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IOT Based Low Cost Irrigation Model

Ashish Kumar[1], Pawan Kumar Patnaik[2] , Sargam Gupta[3]

[1]Mtech. Scholar Department of Computer Science and Engineering, Bhilai Institute of Technology, Durg, India.
[2]Associate Professor Department of Computer Science and Engineering, Bhilai Institute of Technology, Durg India.
[3]Assistance Professor Department of Computer Science and Engineering, Bhilai Institute of Technology,Durg, India.

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Abstract - *The purpose of the paper is to provide a low-cost irrigation model for farming fields and make a system to monitor some parameters required for a successful installing a low-cost irrigation system. This system not only solved the cost of the system but also provides necessary data that is required to know about the field area of the farmer. This paper also includes the purposed concept of irrigation systems in which this paper publish how important to be automated irrigation is needed to farmers can achieve their goal and helps to reduce the burden from them.*

Key Words: Irrigation, IoT (Internet Of Things), NodeMCU, Sensor, Actuators, Cloud, Blynk Etc.

1. INTRODUCTION

For any living being, water is the second most important material after oxygen. Water supply for plants, Trees, Flowers, and Farming fields is called an irrigation system. Irrigation needs continuous monitoring of the water level and soil moisture of plants. In Modern days costing of every item has increased due to world order, pandemic, recession, disturbed supply chain, chip shortage [1], and these busy schedules people don't have sufficient time to monitor every single plant in the field, but there are hopes on IoT technologies [2] that can reduce the burden that generated due lack of time and money.

In India, the country depends on farming for a huge amount of GDP contribution and at least 70% of people [3] depend on farming for their living. The country not only produce food for itself but also to export other needy countries and donation, charities in poor countries through International organizations but remain in this position country have to enhance productivity with the help of technology. For high-quality products and to reduce the burden from the farmer needs to have a good irrigation system [4] because for high productivity water supply is the most important thing in farming.

Irrigation needs to start water pump on time if soil moisture reduces this concept [5] is used to make a system using Internet of Things technology. The project aims to make a low-cost irrigation system using IoT technologies.

It is necessary to monitor the environmental conditions in and around the field and soil moisture. The Internet of Things (IoT) has the potential to make the device for irrigation at a very low cost with the number of sensors [6] to collect data from the soil, weather, light intensity, raindrop, etc.

The parameters that have to be properly monitored are soil characteristics, weather conditions, moisture, temperature, etc. This can be possible by using IOT technology with sensors and actuators that can sense the field condition and perform the certain task accordingly sensors are used to monitor and collect information about the field conditions, and those data are collected to make a low-cost irrigation system.

2. PRELIMINARIES

For the implementation model, it needs to follow some steps one by one.

Step 1

Firstly one breadboard is required to arrange all the equipment into one system. The types of equipment are sensors like Soil moisture sensor, DHT11 sensor, LDR sensor, Water sensor, Actuator like Relay module is needed to perform the task, microcontroller board NodeMCU and connecting wires with the USB cable to connect the system to the computer and motor pump for irrigation. Connection of all the sensors to the breadboard as per circuit diagram.

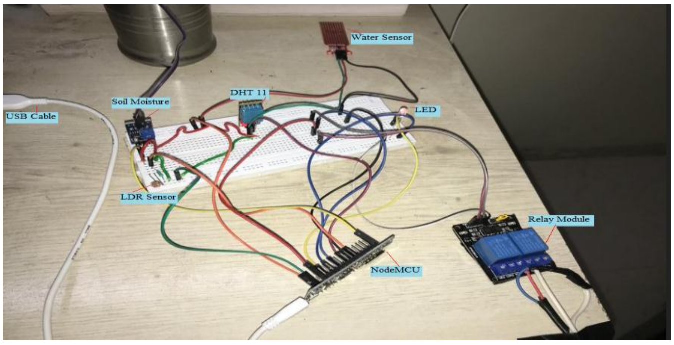


Fig 2.1

Step 2

Create a connection of sensors, and actuator, on the breadboard to the NodeMCU with connecting wires called model. That model is now connected to the computer through a cable. Open the computer start downloading and install the Arduino IDE to write a code. On IDE create a sketch file and write a code according to the performance we want from the model. Before writing a code you have to include libraries and select port and board for a controller.

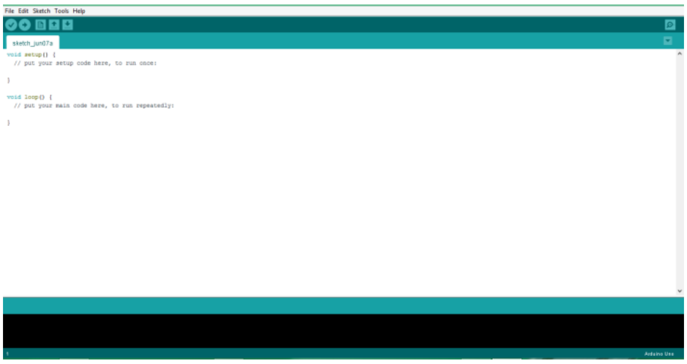


Fig 2.2

Step 3

In the IDE there has a working area where we can write a code has two parts one is void setup we have to explain the setups like sensors, and actuators with NodeMCU's pin address and the other is the void loop where we write a code if we want to run that code number of times and don't want to write again and again this part saves the code length. From writing a code firstly we have to include some header files then write code in the void setup part after setup a part of the code write to the void loop and save the code. After saving check the connection of the USB to the computer and also check the software tool section if the right board is selected or not then verify and compile the code. After a successful compile of code upload that code and check the NodeMCU, it starts blinking which means the code is sent to the model through NodeMCU. Then open the serial monitor it starts receiving data and showing in the serial monitor itself.

Step 4

In this model, we have used Blynk Cloud to monitor the data that we are getting from the sensors. Blynk is used for IoT purposes to visualize the data systematically with their tools. But before we need to include some libraries for blynk **BlynkSimpleEsp8266.h** and also need Template ID, Device name, Auth Token, SSID, and Password to connect wifi module of NodeMCU. Auth Token, Template ID, and Device name are given to the Blynk web after creating a new Device. It needs to create metadata for data to visualize. The SSID and Password mentioned on the code should be the same as the device's SSID and Password which have been used to visualize the data that came from sensors.

Step 5

The model has to install in the area where it may collect real-time data from the environment like temperature, humidity, soil moisture, and raindrop value. And those data may send to the relay module to operate the motor pump if moisture is less than the predefined value through the NodeMCU microcontroller. The microcontroller controls and evaluates those data into the information and also seen by the serial monitor if reading is taken from the sensors. The actuator performs the task given by the microcontroller.

3. ALGORITHM FOR SENSING ENVIRONMENTAL PARAMETERS

For writing a code system has to install Arduino IDE. In this IDE first open file select preferences then put the URL into the Additional board manager and click OK. Select Port and Board from Tools. Include and manage libraries from sketch.

In code, you have to include the libraries for sensors, and software that you used in a particular project we need DHT11, Blynk, and ESP8266 module libraries to include.

```
#include <ESP8266WiFi.h>
#include <BlynkSimpleEsp8266.h>
#include <DHT.h>
```

Fig 3.1

We are also using Blynk cloud to visualize the data from a sensor to consumers' mobile and desktop so we have to define the Template ID, Device name, and Auth token to connect with Blynk cloud.

```
#define BLYNK_TEMPLATE_ID "TMP[redacted]m"
#define BLYNK_DEVICE_NAME "Low Cost Irrigation Model"
#define BLYNK_AUTH_TOKEN "MGY[redacted]SW4ozM"

#define BLYNK_PRINT Serial
```

Fig 3.2

As consumers, SSID and Password mention SSID and Password.

```
char auth[] = BLYNK_AUTH_TOKEN;

char ssid[] = "Ashish sahu";
char pass[] = "ashish12";
```

Fig 3.3

In void setup code for begin all the sensors, software, wifi, and serial monitor and also for PinMode used for sensors and actuators.

```
void setup()
{
  // Debug console
  Serial.begin(9600);

  Blynk.begin(auth, ssid, pass);

  dht.begin();

  pinMode(soilmoisturepin, INPUT); //SoilMoisture

  pinMode(relaypin, OUTPUT); //Relay


  pinMode(ldrpin,INPUT); //LDR
  pinMode(ledpin, OUTPUT);

  pinMode(raindroppin, INPUT); //RainDrop

  // Setup a function to be called every second
  timer.setInterval(3000L, sendSensor);
}
```

Fig 3.4

In void loop sensors sense the environment condition continuously in a loop.

```
void loop()
{
  Blynk.run();
  timer.run();
}
```

Fig 3.5

Finally in void send sensor codes for a sensor to read data and actuator performs when condition meets, print in serial monitor also print into Blynk cloud.

```
float h = dht.readHumidity();
float t = dht.readTemperature();

  Blynk.virtualWrite(V5, t);
  Blynk.virtualWrite(V6, h);
```

Fig 3.6

In this project soil moisture senses the value of moisture. If moisture level drops below the predefines value then it trips the relay module which is connected to the water pump then the water pump starts. The flow of water penetrates and consume by the soil then moisture level increases and is measured by the soil moisture. If the moisture value decreases the predefined value then it trips the relay to stop the water pump. This project also has DHT11 for Humidity and Temperature, a Water sensor for Rainwater drop sensing, an LDR sensor for sunlight intensity sensing, And a relay module to ON/OFF the water pump.

4. RESULT AND DISCUSSION

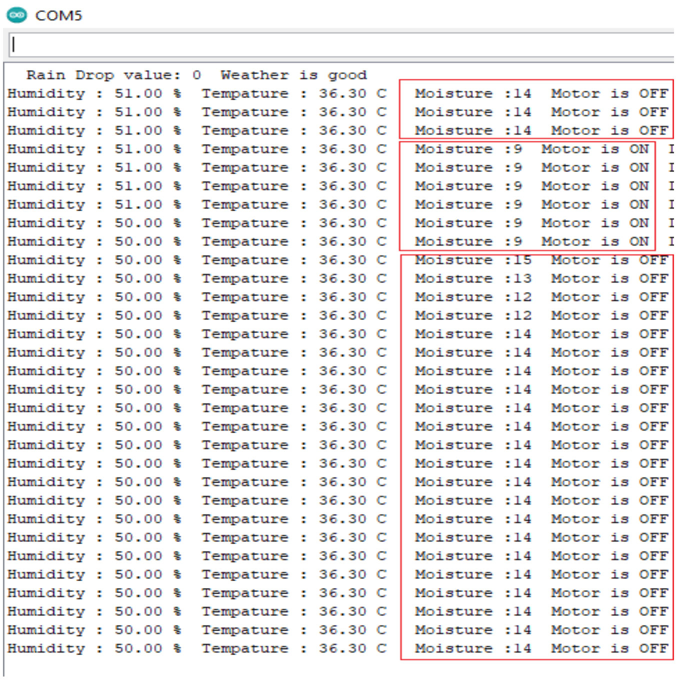
The sensor data are observed by Serial Monitor and Blynk as given in fig 4.1 motor pump starts if the moisture level decreases and it detects the value of Temperature, Humidity, Moisture, water drop, and Light Intensity with the cost of 945₹ only. It is affordable to the poor formers.

Table 4.1: Cost estimation

Sr. No.	Devices	Cost
1.	NodeMCU	295 ₹
2.	Relay Module	120 ₹
3.	DHT11	90 ₹
4.	Soil Moisture	85 ₹
5.	Raindrop Sensor	80 ₹
6.	LDR	10 ₹
7.	LED	5 ₹
8.	Water Pump	110 ₹
9.	Breadboard	80 ₹
10.	Resistors	10 ₹
11.	Connecting Wire	40 ₹
12.	Misc.	20 ₹
	Total	**945 ₹**

Below fig 4.1 and fig 4.2 are from the serial monitor has shown the result from sensors connected to the microcontroller, sensors named DHT11 show Humidity and Temperature value, soil moisture sensor show moisture value, LDR sensor shows Light intensity value, and water sensor shows rain drop value. Here only the soil moisture sensor is connected to the analog pin because only one analog pin is available in the NodeMCU microcontroller, so it shows in an analog manner. Other sensors like LDR and water sensor are connected to the digital which have only two output that is low and high (0 and 1023). Only the DHT11 sensor has a capability that shows values in an analog manner even if it is connected to a digital pin, it shows two different parameter values which are temperature and humidity.

Here temperature and humidity values are coming from the environment directly. The soil moisture sensor is inserted into the soil which measures the permittivity of material that is accountable for the moisture level of the soil. Soil moisture sensor senses moisture of soil and it operates the water pump as ON if the moisture level is below the predefined value and as of it moisture level is above the predefined value. LDR sensor measures the light intensity for plants. And a water sensor measures the rain drop like raining or good weather.


```
COM5
 Rain Drop value: 0  Weather is good
Humidity : 51.00 %  Tempature : 36.30 C  Moisture :14  Motor is OFF
Humidity : 51.00 %  Tempature : 36.30 C  Moisture :14  Motor is OFF
Humidity : 51.00 %  Tempature : 36.30 C  Moisture :14  Motor is OFF
Humidity : 51.00 %  Tempature : 36.30 C  Moisture :9  Motor is ON  I
Humidity : 51.00 %  Tempature : 36.30 C  Moisture :9  Motor is ON  I
Humidity : 51.00 %  Tempature : 36.30 C  Moisture :9  Motor is ON  I
Humidity : 51.00 %  Tempature : 36.30 C  Moisture :9  Motor is ON  I
Humidity : 50.00 %  Tempature : 36.30 C  Moisture :9  Motor is ON  I
Humidity : 50.00 %  Tempature : 36.30 C  Moisture :9  Motor is ON  I
Humidity : 50.00 %  Tempature : 36.30 C  Moisture :15  Motor is OFF
Humidity : 50.00 %  Tempature : 36.30 C  Moisture :13  Motor is OFF
Humidity : 50.00 %  Tempature : 36.30 C  Moisture :12  Motor is OFF
Humidity : 50.00 %  Tempature : 36.30 C  Moisture :12  Motor is OFF
Humidity : 50.00 %  Tempature : 36.30 C  Moisture :14  Motor is OFF
Humidity : 50.00 %  Tempature : 36.30 C  Moisture :14  Motor is OFF
Humidity : 50.00 %  Tempature : 36.30 C  Moisture :14  Motor is OFF
Humidity : 50.00 %  Tempature : 36.30 C  Moisture :14  Motor is OFF
Humidity : 50.00 %  Tempature : 36.30 C  Moisture :14  Motor is OFF
Humidity : 50.00 %  Tempature : 36.30 C  Moisture :14  Motor is OFF
Humidity : 50.00 %  Tempature : 36.30 C  Moisture :14  Motor is OFF
Humidity : 50.00 %  Tempature : 36.30 C  Moisture :14  Motor is OFF
Humidity : 50.00 %  Tempature : 36.30 C  Moisture :14  Motor is OFF
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Humidity : 50.00 %  Tempature : 36.30 C  Moisture :14  Motor is OFF
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Humidity : 50.00 %  Tempature : 36.30 C  Moisture :14  Motor is OFF
Humidity : 50.00 %  Tempature : 36.30 C  Moisture :14  Motor is OFF
```
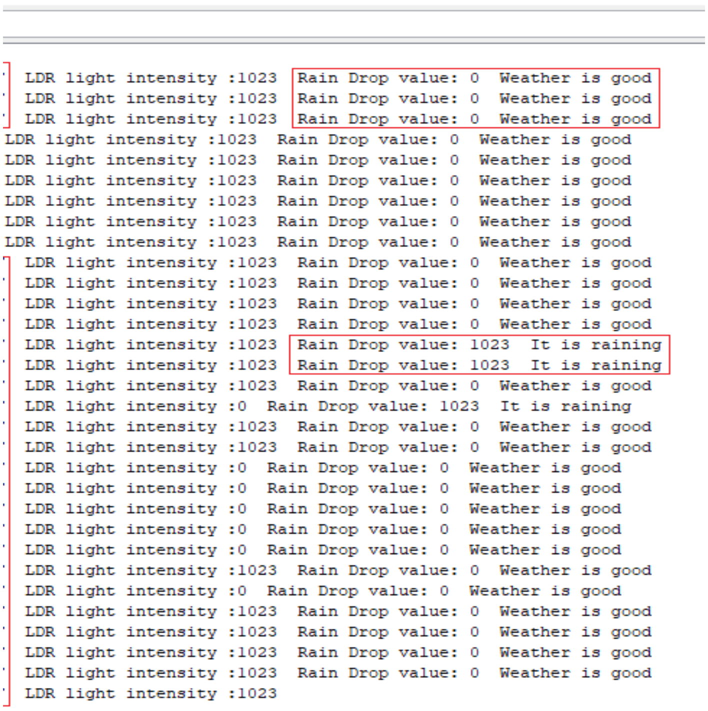

Fig.4.1


```
LDR light intensity :1023  Rain Drop value: 0  Weather is good
LDR light intensity :1023  Rain Drop value: 0  Weather is good
LDR light intensity :1023  Rain Drop value: 0  Weather is good
LDR light intensity :1023  Rain Drop value: 0  Weather is good
LDR light intensity :1023  Rain Drop value: 0  Weather is good
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LDR light intensity :1023  Rain Drop value: 0  Weather is good
LDR light intensity :1023  Rain Drop value: 0  Weather is good
LDR light intensity :1023  Rain Drop value: 0  Weather is good
LDR light intensity :1023  Rain Drop value: 1023  It is raining
LDR light intensity :1023  Rain Drop value: 1023  It is raining
LDR light intensity :1023  Rain Drop value: 0  Weather is good
LDR light intensity :0  Rain Drop value: 1023  It is raining
LDR light intensity :1023  Rain Drop value: 0  Weather is good
LDR light intensity :1023  Rain Drop value: 0  Weather is good
LDR light intensity :0  Rain Drop value: 0  Weather is good
LDR light intensity :0  Rain Drop value: 0  Weather is good
LDR light intensity :0  Rain Drop value: 0  Weather is good
LDR light intensity :0  Rain Drop value: 0  Weather is good
LDR light intensity :0  Rain Drop value: 0  Weather is good
LDR light intensity :1023  Rain Drop value: 0  Weather is good
LDR light intensity :0  Rain Drop value: 0  Weather is good
LDR light intensity :1023  Rain Drop value: 0  Weather is good
LDR light intensity :1023  Rain Drop value: 0  Weather is good
LDR light intensity :1023  Rain Drop value: 0  Weather is good
LDR light intensity :1023  Rain Drop value: 0  Weather is good
LDR light intensity :1023
```

Fig . 4.2

Below fig 4.3 shows the user interface from the Blynk cloud. Here status for the water pump like the motor is ON or OFF which are from the DHT11 sensor, just below it shows temperature and humidity values. And after moisture which is from the soil moisture sensor and LED values which are from the LDR sensor which means it measures light intensity more than the predefined value. At last, it shows the good weather from the water sensor which measures rain water drop value if it is raining or not.

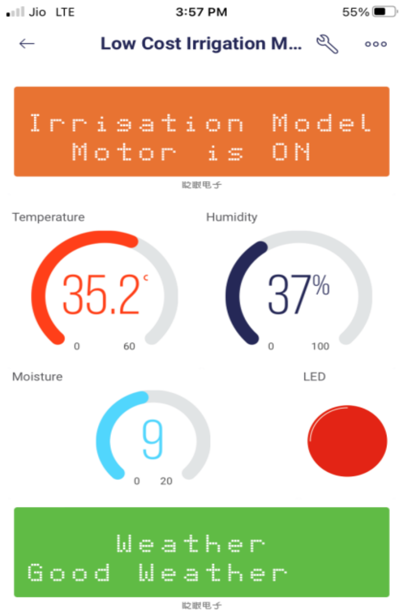

Fig 4.3

5. CONCLUSION

Our main objective is to reduce the cost of the model for irrigation. This type of model costs around 2000-5000 INR this is very costly for middle-class people. This would be unaffordable for poor farmers who wanted technology in an irrigation system. It is a low-cost model with just 945⍰ INR. Burdon of work on farmers, gardeners, and users have in the field are to monitor all the area and irrigate the all the plants those problems are eliminated by this model. This model provides facilities like sensing parameters value and operates the water pump as needed. This is an automatic system that operates as ON when the sensed value crosses a predefined value. It measures all requirements related to the field as atmospheric condition, moisture, temperature, and light intensity which could help set up an irrigation model it means the farmers or user who has this device can measure all the above values about their plants and around the farming fields area. IoT has the potential to do itself and increased the growth of productivity. Technologies used in irrigation can enhance productivity by giving information about water needed and starting automatic supply ON according to what data machine collected throughout the monitoring process and it provides data for the water requirement of the particular plant. It saves time for users it reduces human involvement in irrigation. It doesn't need any technician or operator to operate this device it overcomes the problem of human resource requirements. It changes the way of irrigation. It increases the quality and quantity of production.

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