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Design and Implementation of Smart Energy Farming System

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Abstract -Farming has been one of the most important industries in human history since it provides humans with indispensable resources such as food, fiber, and energy. The Agriculture industry could be further developed by employing new technologies, in particular, the Internet of Things. we present a connected farm based on Internet of things systems, which aims to provide smart farming systems for end users. A detailed design and implementation for connected farms are illustrated, and its advantages are explained with service scenarios compared to previous smart farms. We hope this work will show the power of IoT as a disruptive technology helping across multi-industries including Farming.This paper proposes a design and implementation approach of smart farming system using connected-agronomics technique for fig farm application. Nowadays, fig plants having a rapid growth in the current market demand due to its rich in natural health benefiting nutrients, antioxidants, and vitamins where some farming systems have been used in maintaining fig plant's environmental resources to grow without fail. Smart farming is a system applied to provide user with real time information and plan for desired plant such as time intervals for watering systems. There are two major problems on maintaining the fig fruit quality; watering system fail during emergency blackout and a contagious disease known as leaf rust due to external environments.

Key Words:Iot, GSM, Microcontroller, Real time monitoring, Renewable Energy, Sensors, Smart Farming.

1. INTRODUCTION

Agricultural lands are the heart of any country for economic development. Thus, it is the primary duty of the Government to preserve and protect the fields by any means. Science and new technologies have evolved but nothing could replace the dependency on agricultural farmlands. New technologies have been proposed for the betterment of the farmers, so that they can get a better result with more accuracy and less effort but with some limitations.From past years farmers face problems due to climate change or due to natural disasters like floods, famines, etc. It raises the topic of smart farming or smart agriculture but the misconception about the smart farming is many people think that smart farming is about automated system which starts the motor pump and start the water flow whereas some people consider that it just monitors the field.

At present, India holds the 2nd position in the farm output. Over 70% of the rural households depend on agriculture as their principal means of livelihood. But the pressure on farms increased due to increase in population. Thereby, Per Capita availability of food grains went up to 528.77g per day, which was 395g in early fifties, which leads to more consumption of non- renewable energy. Keeping in mind the practical problem faced by the farmers, we have triedto put forward an alternative agricultural model for the betterment of the next generation. We have implemented various modules like soil moisture sensor, humidity sensor, temperature sensor, electronic scarecrow (PIR sensor), GSM under a single agriculture system to make it smarter. We have also tried to use solar tracker power system as an alternative energy source.

2. PROBLEM FACED

Nearly 80% of the 140 million Indian farming families holds 2 acres of land. As land holdings are small, more people invariably work on the farms in rural areas and coupled with the obsolete technology of traditional manual methods, thus productivity gets limited and farm incomes come down.

2.1 Inefficient Soil and Surrounding Condition testing

Sometimes it happens when the seeds failed to germinate properly or abnormal growth or dysfunction of a plant. The reasons could be improper soil preparation, planting in cold soil, extremes of watering, improper use of fertilizer etc. It is very much disappointing to have prepared the soil and sown the seed, only to have a partial or complete failure of germination or dysfunction. That's the reason it is very much essential to test the soil before seeding. Only by seeing the field or by experience it is quite difficult to get an accurate assumption of the soil moisture, temperature, and humidity. It is impossible for the farmers to keep update about the conditions of the agricultural lands all the time.

2.2Poor Irrigation System

Water has a huge impact on the on-food production. Farmers must manually control the water pump at regular interval. They may have to travel a long distance only for switch ON thepump and wait until the pump mustbe switched OFF. Which results in waste of time.

2.3 Non-Reliable Power Supply

Throughout India, the supply of electric power falls short of

the country's needs. The supply of power to Indian agriculture, vital for successful irrigation, is in particularly grave condition. Due to the erratic electric power and maximum of the farmland are out of electricity service, farmers must purchase unnecessarily high-powered electric pumps and alternate diesel pumps results in increase of the maintenance cost.

2.4 Incompetent Scarecrow

Many crops are damaged by birds, with a little knowledge available of actual economic loss is done by House Sparrows, House Crow etc. Often animals are derided as pests as they cause damage to agriculture by feeding on crops or parasitizing livestock. Farmers generally keep a scarecrow in the land to distract the birds but birds getting cleverer, and they ignore those scarecrows as they don't take any action, and also it is impossible for the farmers to remain all the time in the field to them away from the farms.

2.5 Lack of Data Management System

When a farmer must manage more than one field, due to the lack of proper technology he/she must memorize all the condition (or status) of the fields and take appropriate decisions but there is a chance that farmer may not memorize properly and takes a wrong decision.

3. METHODOLOGY AND ANALYSIS

To solve the mentioned problems and to reduce the manual effort of the farmers we took a step towards automation and develop these smart systems and here, we address each and every module as a component interfaced with Arduino UNO microcontroller of the "Smart Energy Farming System".

Arduino UNO

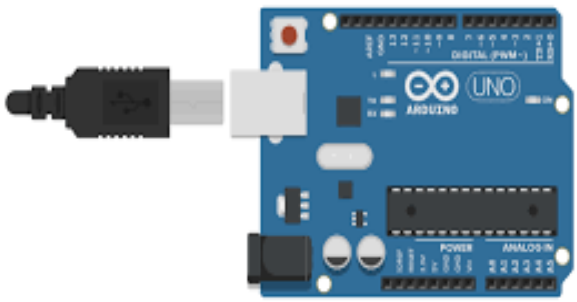


Fig -1 Arduino UNO

The microcontroller used here is an Arduino UNO. The UNO is a Microcontroller board based on ATMEGA 328P which has a 32Kb of flash memory for storing code. The board has a 14 digital input and output pins, 6 analog inputs, 16 MHz quartz crystal, USB, an ICSP circuit and a reset button. The UNO can be programmed using the software Arduino IDE. Arduino board designs use a variety of microprocessors and controllers in system to read inputs light on a sensor, to twitter message and turn it into an output activating a motor and turning on an LED.

Soil Moisture Sensor

A solution to resolve the difficulty of manual soil testing and the surrounding environment as discussed in the previous section will be very much helpful for the farmers. An automated analysis can be done by this module with which a farmer will be aware of the soil moisture level, temperature, humidity. It will be further helpful for the farmer to make the decision that if seeds can be sprout or more water and fertilizer is required or not.

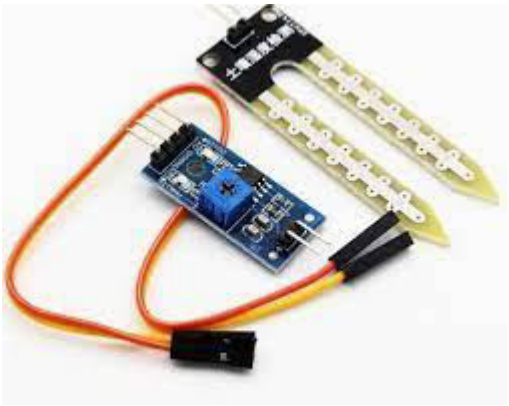
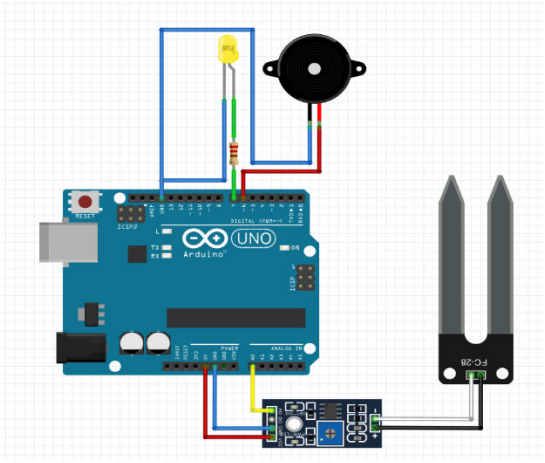


Fig -2 Soil Moisture Sensor

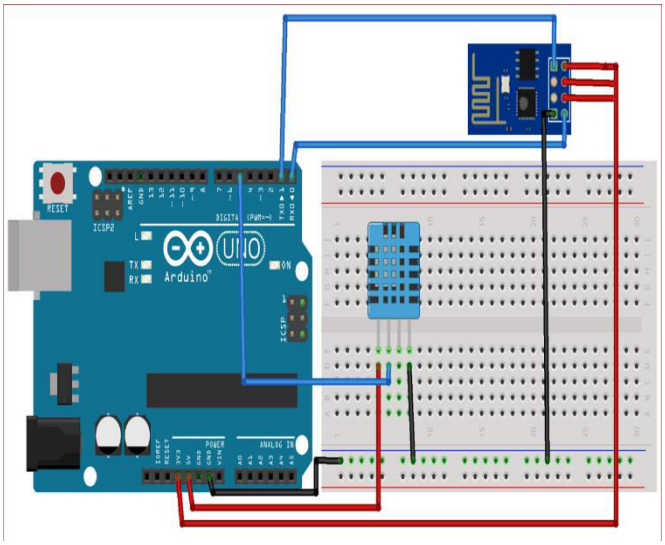
Arduino Interfacing with Soil Moisture Sensor

Soil Moisture sensor used to measure the moisture content of the soil during farming. Copper electrodes are used to sense the moisture content of soil. We tested Soil moisture sensor separately with Arduino it shows favorable result. In set-up function, some value is set for moisture if its breakdown set value then water pump will start until reached to its set value. Also, we used buzzer for helping farmer when water level lower or moisture of soil decrease.The module will show every details of the soil condition on an LCD screen. The module is made of different sensors like moisture sensor (YL69), temperature sensor (LM35), humidity sensor (DHT11). By pressing a button, a farmer can know about various conditions of the soil. It helps the farmer to increase the knowledge of the environment.In this project, we are using the **DHT11 sensor for sending Temperature and Humidity data using Arduino**. By this method, we can monitor our DHT11 sensor's temperature and humidity data over the internet using the Things peak IoT server. And we can view the logged data and graph overtime.

Fig -3 Test Results of DHT11 Sensor



(a)



(b)

Fig -4 Arduino Interface with (a)Soil Moisture Sensor and (b) DHT11 Sensor

Specification of Soil moisture sensor:

- Power Supply :3 to 5 V power and I/O
- Good for 0–100% humidity readings with 2–5% accuracy
- 2.5 mA max current use during conversion
- No more than 0.5 Hz sampling rate (once every 2 s)
- Good for -40 to 80° C temperature readings ±0.5 C accuracy
- 4 pins with 0.1" spacing
- Body size 15.1 mm × 25 mm × 7.7 mm

Solar Tracking System (Renewable Power Supply)

An alternative energy source is badly required. Now a day, the best alternative is to use a renewable energy source and more precisely is the 'Solar Energy'. Solar energy technology is not yet mature enough to be widely accepted as a primary energy source for the general population, it does have some unique advantages. Considering the need of renewable energy source, we develop this module known as the solar tracker to supply the electricity required for the farmland and perform as an alternative power source.

Fig -5 Light Dependent Resistance

A solar tracker is a device that orients a solar panel towards the direction of the Sun. For flat-panel photovoltaic systems, trackers are used to minimize the angle of incidence between the incoming sunlight and a photovoltaic panel. This module, we have made, is basically an automatic single axis solar tracker. Here Light Dependent Resistance (LDR) is used for sensing the sun light direction. The panel will automatically rotate towards the sun to get the maximum intensity of light and is able to concentrate as much energy as possible.

Arduino Interfacing with Light Dependent Resistance

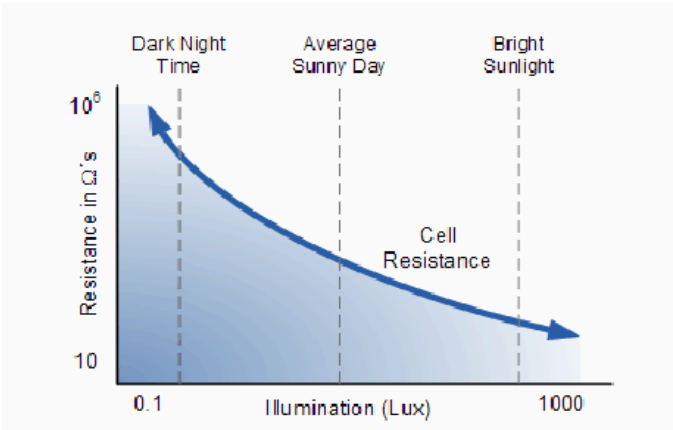


Fig -6 Experimental Result of LDR

LDR is a passive component that decreases resistance with respect to receiving luminosity (light) on the component's sensitive surface. The resistance of a photoresistor decreases with increase in incident light intensity.

Passive infrared Motion Sensor

A passive infrared sensor (PIR sensor) is an electronic sensor that measures infrared (IR) light radiating from objects in its field of view like human and animals motion. Problems caused by the birds as discussed in the previous section, strong equipment is required to help the farmer to get rid of this unsustainable problem. So, when it comes to keep birds, raccoons and other pests away from the farmland, the Electronic Scarecrow (PIR sensor) Unit is one of the best ideas we have encountered. Electronic scarecrow can be used to keep pests off from farmland. It is not like an ordinary scarecrow, used to distract or to scare the birds or animals, but a unique module to keep the threats away from the crops. PIR sensors is made of pyro-electric material which has two slots in it.

Fig -7 PIR Motion Sensor

When an object like bird passes by, it first intercepts one half of the sensor which causes +ve differential change between the two halves and when the object leaves the reverse happens which generate a –ve differential change, thus change of pulses are detected. HT-7133 voltage regulator, BIS0001 micro power PIR motion detector IC, Fresnel lens helps for the operation. When any object is detected the unit will perform some actions to keep them away from the crops. A buzzer may be used in this module to make a noise to keep the unwanted species away.

Arduino Interfacing with Passive Infrared sensor

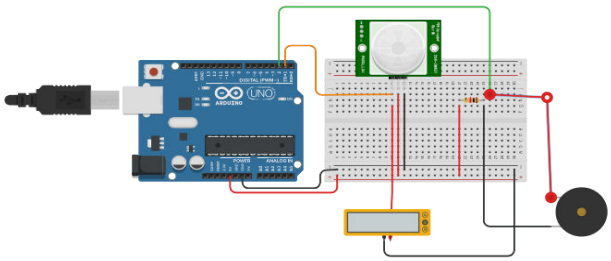


Fig -8 Arduino Interface with PIR motion sensor through buzzer and LCD display

Here we are using HC-SR501 motion sensor which has Sensing range of less than 120 degree, within 7 meters through Buzzer if any suspicious activity occurs on field it will sound until object escape from that place.

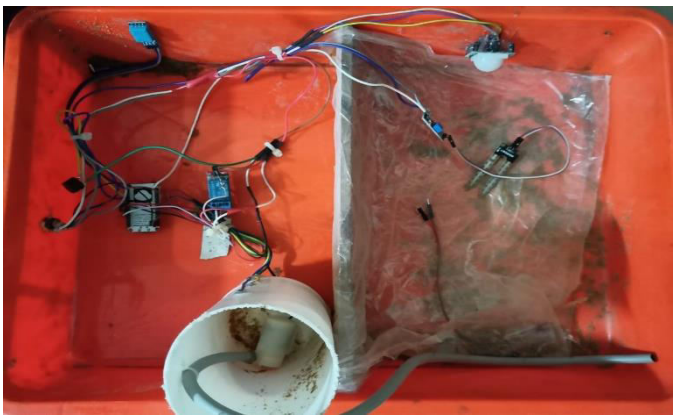


Fig -9 Small-Scale Experimental Model setup of "Smart Energy Farming System"

4. PROGRAM CODE

For implementation of system, we executed program in Arduino Software as follow:

```
#define BLYNK_PRINT Serial

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#include <ESP8266WiFi.h>

#include <BlynkSimpleEsp8266.h>

#include <DHT.h>


char auth[] =
"TUSNUQRiLOiMkH8op6aiZynHuXhPmWFY";

char ssid[] = "TUP ELECTRONICS";  //change ur
hotspot/wifi name here

char pass[] = "tup@1234"; //change urpassward here


#define DHTPIN D3          // What digital pin we are
connected to

int SoilSensor=A0;

int Motion =D1;

int Buz=D2;

int L1=D5;

int L2=D6;

int Pump=D7;


#define DHTTYPE DHT11     // DHT 11

//#define DHTTYPE DHT22   // DHT 22, AM2302, AM2321

//#define DHTTYPE DHT21   // DHT 21, AM2301

DHT dht(DHTPIN, DHTTYPE);

BlynkTimertimer;

// This function sends Arduino's up time every second to
Virtual Pin (5).

// In the app, Widget's reading frequency should be set to
PUSH. This means

// that you define how often to send data to Blynk App.

void sendSensor()

{

  //float h = dht.readHumidity();

  //float t = dht.readTemperature(); // or
dht.readTemperature(true) for Fahrenheit


  // You can send any value at any time.

  // Please do not send more that 10 values per second.

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

```
Blynk.virtualWrite(V6, t);
 int S=analogRead(SoilSensor);
Blynk.virtualWrite(V7, S);
 if(S>800)
 {
digitalWrite(Pump,LOW);
delay(2000);
 }
 else
digitalWrite(Pump,HIGH);
}

void setup()
{
 // Debug console
Serial.begin(9600);
Blynk.begin(auth, ssid, pass);
dht.begin();
pinMode(SoilSensor,INPUT);
pinMode(Motion,INPUT);
pinMode(Buz,OUTPUT);
pinMode(L1,INPUT_PULLUP);
pinMode(L2,INPUT_PULLUP);
pinMode(Pump,OUTPUT);
 // Setup a function to be called every second
timer.setInterval(1000L, sendSensor);
}

void loop()
{
Blynk.run();
timer.run();
 if(digitalRead(Motion)==LOW)
 {
digitalWrite(Buz,HIGH);
delay(500);
 }
 else
digitalWrite(Buz,LOW);
}
if(digitalRead(L1)==LOW)
 {
Blynk.notify("WATER TANK FULL");
 }
 if(digitalRead(L2)==LOW)
 {
Blynk.notify("WATER TANK BELOW 30%");
 }
}
```

5. RESULT AND CONCLUSION

As you can see, the final result is a timestamped graph with two y axes. The project overall worked quite well, and over more days we were able to see clear periodicity of the temperature (Navy Blue line) and humidity (yellow line), along with a linearly decreasing trend of the soil moisture (Blue line) as expected! This data is completely raw, and there are several ways this project could be made better.

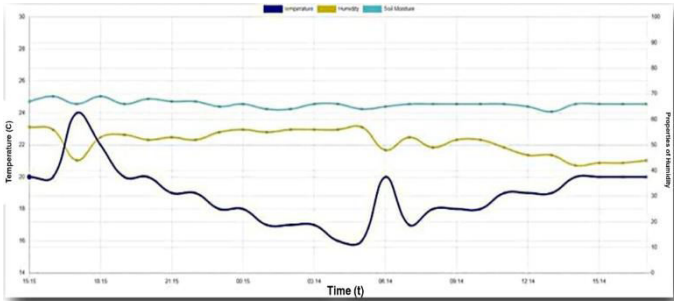

Fig -10 Graphical Representation of all component's observation

By testing the soil with our module, farmers and gardeners will have an accurate data on the condition of the soil i.e., the temperature, moisture level and also the humidity of the surrounding. Testing soil helps to increase the productivity by identifying soil nutrients or soil chemical factors that are limiting plant growth and increases fertilizer use efficiency by indicating appropriate rates for different soils and crops. The Electronic Scarecrow is an Effective Deterrent for several reasons such as it can workday and night without chemicals and can be linked to other Scarecrows. The animals and pests will be far away from the farmland. One Scarecrow covers around 5 meters and can operate up to 6 months on a single 9-volt battery. There is no need to walk to the field just to start the pump and wait until the time when it must be stopped. Solar tracking device and the auto garden light control will help to save energy and use the renewable energy source. The electricity problem of villages can be solved up to some extent. Smart Agriculture Solution'' can be used in so many platforms or organizations related to agriculture or cultivation. Ex- Farmers, Gardeners, Institute of Food and Agricultural Sciences, Ministry of agriculture, Horticulture: Greenhouse Cultivation, Nursery Cultivation. 'Smart Agriculture System' will help the agriculture industry in direct likewise indirect way. This system includes the smart phone application and IOT integration will help to use the advanced technology.

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