School of Computer Science and Engineering

J Component report

Programme : B.Tech(CSE)

Course Title : Comm. For CPS

Course Code : CSE2035

Title: Smart Agricultural System

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Abstract

Agriculture is the primary occupation in our country for ages. But now due to migration of people from rural to urban there is hindrance in agriculture. So, to overcome this problem we go for smart agriculture techniques using IoT. This project includes various features like cloud based remote controlled monitoring, moisture & temperature sensing and proper irrigation facilities. It makes use of wireless sensor networks for noting the soil properties and environmental factors continuously. Various sensor nodes are deployed at different locations in the farm. Controlling these parameters are through any remote device or internet services and the operations are performed by interfacing sensors, Wi-Fi with microcontroller. Designing a mathematical model to give a soil score of the currently using soil and soil score required for each crop saved on database. This concept is created as a product and given to the farmer’s welfare.

Introduction

IoT is in charge of upgrading the agriculture sector by utilising effective techniques and tools to manage crops, land, and animals. In consequence, this has caused waste generation to decline and productivity to skyrocket. Utilizing IoT, this is smart agriculture. In the project we're working on, there are a few IoT applications that include:

- Automated irrigation systems that water the crops at opportune moments
- Any IoT-based technology is centred on data. Smart farms must establish a constant cycle that gathers and analyses data in order to carry out the subsequent set of activities in

order to assure optimization. An illustration of a smart farming cycle that we are following:

- Observation: Sensors are employed to sense the environment and gather data on the soil, temperature, humidity, and other factors.
- Diagnostics: For data analytics, sensor data is transferred to cloud systems based on the Internet of Things.

Actions: The cycle restarts at the beginning when the tasks are performed. Sensors that are playing vital roles in our project

Humidity and Temperature Humidity sensors work by detecting changes that alter electrical currents or temperature in the air. A capacitive humidity sensor measures relative humidity by placing a thin strip of metal oxide between two electrodes. The metal oxide's electrical capacity changes with the atmosphere's relative humidity. Resistive humidity sensors utilize ions in salts to measure the electrical impedance of atoms. As humidity changes, so does the resistance of the electrodes on either side of the salt medium. Two thermal sensors conduct electricity based upon the humidity of the surrounding air. One sensor is encased in dry nitrogen while the other measures ambient air. The difference between the two measures the humidity. *DC motor* using water pump DC motor is used to make water pump. DC motor has two leads one is positive and another one is negative. If we connect them directly to the board then it will damage the board. To overcome this problem, NPN transistor is used to control the switching activity of the motor according to the code.*PH sensor* pH meters are used for soil measurements in agriculture, water quality for municipal water supplies, swimming pools, environmental remediation; brewing of wine or beer; manufacturing, healthcare and clinical applications such as blood chemistry; and many other applications. *Soil* *moisture sensor* The soil moisture sensor consists of two leads that are used to measure volume of water content in soil. These leads allow the current to pass through the soil and in return calculates the resistance value to measure the moisture level. If there is more water in soil then soil will conduct more electricity, means less resistance value along with high level of moisture. In the same manner if there is less water in soil then soil will conduct less electricity, means high resistance value along with low level of moisture. To assist farmers in coping with difficulties, smart farming integrates machine learning and predictive analysis.

Literature survey

Dr.N.Suma, Sandra Rhea Samson, S.Saranya, G.Shanmugapriya, R.Subhashri Associate Professor, Department of ECE, researched the existing technique and one amongst the oldest ways that in agriculture is that the manual technique of checking the parameter. The existing technique and one amongst the oldest ways that in agriculture is that the manual technique of checking the parameters. during this technique the farmers they themselves verify all the parameters and calculate the readings. It focuses on developing devices and tools to manage, display and alert the users exploitation the benefits of a wireless sensing element network system. It aims at creating agriculture sensible using automation and IoT technologies. The lightness features ar sensible GPS based mostly remote -controlled automaton to perform tasks like weeding, spraying, wet sensing, human detection and keeping vigilance. The cloud computing devices which will produce an entire computing system from sensors to tools that observe knowledge from agricultural field pictures and from human actors on the ground and accurately feed the information into the repositories along with the situation as GPS coordinates. This idea proposes a completely unique methodology for sensible farming by linking a sensible sensing system and smart irrigator system through wireless communication technology. It proposes a coffee cost and economical wireless sensing element network technique to acquire the soil wet and temperature from numerous locations of farm and as per the necessity of crop controller to take the choice whether or not the irrigation is enabled or not.rs. during this technique the farmers they themselves verify all the parameters and calculate the readings. It focuses on developing devices and tools to manage, display and alert the users exploitation the benefits of a wireless sensing element network system. It aims at creating agriculture sensible using automation and IoT technologies. The lightness features are sensible GPS based mostly remote-controlled automaton to perform tasks like weeding, spraying, wet sensing, human detection and keeping vigilance. The cloud computing devices which will produce an entire computing system from sensors to tools that observe knowledge from agricultural field pictures and from human actors on the ground and accurately feed the information into the repositories along with the situation as GPS coordinates. This idea proposes a completely unique methodology for sensible farming by linking a sensible sensing system and smart irrigator system through wireless communication technology. It proposes a coffee cost and economical wireless sensing element network technique to acquire the soil wet and temperature from numerous location of farm and as per the necessity of crop controller to take the choice whether or not the irrigation is enabled or not.

Weis E, Berry JA Symposia of the Society for Experimental Biology studied the effect of high temperature on higher plants is primarily on photosynthetic functions. The heat tolerance limit of leaves of higher plants coincides with (and appears to be determined by) the thermal sensitivity of primary photochemical reactions occurring in the thylakoid membrane system. Tolerance limits vary between genotypes, but are also subject to acclimation. Long-term acclimations can be superimposed upon fast adaptive adjustment of the thermal stability, occurring in the time range of a few hours. Light causes an increase in tolerance to heat, and this stabilization is related to the light-induced proton gradient. In addition to irreversible effects, high temperature may also cause large, reversible effects on the rate of photosynthesis.

Plant response to atmospheric humidity by D. A. GRANTZ researched about plants growing in environments differing in prevailing humidity exhibit variations in traits associated with regulation of water loss, particularly cuticular and stomatal properties. Expansive growth is also typically reduced by low humidity. Nevertheless, there is little evidence in plants for a specific sensor for humidity, analogous to the blue light or phytochrome photoreceptors. The detailed mechanism of the stomatal response to humidity remains unknown. Available data suggest mediation by fluxes of water vapour, with evaporation rate assuming the role of sensor. This implies that stomata respond to the driving force for diffusional water loss, leaf-air vapour pressure difference.

The influence of pH and organic matter content in paddy soil on heavy metal availability and their uptake by rice plants by

Fanrong Zeng, Shafaqat Ali, Haitao Zhang, Younan Ouyang, Boyin Qiu, Feibo Wu, Guoping Zhang had experiments done to investigate the effect of soil pH and organic matter content on EDTA-extractable heavy metal contents in soils and heavy metal concentrations in rice straw and grains. EDTA-extractable Cr contents in soils and concentrations in rice tissues were negatively correlated with soil pH, but positively correlated with organic matter content. The combination of soil pH and organic matter content would produce the more precise regression models for estimation of EDTA-Cu, Pb and Zn contents in soils, demonstrating the distinct effect of the two factors on the availability of these heavy metals in soils. Soil pH greatly affected heavy metal concentrations in rice plants. Furthermore, inclusion of other soil properties in the stepwise regression analysis improved the regression models for predicting straw Fe and grain Zn concentrations, indicating that other soil properties should be taken into consideration for precise predicting of heavy metal concentrations in rice plants.

Mathematical model

High temperature, even for short period, affects crop growth especially in temperate crops like wheat. High air temperature reduces the growth of shoots and in turn reduces root growth. High soil temperature is more crucial as damage to the roots is severe resulting in substantial reduction in shoot growth.

Ex: - Wheat: 3 – 4°C Rice: 10-12°C Increases of temperature may cause yield declines between 2.5% and 10%
Average temperature decline could be taken as 6.25%.

The desirable pH range for optimum plant growth varies among crops. While some crops grow best in the 6.0 to 7.0 range, others grow well under slightly acidic conditions. Soil properties that influence the need for and response to lime vary by region. A knowledge of the soil and the crop is important in managing soil pH for the best crop performance.

Ex: -
A soil pH between 6.0 and 7.0, with a target pH of 6.4, should be optimal for micronutrient availability and wheat growth. white rice has a pH of 6 to 6.7, brown rice has a pH of 6.2 to 6.7 and wild rice has a pH of 6 to 6.4.

Here the base line with respect to neutral ph will be considered. Study shows that change in ph can effectively affect the growth by 50%.

Relative humidity (RH) directly influences the water relations of plant and indirectly affects leaf growth, photosynthesis, pollination, occurrence of diseases and finally economic yield.

Ex: -

Optimum relative humidity for rice cultivation lies between 60% and 80%

For high yielding wheat, ideal weather includes humidity in the range of 50 to 60%.

The dryness of the atmosphere as represented by saturation deficit (100-RH) reduces dry matter production through stomatal control and leaf water potential.

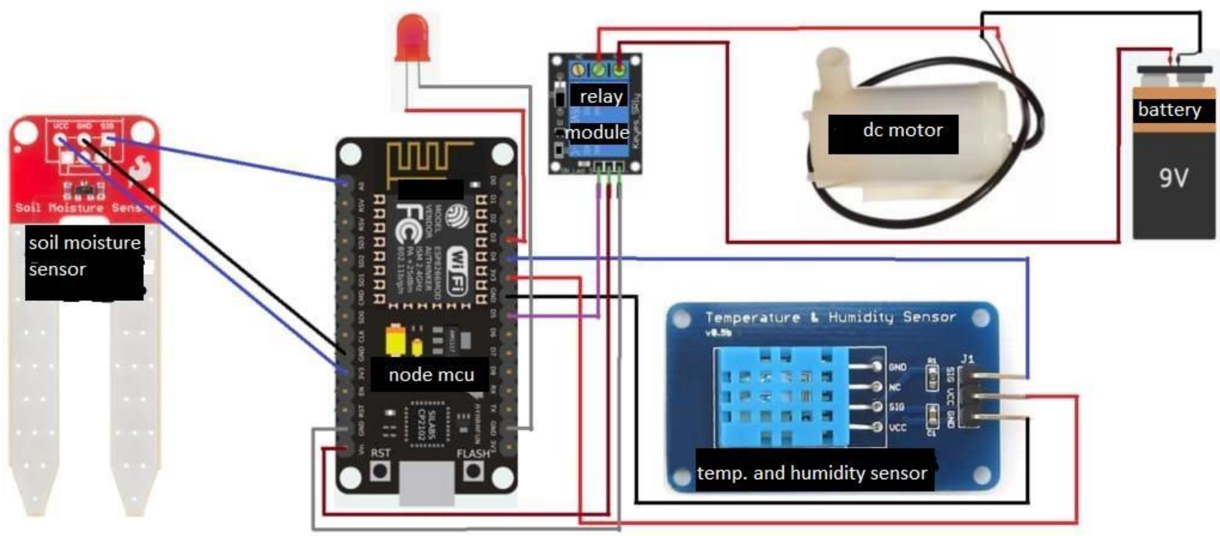
$0.0625*(T-T_{room}) + 0.5*(ph-ph_{neutral}) + 0.4375*(RH/10)$ $T_{room} = 25\ ^0c$

$Ph_{neutral} = 7$

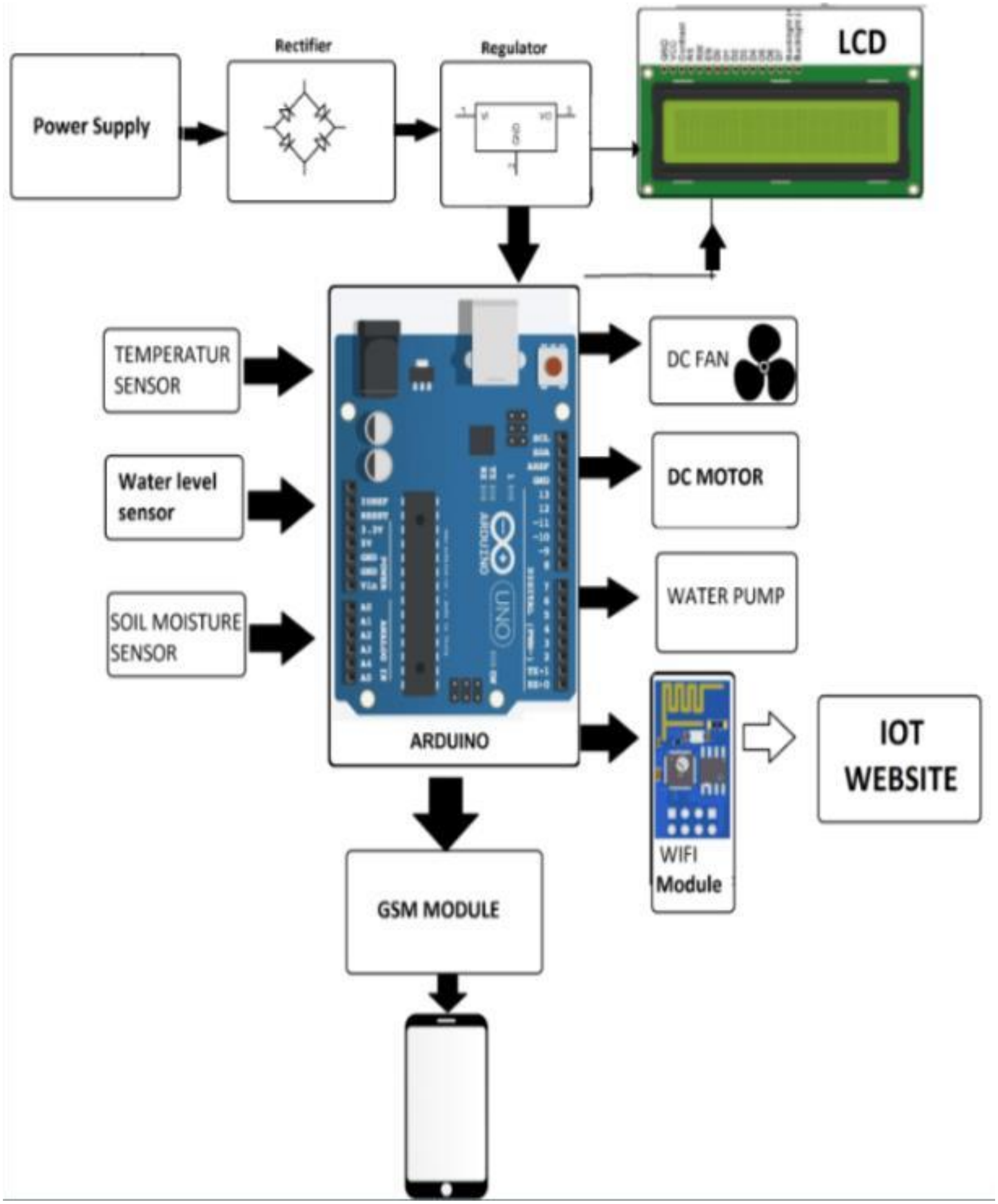
Existing work/system

In the field section, various sensors are deployed in the field like temperature sensor, moisture sensor and PIR sensor. The data collected from these sensors are connected to the microcontroller through RS232. In control section, the received data is verified with the threshold values. If the data exceeds the threshold value the buzzer is switched ON and the LED starts to blink. This alarm is sent as a message to the farmer and automatically the power is switched OFF after sensing. The values are generated in the web page and the farmer gets the detailed description of the values. In manual mode, the user has to switch ON and OFF the microcontroller by pressing the button in the Android Application developed. This is done with the help of GSM Module. In automatic mode, the microcontroller gets switched ON and OFF automatically if the value exceeds the threshold point. Soon after the microcontroller is started, automatically an alert must be sent to the user. This is achieved by sending a message to the user through the GSM module. Other parameters like the temperature, humidity, moisture and the PIR sensors shows the threshold value and the water level sensor is used just to indicate the level of water inside a tank or the water resource.

Proposed work/system



Architecture of Proposed Work



Technology stack

- Arduino ide
- C++
- library <OneWire.h>
- library <SPI.h>
- library <BlynkSimpleEsp8266.h>
- library <DHT.h>

Description

Relay

Relay is an important part of this model. They work as interfacing between electronic circuits and mechanical circuits. Basically relay is a switch which is operated by a relatively small amount of electric current. Relays produce a very high voltage when switched off. This will damage the other components in the circuit. To overcome this a diode is connected. Relay uses DC 12V power for the implementation.

Charging module

ESP8266 NODEMCU

Soil moisture sensor

Soil moisture sensors measure the moisture content in the soil. The sensor measures the water content indirectly by using properties of soil like, such as electrical resistance and dielectric constant. Technologies used in moisture sensors include neutron moisture gauges, electrical resistance of soil and frequency domain sensors such as capacitance sensors. The moisture sensor is inserted in the soil, in order to measure the moisture content of the soil. If there is less water in the material then less electricity will be generated by the soil which indicates resistance is more, therefore moisture level in the soil is low.

DHT11 temperature and humidity sensor

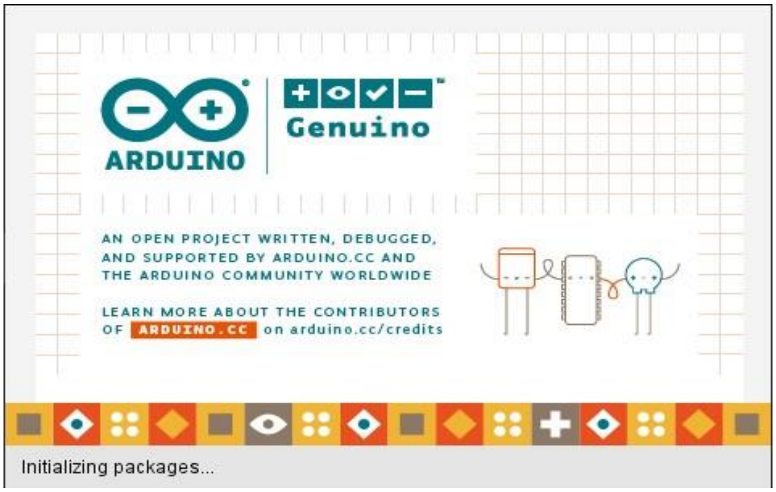
The DHT11 is a basic, ultra low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the air surrounding the plant and sends out a digital signal on the data pin.

Water pump

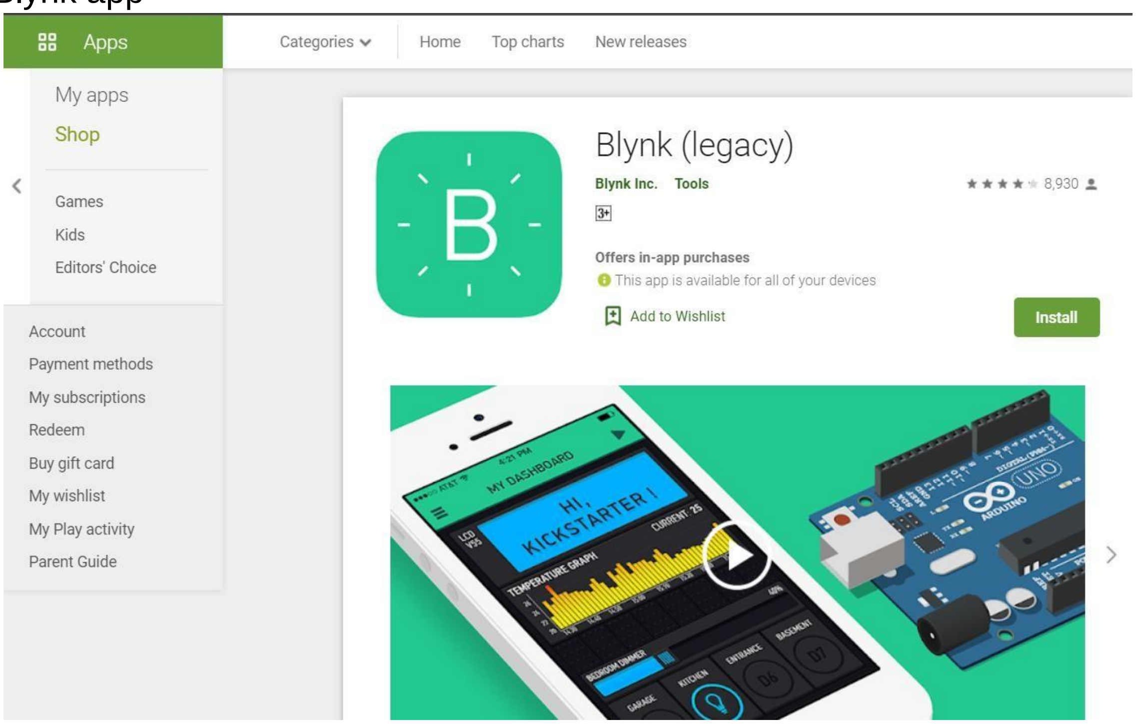
Water pump is used to provide water whenever needed. It can be controlled by interfacing it to a microcontroller. The water pump is turned ON/OFF by sending signals as required.

Software Requirements

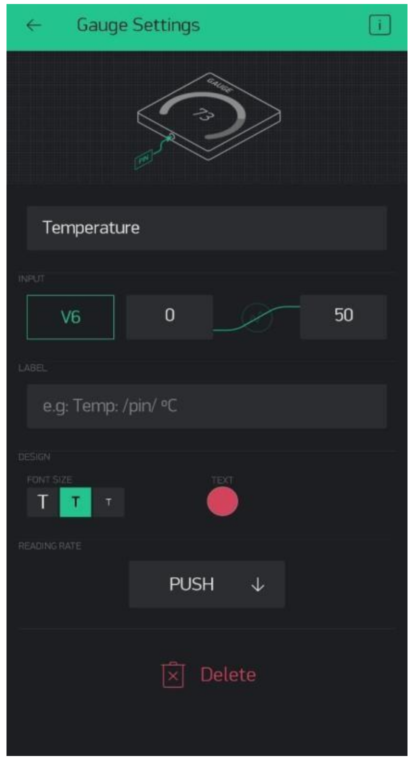
Arduino ide

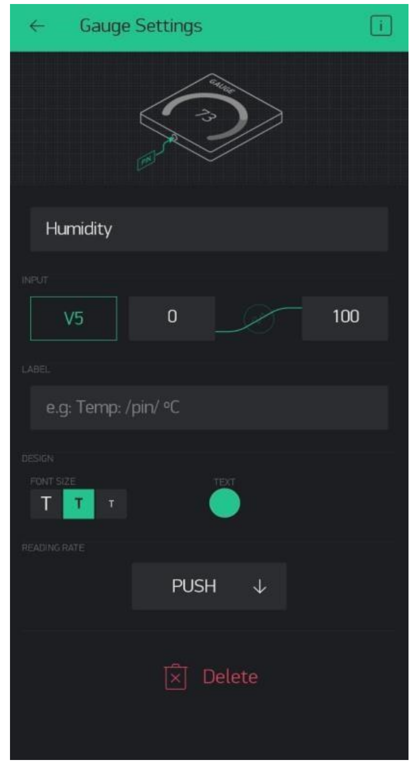


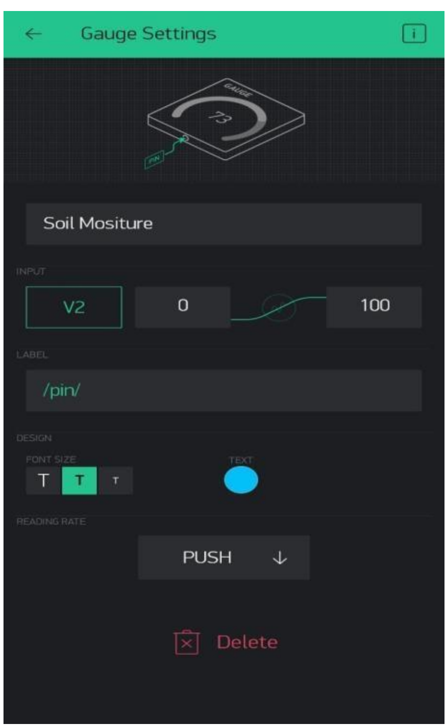
Blynk app

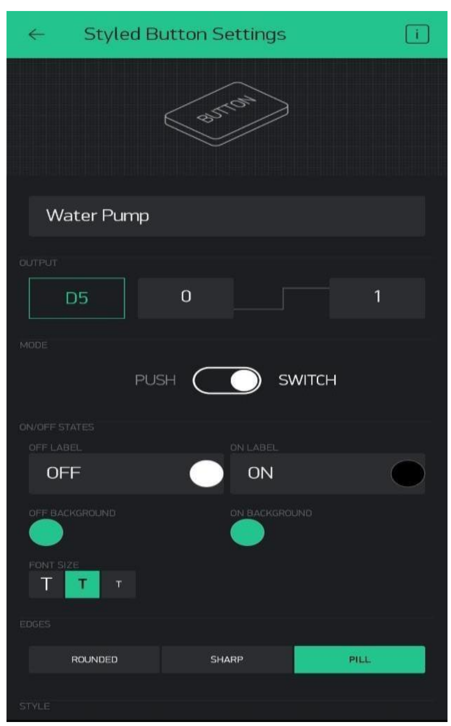


Screenshots of output



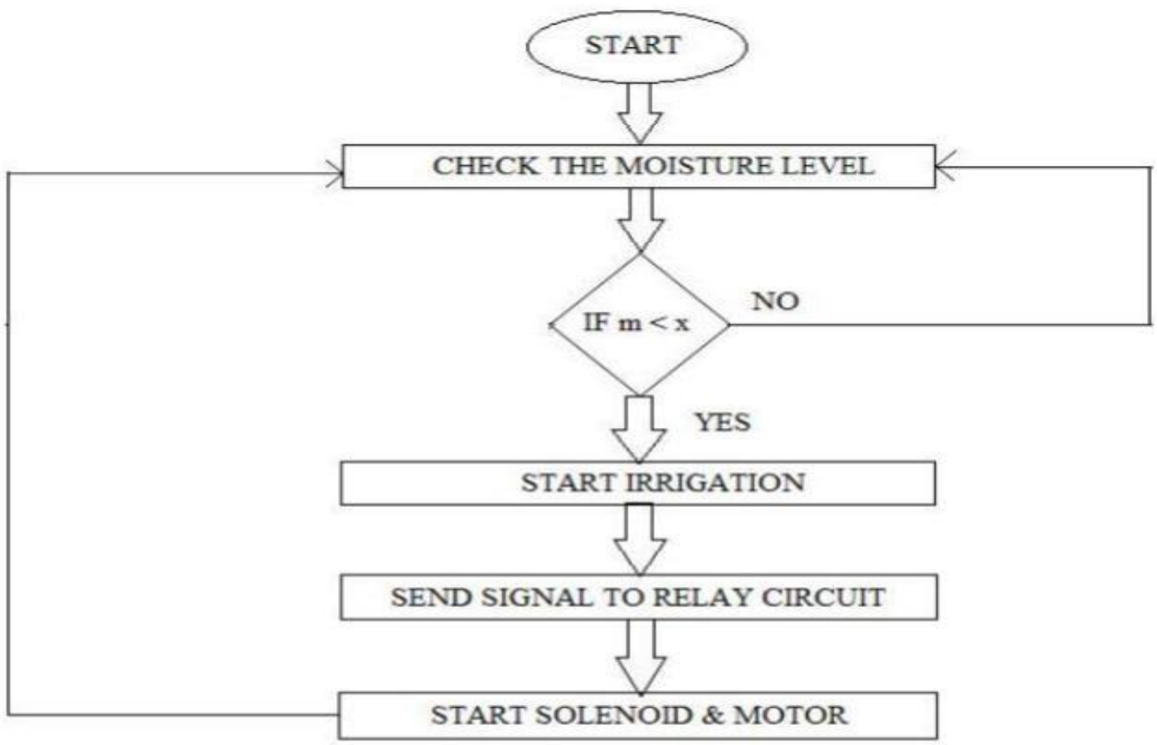






Implementation

The main components of the model are Arduino UNO, temperature sensor, soil moisture sensor, water pump, relay, esp8266 microcontroller and Arduino IDE. We make Arduino connections to



relay, sensors and water pump. Arduino allows water pump to on or off automatically. The relay ground is connected to Arduino ground and relay input to Arduino digital pins. Water pump provides water needed by the plant to survive. This model smart plant watering system is programmed using Arduino IDE software such that it waters the plants based on moisture sensor. It checks soil moisture level, and if it low it triggers the water pump and it will be on until moisture level reaches the threshold.

CODE

```
#define BLYNK_PRINT Serial
#include <SPI.h>
#include <BlynkSimpleEsp8266.h>
#include <DHT.h>
char auth[] ="IbAPkx4iO2W4q7YVX_o3BjMsfOhh2c3I";
char ssid[] = "random";
char pass[] = "12345678";

#define DHTPIN 2
#define DHTTYPE DHT11
DHT dht(DHTPIN, DHTTYPE);
SimpleTimer timer; float H=0;
float T=0;
void sendSensor()
{
float h = dht.readHumidity(); float
t = dht.readTemperature();
H=h;
T=t;

if (isnan(h) || isnan(t)) {
Serial.println("Failed to read from DHT sensor!"); return;
}
Blynk.virtualWrite(V5, h); //V5 is for Humidity
Blynk.virtualWrite(V6, t); //V6 is for Temperature
}
void setup()
{
```

```
Serial.begin(9600); dht.begin();
timer.setInterval(1000L, sendSensor);
Blynk.begin(auth, ssid, pass);
//sensors.begin();
}
int sensor=0;
int relativeHumidity=0;
int Troom = 25;
int phneutral = 7;
int ph = 0;
float minRelativeHumidity = 60.0;
float maxRelativeHumidity = 80.0;    // Range of optimal humidity
values for rice crop
float phMin = 6.0;
float phMax=6.4;                              // Range of optimal PH values
for rice crop
float Tmin = 10, Tmax = 12;                              // Range of optimal
Temperature values for rice crop
float minOptimalValue = 0;
float maxOptimalValue = 10;
float measuredValue = 0;

void sendTemps()
{
sensor=analogRead(A0);
relativeHumidity=145-map(sensor,0,1023,0,330); delay(1000);
maxOptimalValue = 0.0625*(Tmin-Troom) + 0.5*(phMin-phneutral)
+ 0.4375*(maxRelativeHumidity/10);
minOptimalValue    =    0.0625*(Tmax-Troom)    +    0.5*(phMax-
phneutral) + 0.4375*(minRelativeHumidity/10);
```

```
measuredValue = 0.0625*(T-Troom) + 0.5*(7.3-phneutral) +
0.4375*(relativeHumidity/10);
Serial.print("Minimum Optimal Value : ");
  Serial.println(minOptimalValue);
  Serial.print("Maximum Optimal Value : ");
  Serial.println(maxOptimalValue);
  Serial.print("Measured          Value          :          ");
Serial.println(measuredValue);
if(measuredValue>=minOptimalValue                    &&
measuredValue<=maxOptimalValue)
{
  Serial.println("Conditions are suitable for planting the required
crop");
}
else{
  Serial.println("Conditions are not suitable for planting the required
crop");
  digitalWrite(5,HIGH);
}
Blynk.virtualWrite(V2,relativeHumidity); delay(1000);
}
void loop()
{
Blynk.run(); timer.run();
sendTemps();
}
```

Conclusion

After arranging all components with the required board we were able to perform the working of our project, this project helps us to gain in depth knowledge about the environment, type of crops that we come across in daily life, the conditions that need to be completely nourished, we also gained knowledge about the working of sensors, how moisture sensor works, in respect of resistance values how we relate the condition of the soil whether it needs water, whether it is completely wet. The moisture will deliver the moisture level of the soil visible from the app. It will also give the values for humidity and temperature. Each plant has its own favourable environment in which it can grow properly. If we know the adequate moisture level value for each of the plant, we can maintain its moisture to that value as we can read the value of it from the mobile app. This is implemented in this project. Further additions can be done to increase its usability and making it more user friendly.

Future work

The mathematical model that has been implemented is based on the current data sets obtained from different researches as mentioned in references tend to change with adaptability of the plant in the surrounding like plants getting resistant to high temperature or high humidity. With recent studies suggesting that in the next 5-6 years plants will be adapting to the surroundings to match the global climate change which will affect their growth genetically hindering their basic growth requirements and displaying multiple growth abnormalities.

References

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