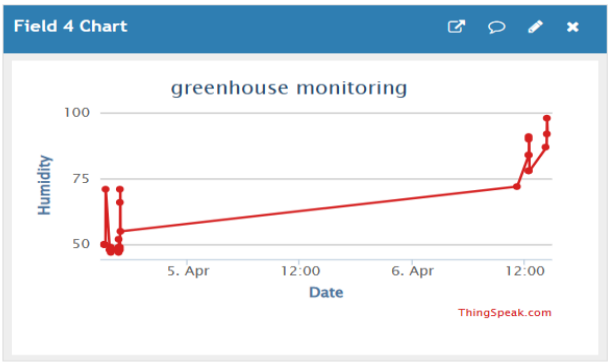
- High Temperature Areas
- Agriculture Areas

V. RESULTS









VI. CONCLUSION

The developed cost effective greenhouse model can be used to monitor and control temperature, light intensity, humidity and soil moisture of a greenhouse in order to increase productivity in farming especially in countries like Bangladesh where there is ample risk of insect infestation, harsh climate and increasing demand of food with the decrease of fertile land.

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