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Smart Agriculture System Using IoT

Sharavani Patil[a], Manali Jadhav[a], Samruddhi Khichade[a], S.P. Mohite[b].

[a]*Student, Sanjay Ghodawat Polytechnic, Atigre, India*
[b]*Faculty (C.S.E), Sanjay Ghodawat Polytechnic, Atigre, India*

A B S T R A C T

From ages agriculture is being done in every country. Agriculture is the craft and science of developing plants. Agriculture was a very important aspect in terms of development of the country. As the world is moving towards the trending technologies for the automation it become very important to introduce these trending technologies in the field of agriculture to increase the production and quality of the crops. Smart agriculture is an emerging concept, because IOT sensors are capable of providing information about agriculture fields and then act upon based on the user input. In this Paper, it is proposed to develop a Smart agriculture System that uses advantages of cutting-edge technologies such as Arduino, IOT and Wireless Sensor Network Smart Agriculture Technology in Farming is the idea that refers to operating farms, utilizing modern information and communication technologies to enhance the quantity and quality of crops. The objective of smart technology is to establish an intelligent foundation system for farm management. In this IoT-based smart farming, a system is built for monitoring the crop field with the help of sensors (light, humidity, temperature, soil moisture, etc.) ... In terms of environmental issues, IoT-based smart farming can provide great benefits including more efficient water usage, or optimization of inputs and treatments on crops. Main benefit of Smart Agriculture System- Automatically irrigate a piece of land and wirelessly spray fertilizers and pesticides using our phone.

Keywords: Smart, Agriculture, System, Using IoT

1.Introduction

Smart Agriculture System Technology is the idea that refers to operating farms, utilizing modern information and communication technologies to enhance the quantity and quality of crops. As the name suggests, this IoT-based project focuses on developing a smart agricultural system that can perform and even monitor a host of farming tasks. For instance, you can schedule the system to irrigate a piece of land automatically, or you can spray fertilizers/pesticides on the crops wirelessly through your smartphone. This IoT-based project can also successfully monitor soil moisture. Such an advanced system can handle the routine agricultural tasks, thereby allowing farmers and cultivators to focus on more manual intensive agricultural tasks. Most of us have a small garden, farmland or a plantation area. Our busy schedule, however, doesn’t allow us to maintain it well. But with the use of technology, we can easily achieve it. So, we are going to make an IoT-based smart agriculture system that can monitor soil moisture. Through this device, we will be able to automatically irrigate a piece of land and wirelessly spray fertilizers and pesticides using our phone while we are busy with other work. Proposed framework utilizes IR sensors to take programmed meter perusing. To get digits isolate out and to ascertain the bill for the month processor is utilized with form calculation. In this system, Arduino is used because it is a Single board microcontroller. On the off chance that we need to, we can utilize the Arduino to surf the web, send an email and numerous all the more utilizing a word processor. After that, this bill is send to the server remotely utilizing WIFI module and show on LCD for client’s reference. Service provider which will have application can see the status of consumption of electricity and according to the electricity consumption per unit bill is generated. From android application user will get the amount of energy consumption and cost [3]. This system uses the current sensor to detect the flow of electricity through the lines as well current sensor also detects the number of units of current transferred through the lines. Later the electricity vendor specifies the cost per unit of current. Number of units consumed is multiplied with the cost per unit, which gives the total cost per consumed energy.

2.LiteratureReview

The system presented by aims at adopting IoT in agriculture to exploit automation approach. Monitoring environmental factors plays a vital role to increase the production of the efficient crops. Two most important natural factors are considered in this study namely temperature and humidity of the field. Humidity sensor sense the water in air. The proposed system consists of temperature (TMP007) humidity (HDC1010) sensors and CC3200 single chip. The CC3200 is a cheap and faster programmable WiFi MCU that enables true, integrated IoT development. If sensor sense abnormal reading, it transmits field information about the temperature, humidity to famers. A camera is linked with this chip to take images and send to farmers via MMS and subsequently the farmer will take appropriate action.Paper describes an online food menu is set up by the proposed food ordering system and as per theirwill customers can easily place the order. Also, customers can easily track the orders with the food menu. The management improve food delivery service and preserves customers database. Motivation to develop the system is from the restaurant management system. To get the services efficiently the users of the system provide various facilities. Restaurants as well as Mess facility is considered by our system for the customers. Mostly mess users are person who are shifted to new cities and this can be considered as a motivation to our system. Another motivation can be considered as the increasing use of smart phones by the customers, so that any users of this system get all service of the system. The system will be designed to avoid users doing fatal errors where users can change their own profile also where users can track their food items.

Benyezza H., Bouhedda M., Djellout K., and Saidi A. (2018). Smart Irrigation System Based Thing speak and Arduino. International Conference on Applied Smart Systems (ICASS). Doi: 10.1109/icass.2018.8651993.
A smart framework proposed to optimize the use of water and assist the famers to monitor their fields remotely without visiting their lands. System consists of two sensors, water level sensor and soil moisture sensor to monitor the moisture in soil. Sensed values transmit to Thing Speak cloud via ESP8266 Wi-Fi module. Talkback is created that makes commands whether water the plants or not. [1]

Rao R., and Sridhar B. (2018). IoT based smart cropfield monitoring and automation irrigation system. 2Nd International Conference on Inventive Systems and Control (ICISC). Doi: 10.1109/icisc.2018.8399118.
Exploits the LM35 temperature sensor and soil moisture sensor that is deployed in field and used to monitor the water supplements. Proposed a system comprises of LM35 temperature sensor, moisture sensor, RPi 3 model B, IC 3208 converter, relay and a buzzer. A threshold value 2.4v is set for soil moisture; this may vary from crop to crop. If the value is found less than the set threshold (2.4v in this case) the soil is classified as dry and signal is sent to turn on the water pump. Otherwise, Soil is classified as wet and motor will be turned OFF. The data acquire from sensors are ingested to the cloud and can be accessible to farmer via his/her mobile/PC. The system let the farmer when to turn ON/OFF the water pump.

Mishra D., Khan A., Tiwari R., and Upadhyay S. (2018).” Automated Irrigation System-IoT Based Approach”. 3rd International Conference on Internet of Things: SmartInnovationandUsages (IoT-SIU). Available: https://ieeexplore.ieee.org/document/ 8519886 [Accessed 25 November 2019].
Uses single sensor and the purpose of this system is to decrease the wastage of resources (water, labour) and increase yields.System presented in [3] [4] can be improved by adding humidity sensor (humidity in air), pH sensor, water level sensor and weather monitoring sensor, GPS technology for a geographical area identification. Data transfer resolution is not mentioned. Implementation of machine learning (ML) will further make the system smart and automate. [4]

L. G., S. P., and V. R. (2017). Smart Agriculture System based on IoT and its Social Impact. International Journal of Computer Applications, 176(1), pp. 1-4. Doi: 10.5120/ijca201 7915500.
Suggested IoT based system that facilitates the water management, crop monitoring and pesticides control. The system has two section agro logger and cloud interface with mobile application. The agro logger comprises of Arduino mini pro microcontroller board, five sensors (LM35 temperature sensor, moisture sensor, barometric pressure sensor, humidity sensor and light sensor) and actuators (consists of sprinkler irrigation valve, fertilizer controlling valve, humidity water spray valve) and these are all connected with Xively (an IoT open source platform enabling developers to connect sensor information to the Web and to shape their own applications on it) via Wi-Fi wireless communication module. Two modes of operations are used in this system; manual mode and auto mode. In manual mode user has to operate sprinkler irrigation valve, fertilization supplements and water spray valve and in auto mode these activities performed by the system. If the sensed information crosses the predefined value heater or fan will be turned ON/OFF. Water consumption is control via Android app in manualmode.[2]

3. Objective and Scope

3.1Objective of project:

Farming is the main occupation in India which accounts to more than 60per of Indian economy. Use of ineffective means of farming leads to decrease in crop output requiring large manpower. Many farmers are abstaining from farming as they could not produce enough profit. We being engineers tend to propose innovative means of farming which will be cost efficient will also boost the economy.

3.2 Scope of project:

Our proposed system will be highly beneficial to farmers as farming accounts to more than 60per of occupation in our country. Also crop production will be increased if our system is used as it uses IOT different sensors to gather information regarding irrigation outputs also provides protection to farms. Also, farmers can use remote technology activate/deactivate water pumps which are powered by clean sources of energy thus keeping the environment clean. We made our project user friendly keeping in mind that our main customers are farmers who are not so educated. First of all, we have to teach them and show them how our project works and how they will be benefited.

4. Core Technology

4.1.1.1. WHAT IS C

C is a programming language as we know .it is a general-purpose computer programming language. It was created in the 1970s by Dennis Ritchie at Bell Labs, and remains very widely used and influential. By design, C's features cleanly reflect the capabilities of the targeted CPU's. It has found lasting use in operating systems, device drivers, protocol stacks, though decreasingly for application software, and is common in computer architectures that range from the largest supercomputers to the smallest micro-controllers and embedded systems.

4.1.1.2 USES OF C

C language is much popular for embedded systems programming due to its flexibility. Programs written in C programming language are easy to read, understand and edit. C language is free, and you do not have to pay anything even if you are using C language for embedded systems. 4.1.1.2 FEATURES OF C The main features of C language include low-level access to memory, a simple set of keywords, and a clean style, these features make C language suitable for system programming's like an operating system or compiler development. Features of C Programming Language: Procedural Language. Fast and Efficient.

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4.1.1.3. C LOOP USED IN OUR PROJECT void loop ():

The loop is another function that Arduino uses as a part of its structure. The code inside the loop function runs over and over as long as the Maker Board is turned on.; (semicolon) The end of a command or statement.

4.1.2. Arduino uno

The Arduino Uno is a type of Arduino board that is provided as an opensource board that uses an ATmega328p microcontroller in the board. The Arduino Uno contains a set of analog and digital pins that are input and output pins which are used to connect the board to other components. There are a total of fourteen I/O pins placed inboard in which six are analog input pins. The board has a USB connection that can be used to a power supply to the board. The board is used for electronics projects and used to design the circuit.

4.1.2.1. What is Arduino uno?

The Arduino UNO is categorized as a microcontroller that uses the ATmega328 as a controller in it. The Arduino UNO board is used for an electronics project and mostly preferred by the beginners. The Arduino UNO board I type of Arduino board only. The Arduino board is the most used board of all Arduino boards. The board contains 14 digital input/ output pins in which 6 are analog input pin, one power jack, USB connector, one reset button, ICSP header, and other components. All these components are attached in the Arduino UNO board to make it functioning and can be used in the project. The board is charged by USB port or can be directly charged by the DC supply to the board.

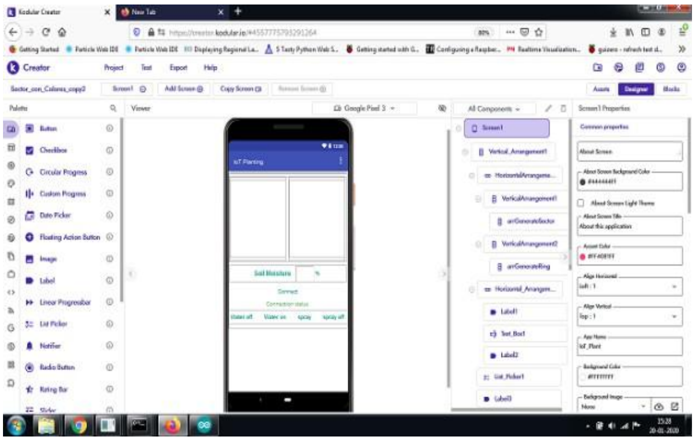
4.1.2.2. Why is Arduino uno used?

The Arduino UNO board is mostly used by the beginners that can use in electronics project and do programming in this board. The board has regular innovation and a bug fix in the design of the board to make the board suitable for the project's use. The Arduino UNO board is considered as the most used board and a standard board used by the rookie in their projects. The Arduino UNO board is primarily used over other Arduino products because of the following reasons. 1) As the board can be easily connected to the other computer system via USB port. The USB port fixed in the board serves two purposes. It can be used to supply the power supply to the board and can act as a serial device to connect the board to a computer system. 2) The board is capable to get the power supply from DC adaptor having a voltage of 12 V. The board can be charged from this external power supply.

4..3.1 KodularCreator

Kodular Creator (formerly known as Makeroid) is the main web app andthe core of all services.It is built primarily for newcomers to computerprogramming to create software applications for the Android operatingsystem (OS). It has a user graphical interface,similar to Scratch, MITApp Inventor, and its distributions. Only by dragging and dropping a fewcomponents, and joining some blocks as in Scratch the app is made.ItrunsonGoogleAppEngine,usingseveralGoogleCloudservices.

ThereisaProject'sDashboardwithcardscontainingeachappdetails.On the creator area, there are two pages:Designer and Blocks.On theDesignerthereisatoppanelwithdropdownsandfourmainsections:Palette,Mock,ComponentsandProperties.OnthePalettesectionthereis a list of all available components to drop on phone's Mock to design theapp. All components can be viewed as a list with its parent in the Componentspanel,andonPropertiessectionuserscanchangevisualpropertiesofthosecomponents.OntheBlockspagethereisaBlocklypanelwhichisusedtojoinb lockstocodetheapp.



4.3.1.1. AppLayout

5. UML Diagrams

5.1 Flowchart:

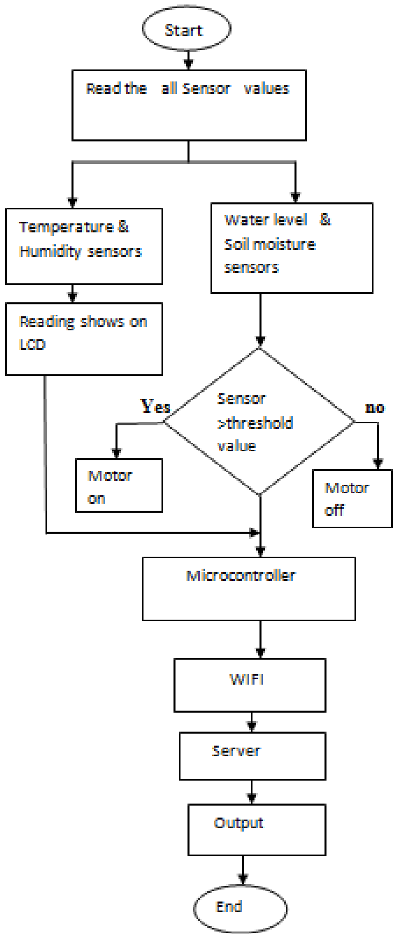
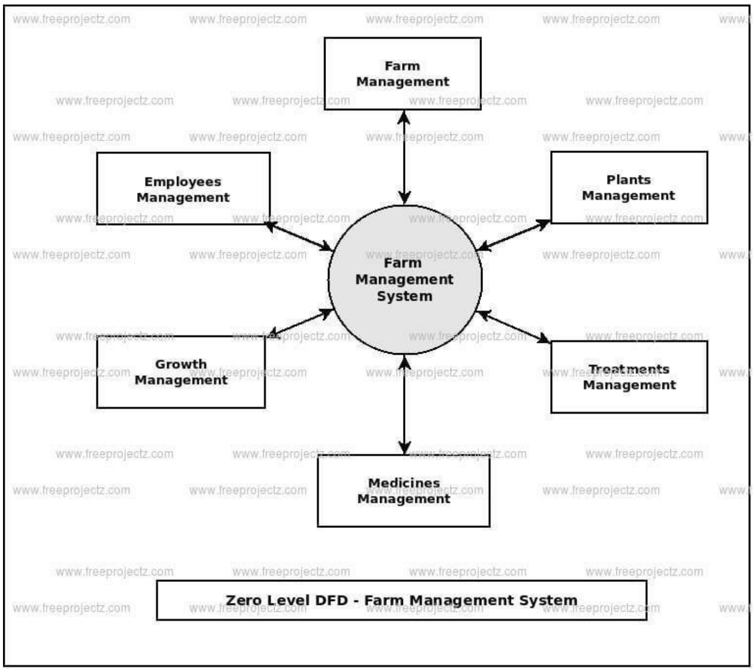
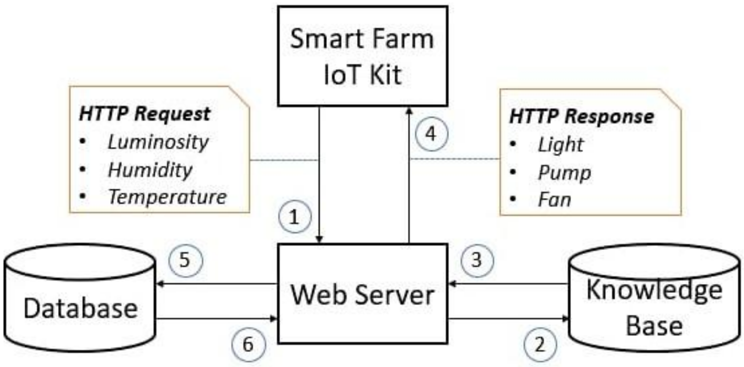


Figure 5.1.1 Flowchart

5.2 Data Flow Diagrams:



5.2.1 DFD Level 0



5.2.2 DFD Level 1

6.System Coding

```
void setup(){
 int fertilizerpin=7;
 int waterpin=6;
```

```
 flo tsoilraw=0.0;
 a
 flo tsolimoist=0.0;
 a
 int senpin=A0;
 int average;
 int val;
 int readval=0;
 int serialA=0;


}
void setup()
{
  Serial.begin(9600);

  pi Mode(senpin,INPUT);
  n
  pi Mode(fertilizerpin,1);
  n
  pi Mode(waterpin,1);
  n
   pinMode(13,OUTPUT);
}
voidloop(){
   if(Serial.available()>2){
    serialA=Serial.parseInt();

  }



   if(serialA==4){
  digitalWrite(fertilzerpin,1);
}
   if(serialA==8){


  digitalWrite(fertilizerpin,0);

}
    if(serialA==7){
  soilraw=analogRead(senpin);
  soilmoist=map(soilraw,1024,0,0,100);
  for(inti=0;i<160;i++)
```

```
    average=average+soilmoist;

  }
  val=average/160;
  average=0;
```

```
Serial.println(val);
delay(1200);
if(val<40){
  digitalWrite(waterpin,HIGH);
  ]
  if(val>60){
   digitalWrite(waterpin,LOW);
  }

  }
```

6.1 Screenshots:

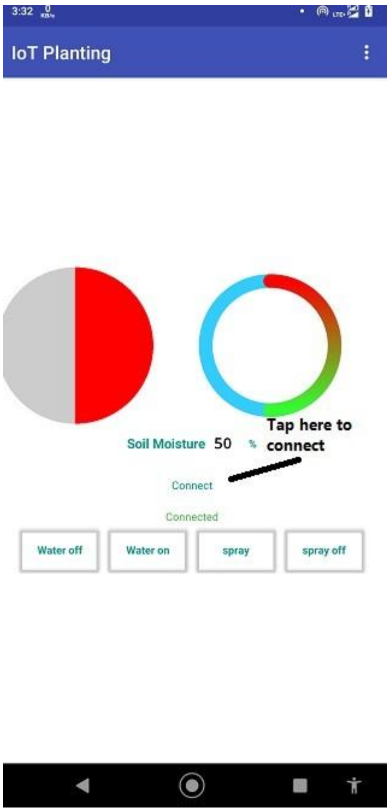


Figure 6.1.1 Starting Screen
This is a Starting Screen

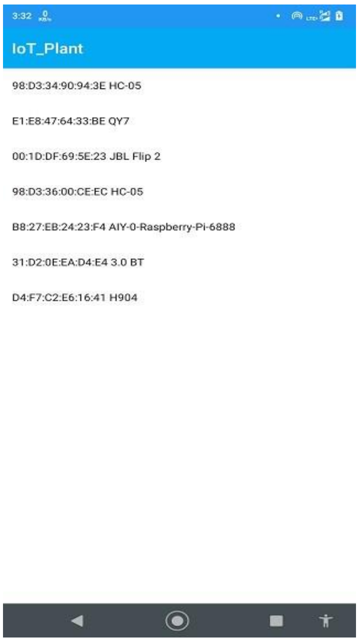


Figure 6.1.2 Bluetooth Devices for connection

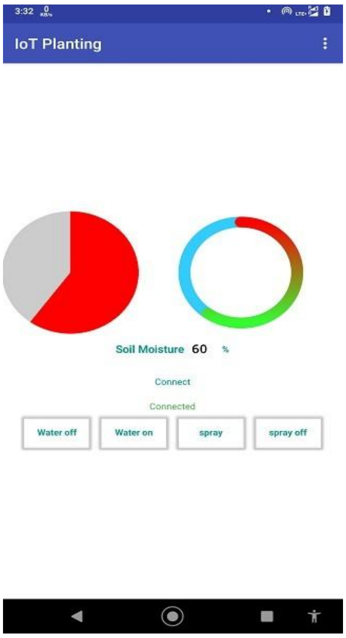


Figure 6.1.3 Showing the data

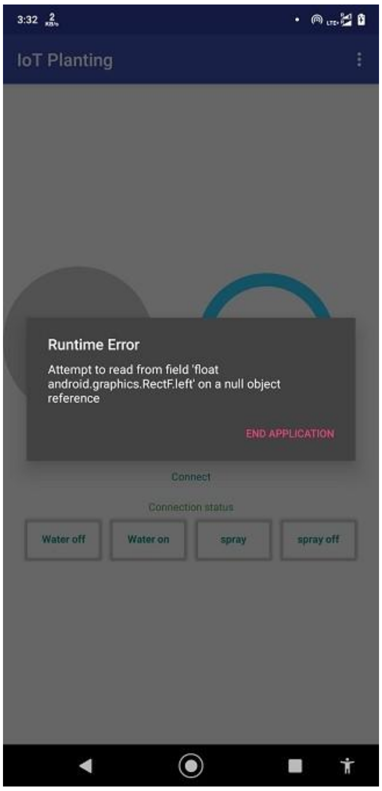


Figure 6.1.4 Version Error

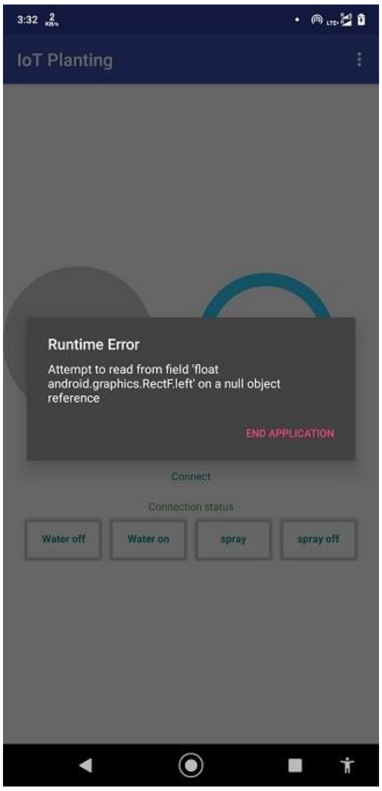


Figure 6.1.5 blue tooth connectivity error

7.Testing and Results of Project

7.1TESTING METHODOLOGIES

- Black box Testing
- White box Testing

7.1 LEVELS OF TESTING

- Unit Testing
- Integration Testing
- System Testing

7.1TESTING METHODOLOGIES

- **Black box Testing**

It is the testing process in which tester can perform testing on an ap- plication without having any internal structural knowledge of application.Usually Test Engineers are involved in the black box testing.

- **White box Testing**

It is the testing process in which tester can perform testing on an appli- cation with having internal structural knowledge. Usually, The Developers are involved in white box testing.

- **LEVELS OF TESTING**

- **Unit Testing**

Unit Testing concentrates on the verification of the smallest element of the program i.e., Module. In this testing all control paths are tested to identify errors within the bounds of the module. The important goal of unit testing is to isolate each part of the program and show individual parts are correct. It is very easy to perform and requires less amount of time because the modules are smaller in size. In unit testing it is possi ble that the outputs produced by one unit become input for another unit hence, if incorrect output produced by one unit is provided as input to the second unit, then it also produces wrong output. If this process is not corrected, the entire software may produce unexpected outputs. To avoid this, all the units in the software are tested independently using unit –testing. In unit testing, the units are tested to ensure that they operate correctly. In software engineering the unit testing is not just performed once dur ing software development, but repeated whenever the software is modified.

- **Integration Testing**

When unit testing is complete, integration testing begins. In integration testing the tested units are combined together to form system as whole. The aim of this testing is to ensure that all modules are working properly according to user's requirements when they are combined. The integration test takes all tested individual modules, integrate them, test them again and develop the software. It ensures that all modules work together prop- erly and transfer accurate data across their interfaces.

Integration testing contains: -

- **Non –Incremental integration:** The entire program is tested asa whole and all errors are identified.

- **Incremental integration:** The program is constructed and testedin small segments, to find out errors.

- **System Testing**

System testing is the next level in the testing and tests the system as a whole. Once, all the components are integrated, the application as a whole is tested to see that it meets Quality Standards. This type of testing is performed by a specialized testing team. System testing can be defined as ”a testing conducted on a complete, integrated system to ensure that the system is according to its specified requirement”.

- **Test Development**
  - Test case Development (check list)
  - Test Procedure preparation. (Description of the test cases)
- **Test Execution**
  - Implementation of test cases. Observing the result.
- **Result Analysis**
  - Expected value: is nothing but expected behavior of application
  - Actual value: is nothing but actual behavior of the application
- **Bug Tracing**
  - Collect all the failed cases, prepare documents.
- **Reporting**
  - Prepare document (status of the application)

Example for GUI Test cases

Table 7.2.1 GUI Test Case

T.C. No	Description	Expectedvalue	Actual value	Result
1	Checking whether all the componentsare properly ar- ranged or not	The GUI must con-tain all the components properly arranged	Arranged prop- early.	Pass
2	Checking the alignment of com- ponents placed.	The align- ment should be in proper way	Alignment shouldbe correct.	Pass

- **System Configuration**
  - **Hardware Requirement**

    Operating System-Windows 7 ,

    Windows 8, Android
    Arduino App Arduino
    Compiler Languages- C
    koduler Creater
  - **Software Requirement**

    Processor - Core 2 DuoRAM -
    512 MB (min)
    Relay Module - 2 Soil
    moisture sensorBluetooth
    HC 05 Solenoid Value
    Pipes
    Wires

- **Advantages of Project**

9.1 Advantages:

1)Modern machines can monitor and control farmer’s efforts.

2)The amount of time saved as a result of the IoT program could besignificant. And, in today’s world, we could all use a little more energy.

3)Maintain a successful soil moisture monitoring system.

4)We can program the system to automatically irrigate a plot of land.

5)We may use your smartphone to spray fertilizers and insecticides onthe crops remotely.

9 Conclusion:

The IoT agricultural applications are making possible for farmers to Automatically irrigate a piece of land and wirelessly spray fertilizers and pesticides using our phone. Large landowners and small farmers must un- derstand the potential of IoT market for agriculture by installing smarttechnologies to increase competitiveness and sustainability in them producSSSSStions. With the population growing rapidly, the demand can be success- fully met if the ranchers, as well as small farmers, implement agricultural IoT solutions in a prosperous manner.

- **FUTURE ENHANCEMENT**
  - Global connectivity through any devices.
  - Minimum human efforts.
  - Faster Access.
  - Time Efficiency.
  - Efficient communication.

REFERENCES:

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2) .Rao R., and Sridhar B. (2018). IoT based smart crop-field monitoring and automa- tion irrigation system. 2Nd International Conference on Inventive Systems and Control (ICISC). doi: 10.1109/icisc.2018.8399118.

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