IoT Fundamentals (J-component)

SMART IRRIGATION SYSTEM USING ARDUINO

Submitted to – Prof. Sriharipriya K C

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ABSTRACT

Agriculture is a major source of earning of Indians and agriculture has made a big impact on India's economy. The development of crops for a better yield and quality deliver is exceptionally required. So suitable conditions and suitable moisture in beds of crop can play a major role for production. Mostly irrigation is done by tradition methods of stream flows from one end to other. Such supply may leave varied moisture levels in filed. The administration of the water system can be enhanced utilizing programmed watering framework. This project – a prototype – aims at programmed water system with framework for the terrains which will reduce manual labour and optimizing water usage increasing productivity of crops.

For formulating the setup, Arduino is used with temperature and moisture sensor. ESP8266 has inbuilt Wi-fi Module. Our experimental setup is connected with cloud framework and data is acquisition is done. Then data is analysed by cloud services. Several thresholds have been set up. The acquired data sent via the sensors to the Cloud. This data is then fed as the input to our code and based on the thresholds used in the code, recommendations are made.

Based on the recommendations the field is irrigated. This reduces manual labour and optimizes water usage increasing productivity and yield of crops ensuring higher profit and income to everyone linked with Agriculture.

INTRODUCTION

India is a horticultural nation, where population is over 1.2 billion, out of which around 70% of the population relies upon horticulture. Agriculture is a major source of earning of Indians and agriculture also has made a big impact on India's economy. Agriculturists have an extensive variety of assorted variety to choose reasonable products of the soil crops. Be that as it may, the development of these crops for ideal yield and quality deliver is exceptionally specialized. It can be enhanced by the guide of innovative bolster. The administration of the water system can be enhanced utilizing programmed watering framework. This project – a prototype only – proposes a programmed water system with framework for the terrains which will reduce manual labour and optimizing water usage increasing yield and productivity of crops.

Presently the computerization is one of the critical parts in the human life which gives comfort as well as lessen burden and helps us to save time We plan to develop a framework that helps the farmer to automatically provide water to the plant according to its need and current water moisture present in the soil. A keen water system is developed with the help of temperature and moisture sensors and Arduino. In the system, we bury moisture sensor into the soil which would notify the system about amount of water present in the soil.

With the help of a program, coded in Arduino platform, the system will check the amount of water required by a plant, with predefined values in the program. If the moisture level is less than the amount of water needed by the plant, the program automates the flow of water from a submersible pump unless a threshold value is reached. This ensures that crop has been provided optimum amount of water without any manual labour or wastage. It improves efficiency of water usage, reduced cost of irrigation water, intelligent irrigation.

DEVICES USED

Mainly embedded systems have been used for the project. Embedded systems are PC systems that is a piece of bigger systems and they play out a portion of the prerequisites of these systems. A few cases of such systems are auto portable control systems; mechanical forms control systems, cell phones, or, on the other hand, little sensor controllers.

1. **Arduino**

Arduino is an open-source hardware and software company, project and user community that designs and manufactures single-board microcontrollers and microcontroller kits for building digital devices. Its hardware products are licensed under a CC-BY-SA license, while software is licensed under the GNU Lesser General Public License (LGPL) or the GNU General Public License (GPL), permitting the manufacture of Arduino boards and software distribution by anyone. Arduino boards are available commercially from the official website or through authorized distributors.

Arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (‘shields’) or breadboards (for prototyping) and other circuits. The boards feature serial communications interfaces, including Universal Serial Bus (USB) on some models, which are also used for loading programs from personal computers. The microcontrollers can be programmed using the C and C++ programming languages, using a standard API which is also known as the “Arduino language”. In addition to using traditional compiler toolchains, the Arduino project provides an integrated development environment (IDE) and a command line tool developed in Go.

2. **Temperature Sensor**

Temperature Sensors measure the amount of heat energy or even coldness that is generated by an object or system, allowing us to “sense” or detect any physical change to that temperature producing either an analogue or digital output.

There are many different types of Temperature Sensor available and all have different characteristics depending upon their actual application. A temperature sensor consists of two basic physical types:

- Contact Temperature Sensor Types – These types of temperature sensor are required to be in physical contact with the object being sensed and use conduction to monitor changes in temperature. They can be used to detect solids, liquids or gases over a wide range of temperatures.

- Non-contact Temperature Sensor Types – These types of temperature sensor use convection and radiation to monitor changes in temperature. They can be used to detect liquids and gases that emit radiant energy as heat rises and cold settles to the bottom in convection currents or detect the radiant energy being transmitted from an object in the form of infra-red radiation.

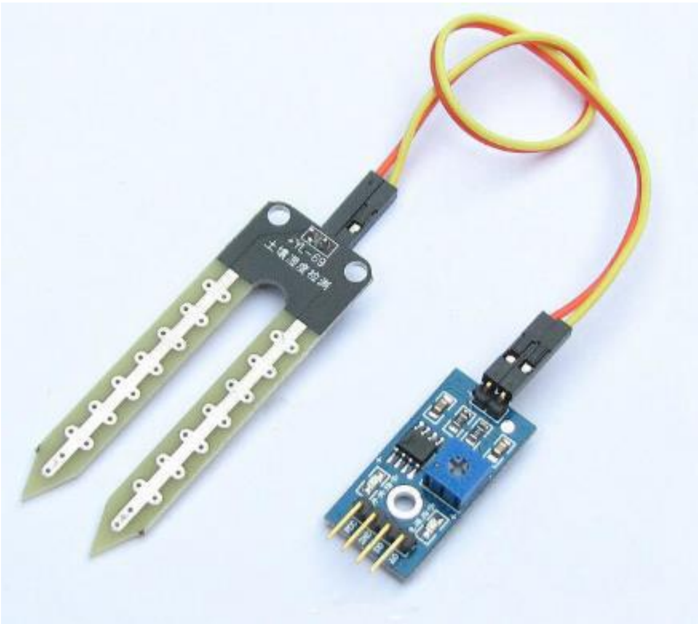
3. **Soil Moisture Sensor**

Soil Moisture Sensors works on the principle of Dielectric permittivity. The dielectric permittivity is the amount of electricity that can be passed through the soil. The dielectric permittivity is a function of water content present in the soil. Hence by measuring the dielectric permittivity we could measure the soil moisture content.

A fixed (user defined) threshold value is set and data is acquired till it reaches the threshold value. Once it has reached the stipulated value the soil moisture sensor bypasses the reading of the value for one cycle.
This rugged sensor is inserted into the soil to be tested, and the volumetric water content of the soil is reported in percent.

Advantages of using Soil Moisture Sensor:

- Easily integrable with Arduino Platform
- Inexpensive
- Operates over a varied temperature range (- 40 - + 60 C)
- Accuracy: - ±4% typical



APPLICATIONS OF OUR PROJECT

Drip Irrigation System

Drip irrigation is a type of micro-irrigation system that has the potential to save water and nutrients by allowing water to drip slowly to the roots of plants, either from above the soil surface or buried below the surface. The goal is to place water directly into the root zone and minimize evaporation. Drip irrigation systems distribute water through a network of valves, pipes, tubing, and emitters. Depending on how well designed, installed, maintained, and operated it is, a drip irrigation system can be more efficient than other types of irrigation systems, such as surface irrigation or sprinkler irrigation.

Operation

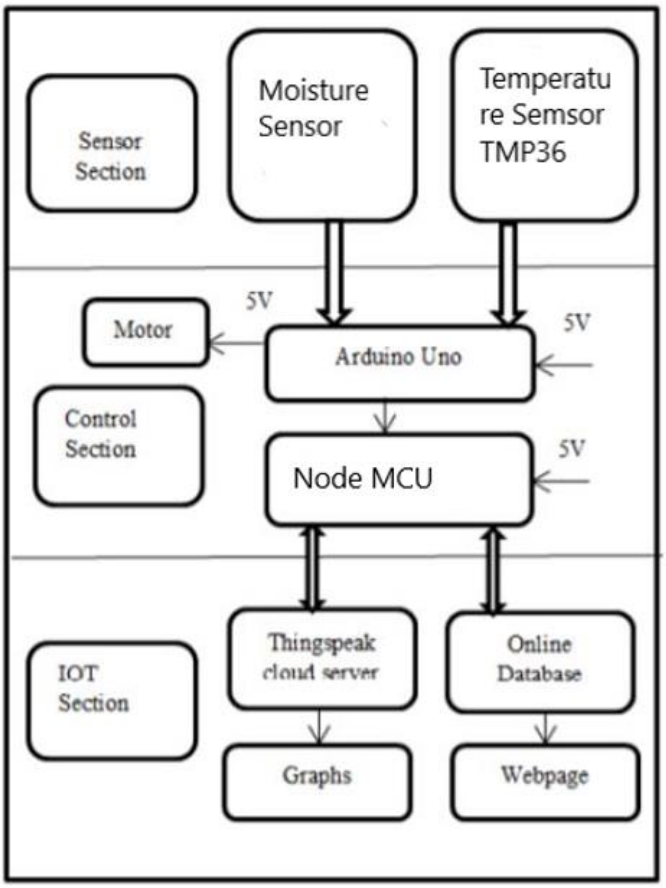
In drip irrigation systems, pump and valves may be manually or automatically operated by a controller. Most large drip irrigation systems employ some type of filter to prevent clogging of the small emitter flow path by small waterborne particles. New technologies are now being offered that minimize clogging. Some residential systems are installed without additional filters since potable water is already filtered at the water treatment plant. Virtually all drip irrigation equipment manufacturers recommend that filters be employed and generally will not honour warranties unless this is done. Last line filters just before the final delivery pipe are strongly recommended in addition to any other filtration system due to fine particle settlement and accidental insertion of particles in the intermediate lines. Drip and subsurface drip irrigation is used almost exclusively when using recycled municipal wastewater. Regulations typically do not permit spraying water through the air that has not been fully treated to potable water standards. Because of the way the water is applied in a drip system, traditional surface applications of timed-release fertilizer are sometimes ineffective, so drip systems often mix liquid fertilizer with the irrigation water. This is called fertigation; fertigation and chemigation (application of pesticides and other chemicals to periodically clean out the system, such as chlorine or sulfuric acid) use chemical injectors such as diaphragm pumps, piston pumps, or aspirators. The chemicals may be added constantly whenever the system is irrigating or at intervals. Fertilizer IIP – GROUP D 9 savings of up to 95% are being reported from recent university field tests using drip fertigation and slow water delivery as compared to timed-release and irrigation by micro spray heads. Properly designed, installed, and managed, drip irrigation may help achieve water conservation by reducing evaporation and deep drainage when compared to other types of irrigation such as flood or overhead sprinklers since water can be more precisely applied to the plant roots. In addition, drip can eliminate many diseases that are spread through water contact with the foliage. Finally, in regions where water supplies are severely limited, there may be no actual water savings, but rather simply an increase in production while using the same amount of water as before. In very arid regions or on sandy soils, the preferred method is to apply the irrigation water as slowly as possible. Pulsed irrigation is sometimes used to decrease the amount of water delivered to the plant at any one time, thus reducing runoff or deep percolation. Pulsed systems are typically expensive and require extensive maintenance. Therefore, the latest efforts by emitter manufacturers are focused on developing new technologies that deliver irrigation water at ultra-low flow rates, i.e. less than 1.0 liter per hour. Slow and even delivery further improves water use efficiency without incurring the expense and complexity of pulsed delivery equipment. An emitting pipe is a type of drip irrigation tubing with emitters pre-installed at the factory with specific distance and flow per hour as per crop distance. An emitter restricts water flow passage through it, thus creating head loss required (to the extent of atmospheric pressure) in order to emit water in the form of droplets. This head loss is achieved by friction/turbulence within the emitter.

IMPLEMENTATION

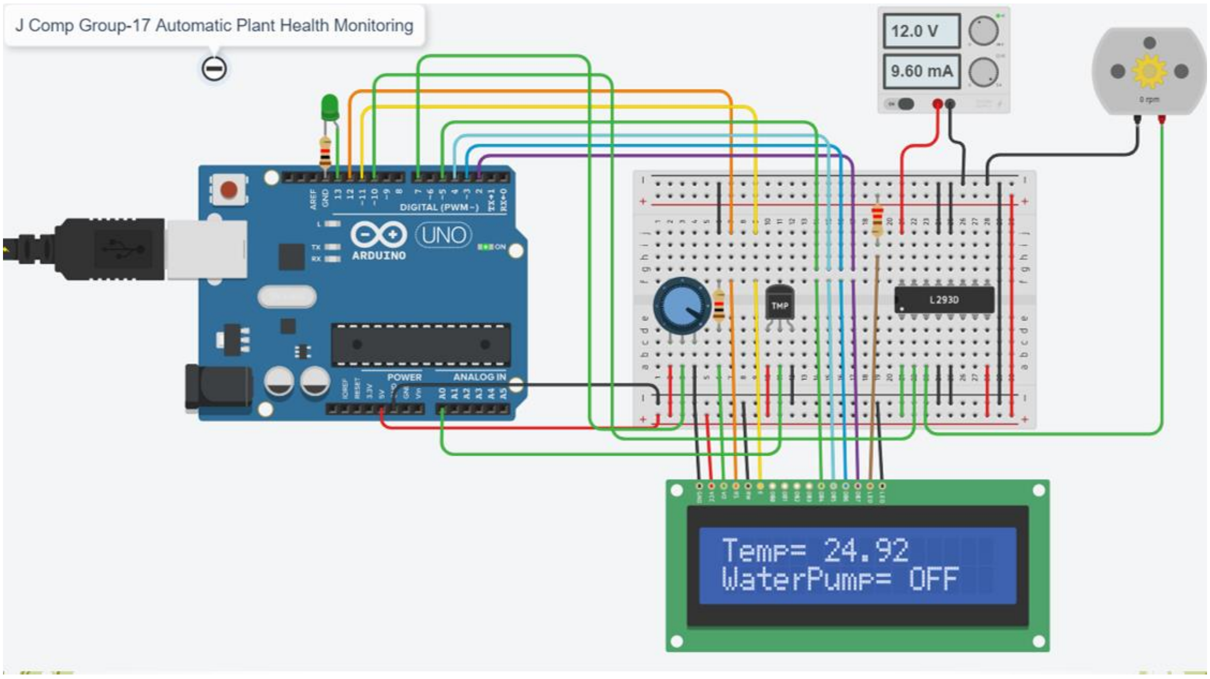
Components Required

- Arduino Uno R3
- LCD 16 x 2
- Moisture Sensor
- 220Ω Resistor
- 1 kΩ Resistor
- Green LED
- DC Motor
- H-bridge Motor Driver
- 12 , 5 Power Supply
- Temperature Sensor[TMP36]

Workflow Flowchart:-



CIRCUIT



CODE

Arduino Code

```
#include<SoftwareSerial.h>
#include<LiquidCrystal.h>
LiquidCrystal lcd(12, 11, 5, 4, 3, 2);
int led=13;
int flag=0;
const int TMP = A0;
#define motor 10
#define moisture_sensor 7
void setup()
{
  lcd.begin(16,2);
 // Serial1.begin(9600);
  Serial.begin(9600);
  pinMode(led, OUTPUT);
```

```
 pinMode(motor, OUTPUT);
 pinMode(moisture_sensor, INPUT_PULLUP);
 lcd.print("Automatic Plant");
 lcd.setCursor(0,1);
 lcd.print("HealthMonitoring");
 lcd.setCursor(4,1);
 delay(1000);
 lcd.clear();
 lcd.print("Group 17");
 lcd.setCursor(0,1);
 lcd.print("Welcomes You");
 delay(1000);
// connect with cloud
 lcd.clear();
 lcd.print("Temp= ");
 lcd.setCursor(0,1);
 lcd.print("WaterPump= ");
}
void loop()
{
 int tmp = analogRead(TMP);
 float Temperature = -40 + 0.488155 * (tmp – 20);
 lcd.setCursor(6,0);
 lcd.print(Temperature);
lcd.setCursor(11,1);
if(digitalRead(moisture_sensor)==1 && flag==0)
  {
   delay(100);
```

```
  if(digitalRead(moisture_sensor)==1)
  {
    digitalWrite(led, HIGH);
    //send message("Low Soil Moisture detected. Motor turned ON");
    digitalWrite(motor, HIGH);
    lcd.print("ON ");
    delay(100);
    flag=1;
  }
 }
 else if((digitalRead(moisture_sensor)==0 && Temperature>40) && flag==0)
 {
  delay(100);
  {
    digitalWrite(led, HIGH);
   // send message("Soil Moisture is Normal but temperature is high. Motor
turned On");
    digitalWrite(motor, HIGH);
          lcd.print("ON ");
    delay(100);
    flag=1;
  }
 }

 else if((digitalRead(moisture_sensor)==0 && Temperature<40) && flag==1)
  {
    delay(100);
    {
```

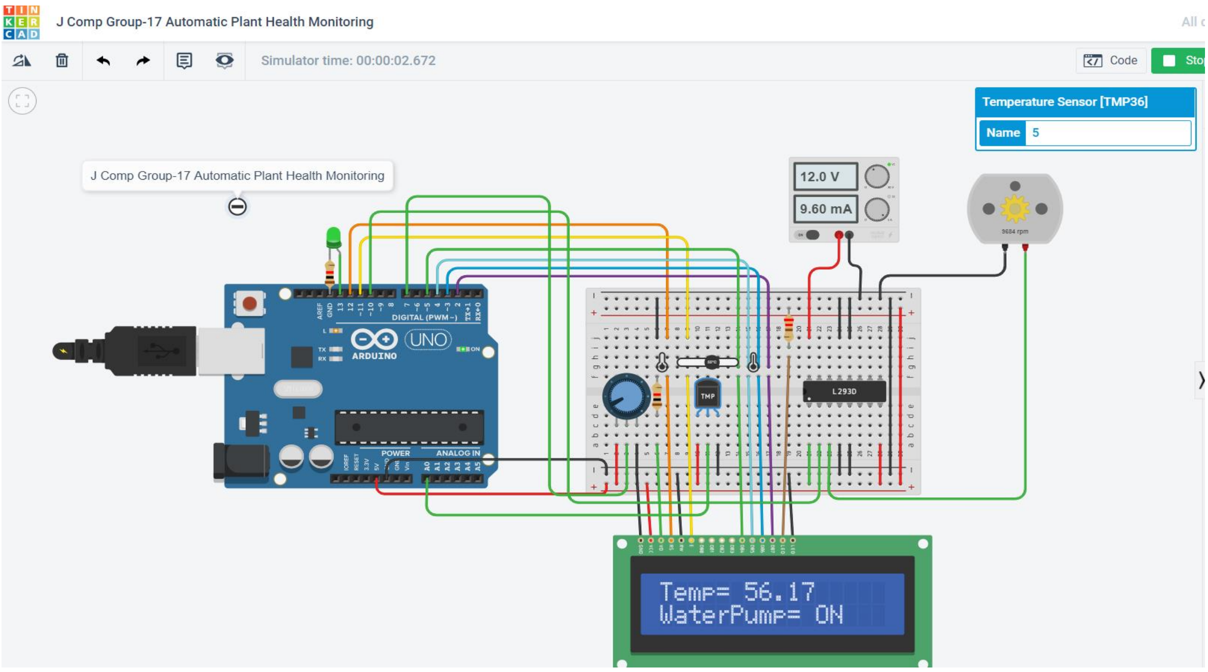
```
      digitalWrite(led, LOW);
     // send message(“Soil Moisture is Normal. Motor turned OFF”);
      digitalWrite(motor, LOW);
      lcd.print(“OFF “);
      delay(100);
      flag=0;
    }
   }
}
```

Thingspeak Python Code

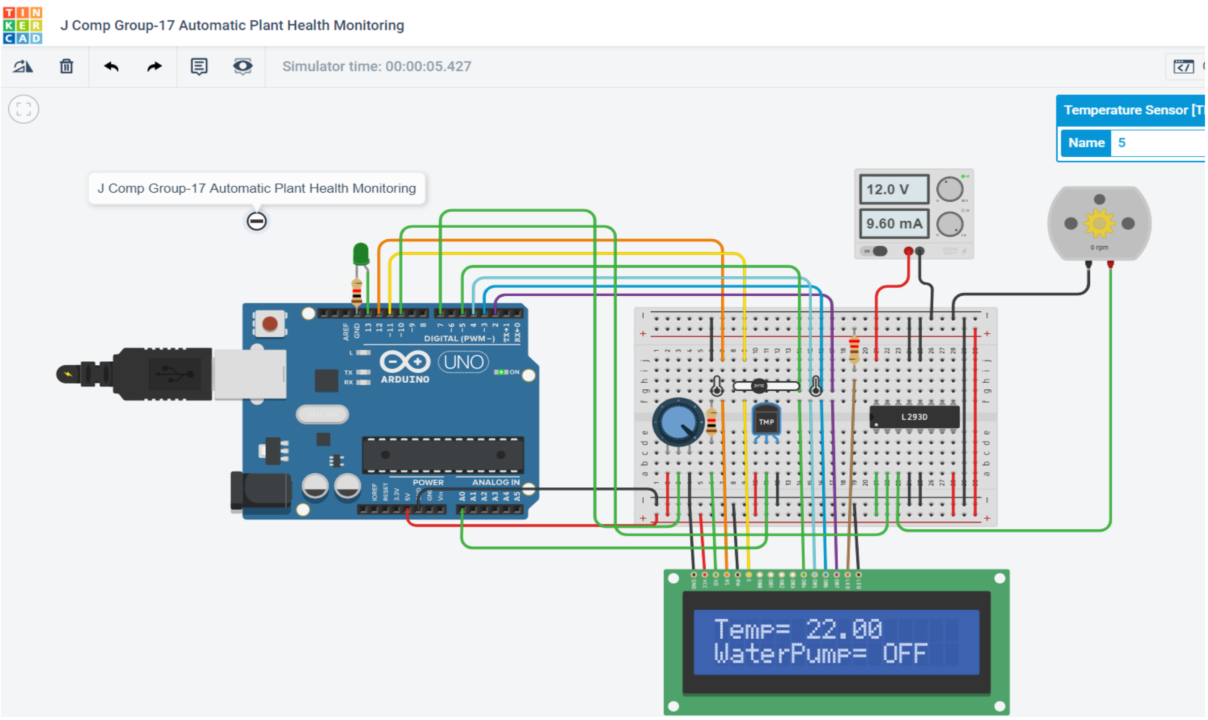
```
import urllib.request
import random
import time
i = 0
while i<20:
    f1 = random.randint(100,500)
    f2 = random.randint(12, 48)
    url = 'https://api.thingspeak.com/update?api_key=##############&field1
='+str(f1)+'&field2='+str(f2)
    f = urllib.request.urlopen(url)
    print(f.read())
    time.sleep(15)
    i = i+1
```

Simulation Results

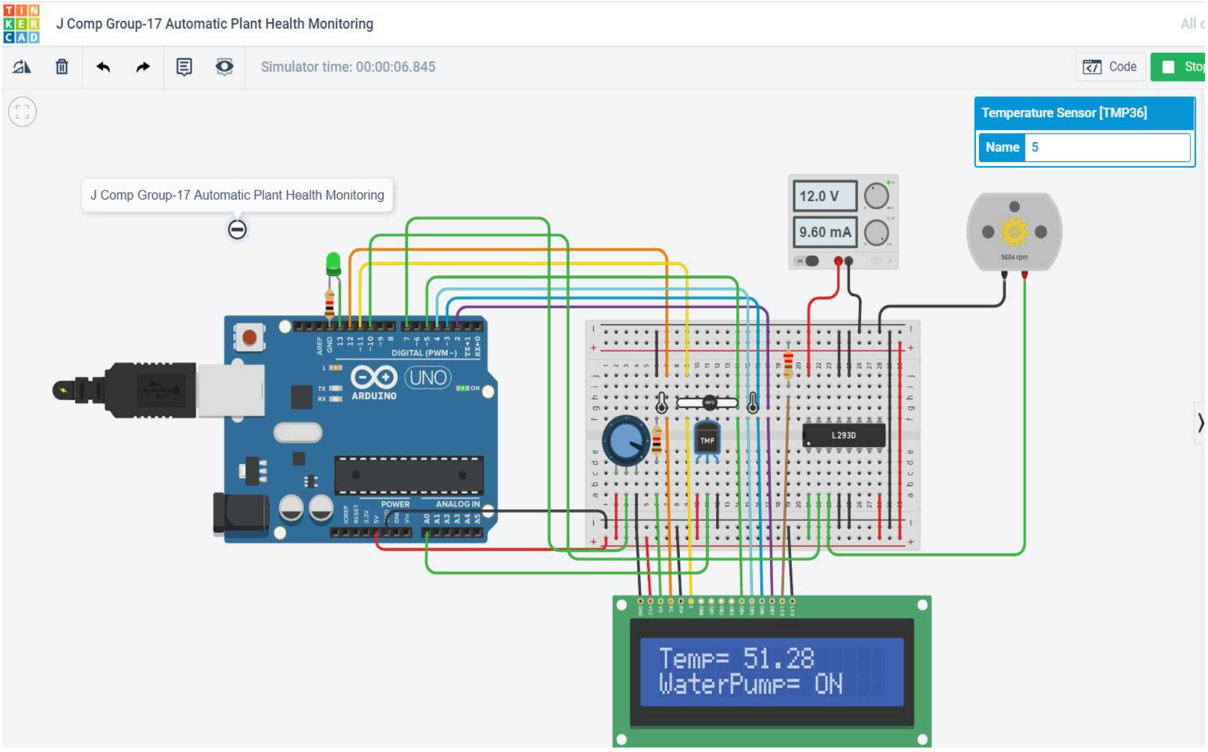
When the temperature is high and moisture content is low, the pump gets turned on:



When the temperature is low and moisture content is normal, the pump gets turned off:

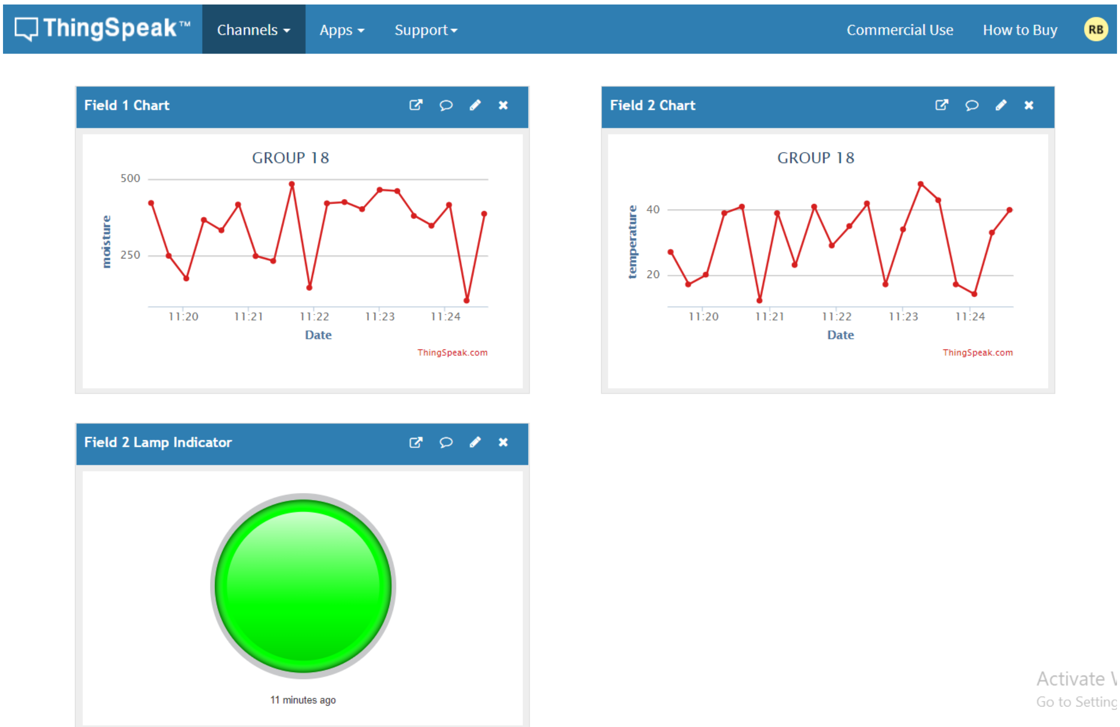


When the moisture content is normal but temperature is high then the pump gets turned on:

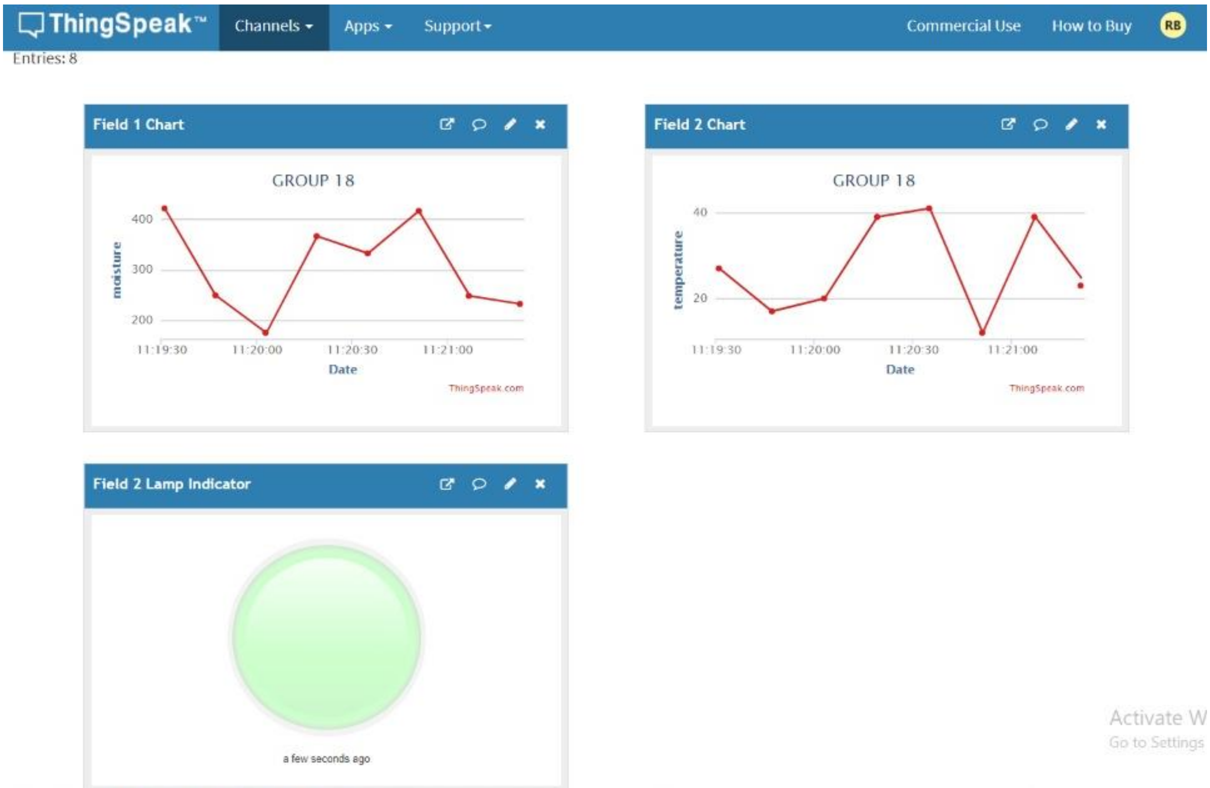


ThingSpeak Channel

The Thingspeak channel is used to monitor the state of the motor and also the temperature and moisture of the soil. The lamp turns on when the motor is running and off when the motor is off.



When the motor is off due to the current reading:



Conclusion

India is a country with most of agriculture on its land. Irrigation is need of agricultural outputs. The procedure used to implement an automatic irrigation in India is done in a customary way which is financially luxurious and loose bringing about minor profitability and misfortunes in manures. So we have designed a smart irrigation system based on IoT using temperature and moisture sensor. It may check the moisture content levels of soil in farm and can generate moisture level data through sensors.

Accordingly irrigation based decisions are taken by system automatically to start water pump and to divert the flow of pump motor for irrigation. Designed system can irrigate field with lesser amount of water. Crop can be maintained with its suitable threshold moisture levels for better yields.

Reference

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