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IOT Based Green House Monitoring and Controlling with Arduino

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Abstract: Greenhouses offer a controlled environment for growing plants. For a green house system to function effectively, it needs to consistently oversee and control various environmental elements such as hotness, dampness, soil moisture, light strength, and soil p H. The main objective of the project is to create a cost-efficient design to promote optimal plant growth and yield. Arduino system that allows for constant updating and adjustment of environmental parameter values. The DHT 11,s and acidity, LDR plus dryness are the important sensors in the project, measuring moisture, temperature, water purpose, light strength, and earth wetness. Android smart phones receive environmental data both offline and online. The present situation of the surrounding circumstances is displayed in an SMS sent via a GSM modem. The user gets atext when this sensor value goes above a specific threshold. Farmers can observe and control their green houses from anywhere. SMS commands can be used to change environmental factors like the fluid pump, motor breathe, refrigeration fan, emission fan, and manufactured illumination fluids pump, engine breathe, cooling fan, exhaust fan, and false lighting. To prevent SMS charges, data parameters are sent to mobile phones using Ethernet. Using Ethernet, all environmental data is sent to the machine ad kept on the data file in this way, the Android app allows the user to monitor andmanagesettings.

Keywords: Green house, Soil Moisture Sensor, Temperature and Humidity Sensor, LDR Sensor, Wi-Fi Module, Arduino Uno.

I. INTRODUCTION

Numerous factors in modern green houses must be observed and regulated to maintain the quality and quantity of plants. Nonetheless, in order for plants to grow optimally, several conditions need to be met including humid climate, soil moisture, temperature, light intensity, and soil pH. Therefore, a greenhouse screening and control structure utilizing sensors and Arduino has been developed. The project uses a microcontroller named Arduino. Arduino can control motors, lights, and other actuators while also getting input from various sensors. Four sensors employed are the pH, LDR, DHT11, ands and dryness detectors. The DHT11 sensor measures humidity or temperature, while a sand dampness detector calculates the fluid matter of sand. A pH detector can be utilized to determinethe pH of the sand. An LDR sensor can be used to calculatethe strength of light [1]. The Arduino is connected to a motorpump, coolant fan, ventilation fan, water pump, and artificial lighting as well [2].

Smart phones can access environmental parameters both online and offline. Surrounding data is transmitted to an Android phone through Ethernet and a GSM machine. The user can turn on the blower by transmitting a text after receiving a notification that the temperature has exceeded a set limit. By sending an additional text message, the cell phone user switches off the blower once the temperature meets the standard [3]. Once the humidity level exceeds a specific threshold, the mobile user can activate the ventilation fan by sending another SMS to the system. The cell phone owner switches off the ventilation blower by sending an additional information once the humidity level goes back to normal. The cell phone owners switch on the machine pump to spray acidic or alkaline solution if the soil pH exceeds a set limit, signaledby an SMS from the system. Likewise, if light levels drop below a certain point, the system alerts the user to turn on artificial lights via SMS. Ultimately, the system will alert the mobile user via SMS if the soil moisture sensor indicates dry soil, and the user can textback to activate the water pump. To reduce SMS expenses, all environmental data is transmitted to the server via Ethernet and kept in a data file. Consequently, the owner can oversee and control configurations via the Android app. Farmers are able to effectively oversee and control environmental conditions on their farms with significant support from this equipment. Farmers are notrequired to go to their farms. Changing any environmental factorcould pose a risk to individuals in biomedical industries and lead tofinancial damage in pharmaceutical and agriculture sectors. If these expenses are dealt with promptly, they can be avoided. The remainder of the document is structured as given in the segment II covers an synopsis of the system structure. The system flow chart is shown in Segment III. Segment IV provides reports and surveys. Ultimately, segment V includes final observations.

II. SYSTEM OVERVIEW

The current greenhouse screening includes two parts: one forcontrol and the other for monitoring. The monitoring system includes a DHT11 detector an LDR detector, a soil moisture detector, and apH sensor for monitoring environmental conditions. In addition, an Ethernet link and a GSM machine areapplied to transmit surrounding data to an smart application. Cooling fans, exhaust systems, water pumps, artificial lighting, and motor pumps make up the regulating component. The system is centered around the Arduino microcontroller. Figure1 displays the sketch of the green house screening and viewing.

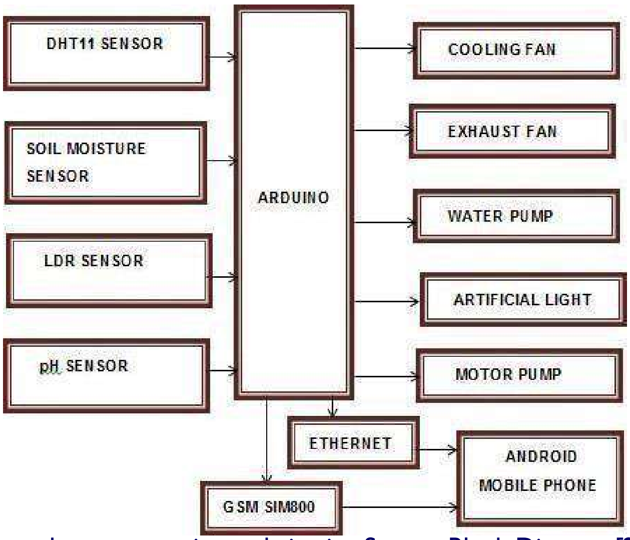

Fig.1. Green house screening and viewing System Block Diagram [2]

Arduino

The software is a small machine that is open-source. The AT mega 328P microcontroller is what constitutes it. It provides options for an output voltage of either 3.3V or 5V. It utilizes acoaxial cable for receiving voltage input from a switchable power source or a USB cable for receiving voltage from a computer. The board can potentially access X information. Sketches are uploaded by utilizing the Arduino IDE. Arduino Uno, Arduino Mega, Arduino Yun, and other board styles are included in the array of available types. A setup where an Arduino Uno body is taken. It is achievable and cost-effective [4]. Figure2 displays Arduino Uno.

Fig.2. Arduino Uno [4]

The Italian word "uno" has one meaning. It features an ICSPheader, a 16 MHz crystal oscillator, six analog input keys, a power connector, and 14 digital input or output keys. Operating voltage is 5volts, while7 to 12volts is the suggested input voltage [5].

Sensor

The DHT11 sensor, pH detector, LDR detector, and sand dryness detector are the four detectors that are employed.

DHT11 Detector

The DHT11 sensor is used to monitor both dampness and warmth. It is an in expensive ampness and warmth detector. It is very long-lasting, very efficient, and reliable. It has adryness calculating element and a rheostat for calculatinghotness and dryness, respectively [4]. The DHT 11 sensor is seen in Fig. 3.

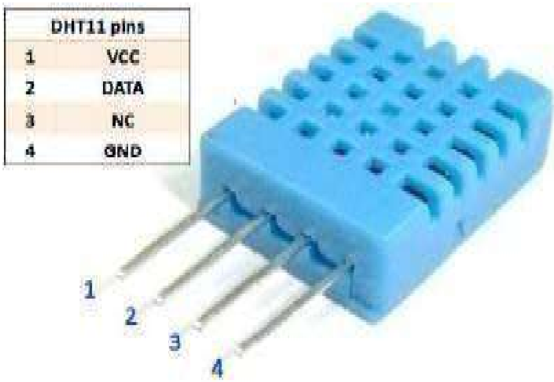

Fig.3. DHT 11Sensor [4]

One type of varying rheostat is a thermistor. A thermistor'sresistance changes as the hotness does. The humidity sensor part contains two electrodes separated by a substrate that retains moisture. Consequently, resistance in points of plates changes as dryness does. It is calculated on how the resistance changes. A 3.3V and a 5V operational voltage are used.
The following formula is used to get temperature from outgoing current:

Temperature = (Vout*100) / 5 ^{0}C (1)

The relative humidity may be determined from output voltageusing the followingequation:

RH= ((Vout/Vsupply)-0.16) / 0.0062% (2) [6]

Fig 4. Soil Moisture Sensor [7]

Soil Moisture Sensor

A To determine the wetness content, utilize soil moisture detector. To determine the liquid material, utilize a soil saturation detector. in the soil. An insulating substance securely separates the two metal rods in this soil moisture sensor [7]. Figure 4 displays a sensor for detecting soil moisture levels.

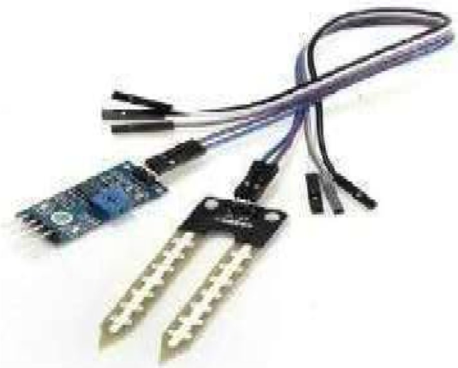

Fig.5. LDR Sensor Module

Resistance is measured as electricity is passed via the sand taking two metal plates. Resistance is strong when there is less water present than when there is more water. To adjust the sensor'ssensitivity, it also has a potentiometer. The features include an Arduino compatible interface, low power consumption, great sensitivity, and a 5V operational voltage [8].

LDR sensor module

The light intensity is measured using an LDR sensor module. It features output pins for both digital and a photoconductor is another term for an LDR. Cadmium sulfide (CdS) is taken to create LDR. Cadmium sulfide is applied to the conductive material in a zigzag pattern. The zigzag pattern is analog signals. LDR resistance drops as light intensity rises. LDR resistance rises with decreasing light intensity. The sensitivity of the LDR to light may be changed using the potentiometer knob on the sensor [9]. The LDR sensor module is shown in Fig.5.

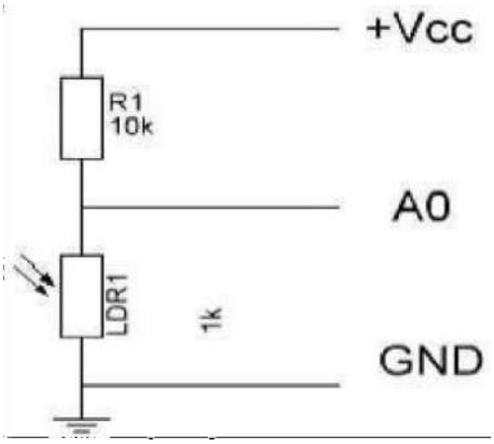

Fig. 6- circuit Diagram [9]

An parallel potential that is proportionate to the incoming light strength falling on the LDR is produced when the circuit issupplied with a 5V supply. The Analog to Digital Converter (ADC) included into the Arduino transforms analog voltages between 0 and 5 volts into digital values between 0 and 1023. The voltage divider in the circuit above consists of a resistor10KΩ at the top and an LDR at the bottom. Thus, the outcome of the voltage is: From (3)

VOUT=(5 *RLDR)/(10+RLDR) (4)

Designed to decrease dark current by increasing dark resistance [10].

RLDR = (10 times the output voltage) divided by (5 minus the output voltage) (3)

ADC considers 5V as 1023 and any voltage below 5V is proportional to the ratio of 5V to 1023.

VOUT divided by analog reading is equal to 5 divided by1023. VOUT= 0.0048875 * Analog reading (5)[7]

The following formula is taken to get the energy in Lumens by the LDR opposition:

Figure 6 displays a circuit with a light sensor.

Fig.7. pH Sensor [9]

Lux= 500/RLDR (6)(4) in(6)

Lux =500(5-VOUT)/(10*VOUT) (7)[7]

pH detector

A pH detector is utilized to determine the pH of the soil. Theacidity or alkalinity of a solution is indicated by its pH level. A pH detector consists of a pH plate and apH detector segment. Figure7 displays a pH detector[9]. The glass electrode and the reference electrode make up the pH probe's two electrodes [12]. The two electrodes consist of smallbulbs containing a silver chloride wire suspended in potassium chloride solutions. The electric field variance among a foreignmaterial and a familiar lipid in the glass electrode is calculated byan acid-base meter. A potentiometer is utilized in the pH sensor unit for calibrating the sensor's reading.

C.GSMSIM800

SIM.800 is a GSM machine that operates on four bands. Itfunctions from 850 to 1900 MHz and from 900 to 1800 MHz. Less power is utilized for sending data, SMS, and voice calls.It is very small in size. Connecting a GSM modem is easy touse. It has compatibility with Bluetooth. It operates with in arrange of 3.3 to 5volts. Refer to Figure 8 for the schematic of GSM SIM800 [11].

Fig.9. GSMSIM800. [11]

D Arduino Ethernet Shield

The internet may be accessed by the Arduino board withthe Arduino Ethernet Shield. It is built around the Ethernet chip Wiznet W5100. An internet protocol stack that supports TCP as well as UDP is offered by the Wiz Net W5100.Upto four socket connections can be made simultaneously using it. Table10 displays the Arduino Ethernet Shields [14].

III. SYSTEM FLOWCHART

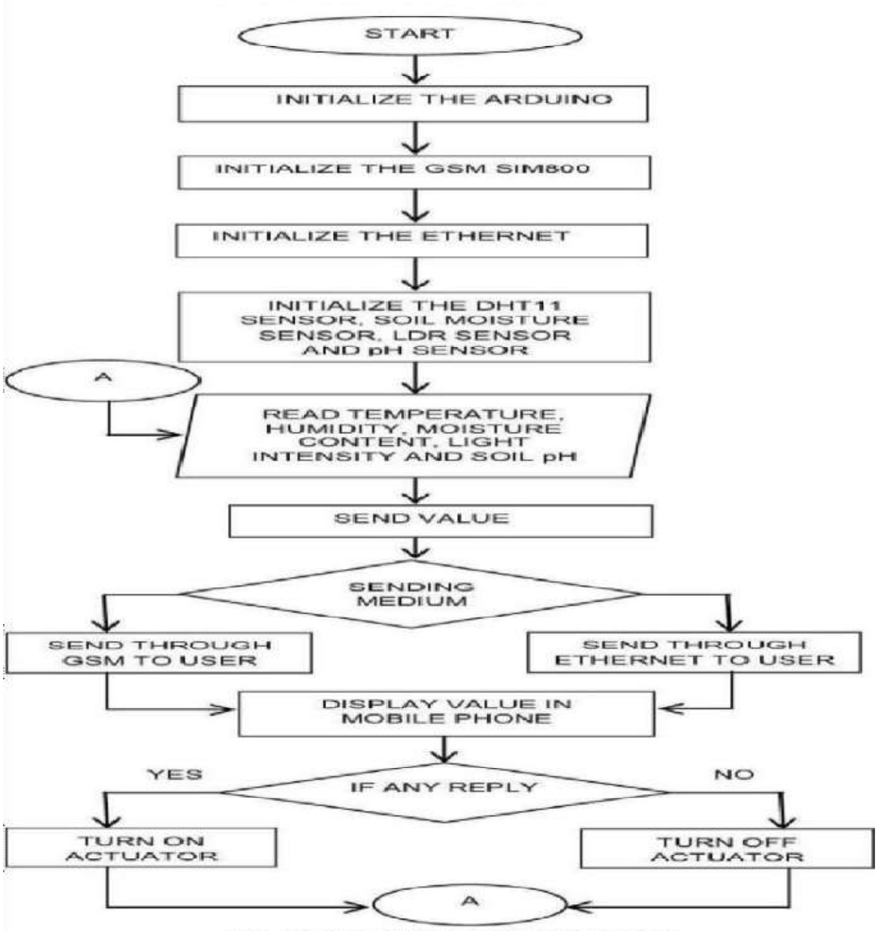

Fig. 10. Greenhouse System Flow Chart

The flow chart in Fig.10 [13] illustrates how the green house system behaves. By providing the necessary +5V power, the Arduino, Ethernet, D H T 11 sensor, soil moisture detector, L.D.R sensor, and pH sensor are configured. The necessary +12V electricity issupplied to the GSM800 to initialize it. When the sensor value rises beyond a certain threshold, the GSM800 notifies the user by SMS. Through the use an additional SMS, the user activates the actuator [15]. Through Ethernet, all surrounding condition are sentto the server and noted in the datafile. Thus, using an Android mobile application, the user may keep an eye on and adjust parameters.

III. RESULTS AND DISCUSSION

By allowing the required +5V potential, all components are activated. The DHT11 detector, pH detector, LDR detector, and sand moisture sensor are the four detector that are utilized. The Arduino is connected to a motor pump, soothing blower, ventilation blower, water pump, and human made illumination as well. The Android device obtains details about the environment through Ethernet connection. All environmental factors are transmittedvia Ethernet to a server, where they are stored in a database [16]. Therefore, by utilizing a smartphone application on anAndroid device, the owner can screen and modify settings. Amobile application for Android is currently in development. Users can login to the program by providing their identity and pass code. Pass code and identity are kept in the data case file. Additionally, a text detailing the current environmental parameters is sent using a Cell that supports GSM. Humidity and temperature are measured using the DHT11 sensor. Warm temperatures make leaves fade, which hinders crops' capacity to bear fruit. The soil in an overheated green house dries up more rapidly and requires more water. A monitoring system can notify users of potentially dangerous situations. When the temperature surpasses a certain threshold, the system sends an SMS to the smart phone owners, who activate the fan by sending the text "FANON". Whenever a smartphone owner initiates the text "STATUS," the current state of the surrounding conditions is conveyed to them. The fan is turned off by the mobile user by sending the text "FANOFF" whenever the hotness reaches the typical limits. The transpiration and photosynthetic processes of plants are impacted by high humidity. Transpiration helps plants get nutrients to the leaves after they receive fluid and mineral from the soil via the root [17]. An excessive amount of humidity slows down the process and stops nutrients from being absorbed. Plants are unable to cool ourselves if moisture is not released. The technology notifies the mobile user by SMS when the humidity reaches a predetermined level. The user then uses the SMS "EFANON" to switch on the exhaust fan. The mobile owners send the text "EFANOFF" to switch off the exhaust fan when moisture levels return to norm. Figure 11 depicts the operational component of the green house screening and viewing system.

Fig.11. Working Module of Green house screening & viewing [14]

The level of illumination is measured with LDR sensor. Theprocedure of photosynthesis slows down when the amount of light diminishes. The mobile user receives an SMS from the systemwhenever the light intensity falls below a certain threshold. The user responds with the SMS "LIGHTON" to turn on manmade illumination. The cellphone user sends the SMS "LIGHTOFF" toswitch off the artificial illumination when the glowing speed returns to normal. The wetness of soil is calculated with a sanddryness detector. Water is essential to the development of plants.If the sand detector detects no dryness in the soil, the devicetransmits a text to the cell phone owners, who activates the fluidmachine by sending the text "MOTORON".The mobile ownersends the SMS "MOTOROFF" to switch off the water pump whenever the humidity of the soil reaches the desired level [18]. A pH detector is utilized to know the pH of the sand. The pH rangeof a solution is a calculated of its alkalinity or acidity. Usually, the pH scale goes from 0to 14. A solutionis considered to be alkaline if its pH level is above 7, while it is classified as acidic if it falls below 7. Plants require soil that is acidic. The majority of plants do wellwhen the pH level is between 5.5 and 7.5. The soil can become stickyand hard to work with if it has a high level of acidity or alkalinity.Excessive rain, use of fertilizers, plant roots, and acid rain are the main factors that can increases oil pH levels. Metalion levels become dangerous in highly acidic conditions. The most hazardous metal is aluminum, although elevatedconcentrations of iron and chemicals may too impeded living development. Root development is in hibited by aluminum. Thefewer resources of some nutrients, including calcium, magnesium, phosphorus, and molybdenum, can be caused by heavy soil acidity. Lime ($CaCO_3$) is applied to acidic soil to raise its pH. Calcium isfound inlime.[20] Certain metals, such iron, manganes, zincate, and aluminum, precipitate out of the soil solution and become unavailable to plantswhen the pH of the soil rises. High alkaline environments lead to areduction in mineral absorption and nutritional deficits. Poor plant development is mostly caused by nutrients shortage. Alkaline soils have lower phosphorus availability, and excessive calcium content can prevent the absorption of magnesium and potassium.

Acidifying fertilizers, such ammonium sulfate, are applied toalkaline soil to lower its pH. The mobile user activates the motor that throws acid or alkaline solutions by transmitting the text "ACIDIC Sol ON" to the device whenever the pH of thesoil above a certain threshold. Figures 13 and 14 illustrate the regular Arduino device outcome and the mobile outcome of the green house screening and viewing module, respectively.

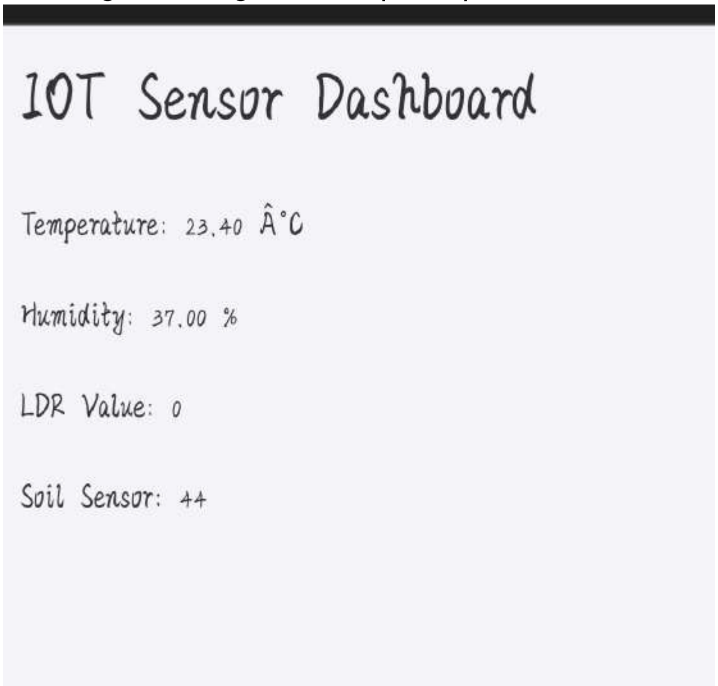

Fig.13. Arduino regular screening Outcome

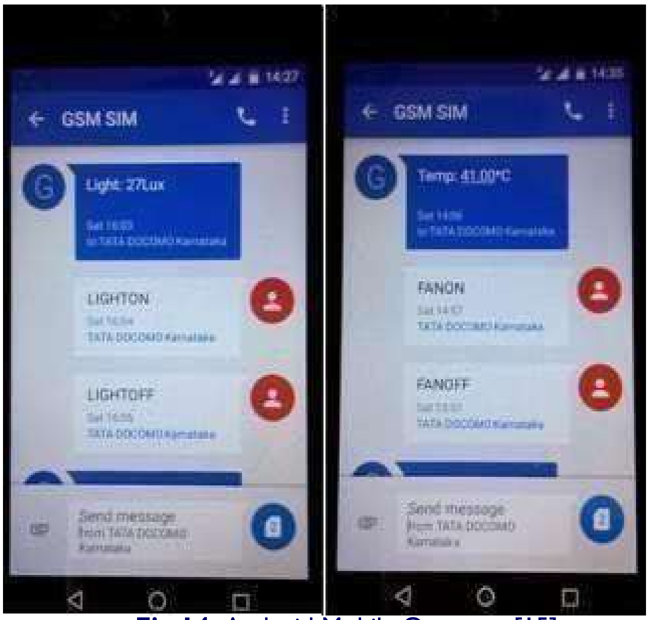

Fig.14. Android Mobile Outcome [15]

IV. CONCLUSION

A system for monitoring and managing green houses is created using Arduino. The primary sensors utilized in this endeavor are the DHT11 sensor, the soil dampness detector, the LDR detector,and the pH sensor. These sensors supply accurate values for hotness, dryness and dampness matter, light strength, and sand pH, respectively. This technology uses the networks of GSM to provide for easy SMS monitoring and remote monitoring of greenhouseconditions. In order to avoid paying for text, Ethernet is utilized totransfer the data condition to mobile phones. The design lowers complexity, maintenance requirements, and electrical consumption. This project may be applied in nurseries, botanical centers, and farming areas

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