IoT in Agriculture
Smart Irrigation System

By,
17BIT103 - Het Shah
17BIT104 - Saiyam Shah
17BIT105 - Karan Sheth

Guided By-

Dr Ankit Thakkar

DEPARTMENT OF INFORMATION TECHNOLOGY
Ahmedabad 382481

ACKNOWLEDGEMENT

We would like to express our deepest appreciation to all those who provided us the support to complete the innovative assignment. We acknowledge with thanks, the support rendered by Dr. Ankit Thakkar, under whose aegis we were able to complete the task in a given period of time. We also appreciate the constructive suggestions given by our friends and classmates.

ABSTRACT/ Outline

- In this report, we have discussed the importance and need of IoT in agriculture and how smart farming can be useful to farmers to increase the crops productivity. We have made a smart irrigation system using IoT hardwares and an application in MIT app inventor through which we are showing real time water content of the soil and also suggesting required water content of particular crops to the farmer. Farmers will also be able to start and stop the motor to supply water through the application which we have created.

CONTENTS

1 Introduction-

1.1 General

Internet of things is a worldwide network of interconnected objects which are addressed uniquely to transfer data through any network without requiring any human interference.

Nowadays with increase in size of population and sudden change in climate we already have reached a limit by the current way of agriculture production as a result food security might be a major problem in near future. Thus we need a smart way for farming which is provided by IoT based smart devices due to which productivity and quality of food both can be increased. Using IoT devices we can collect data on water content in soil, temperature, rainfall, humidity etc.. We can also collect data of any particular crop growth in different environmental conditions and suggest to the farmer how much water content is required, how much temperature is best suited by the crop , etc. to have the farmer best yield for his work and wastage of resources can also be avoided. It has been predicted that production of food will be increased by 70% till 2050 using IoT based smart devices.

1.2 The Benefits of smart farming:

1.2.1 Crop water Management - With the data we get from IoT devices we can know how much water is required by the crop and with the help of soil moisture sensors we can know water content in the soil and provide the water accordingly reducing wastage of water.

1.2.2 Precision Agriculture - This approach is based on real time data on the condition of the crop to ensure that crop gets exactly what it requires at exact time with change in environmental condition to give better yield and reduce the chances of crop damage.

1.2.3 Automation - By automation of multiple processes like irrigation using IoT devices work can be done efficiently and precisely.

1.2.4 Planning - You can know what will be the output of your product and how much crop is needed to be harvested so that product doesn't go unsold by analysis of the market using IoT based devices.

1.2.5 Pest management - Sometimes crops destroyed by the predators which can be avoided by PIR sensors that detect the motion of predators and can warn the farmer about it. Thus damage can be avoided.

2 Literature Survey

2.1 General

The Literature survey covered papers and books that introduced IoT in Agriculture in detail and discussed the process of how it can change the future of agriculture. Papers that focused primarily on the technology underlying IoT in Agriculture were studied to determine the topics.

Application of IoT in agriculture

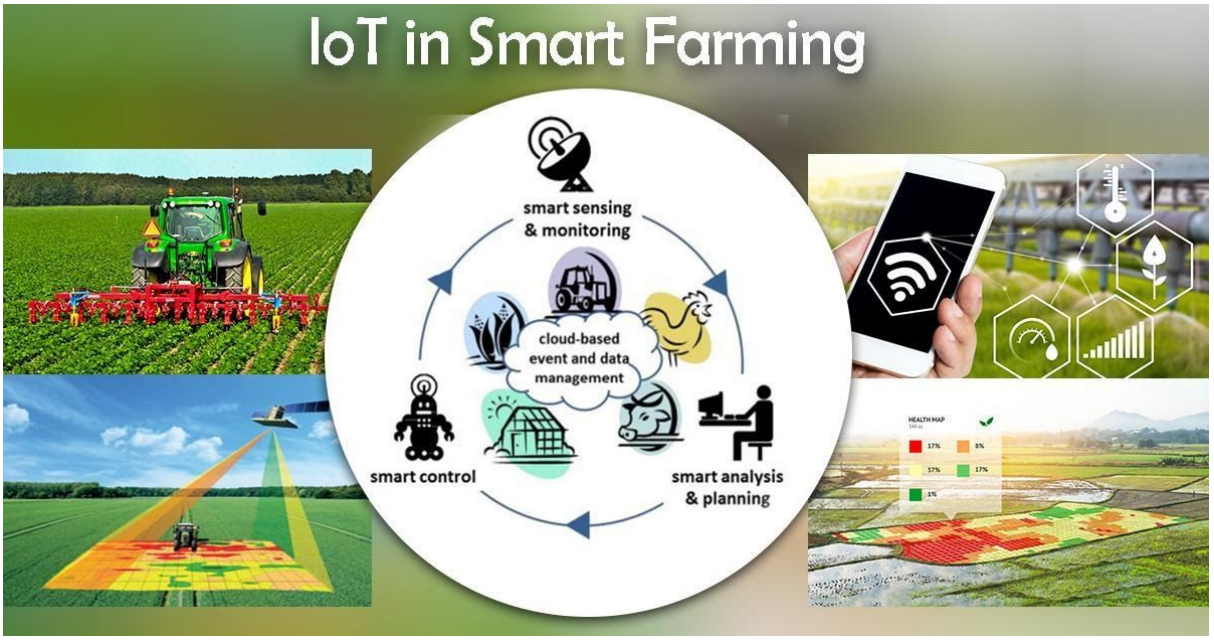

Fig - 3.1 Smart Farming

3 Smart Irrigation System

Smart Irrigation system has been developed so that with the same piece of land how can you give the farmers more opportunities to give better result and also by making their work easier by making them understanding what crop should be grown when and what is ideal time for watering the plants and when should farmer not provide water by assessing the weather forecast. One such smart irrigation system is made using components like

3.1 Components Used -

- Arduino Uno
- Soil Hygrometer module(YL-69)
- HC-05 Bluetooth Module
- Motor/water pump
- Plant
- Relay Switch
- Jumper wires
- Breadboard

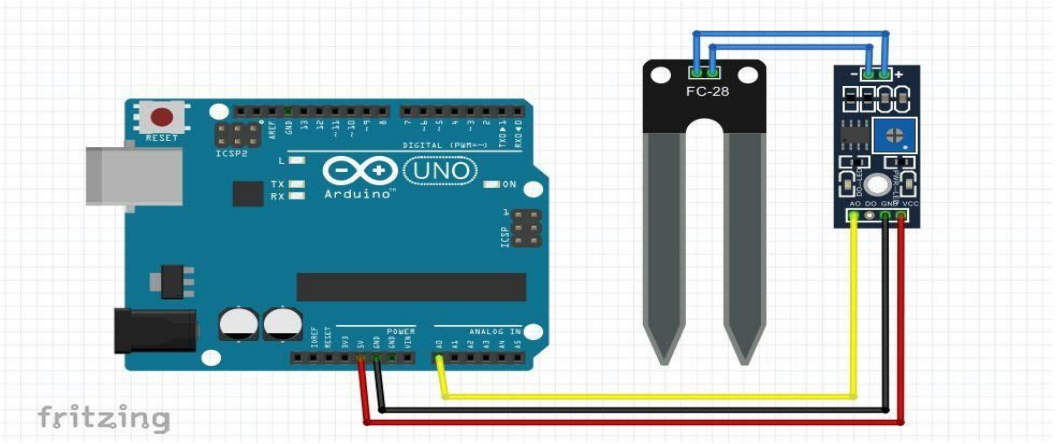

Fig - 3.2 Soil Moisture Sensor

3.2 Working of Sensor

- The soil hygrometer module which is used to measure the amount of water in the soil consists of two probes.
- Of these two probes one is positively charged and other is negatively charged thus it allows current to pass through soil and then moisture value is measured with help of resistance value and then that moisture value can be converted to percentage moisture with help of map function in arduino.
- Less is the resistance more is the moisture value and thus the resistance will be less when the moisture content will be more.

3.3 How does it work?

- Here soil moisture sensor is used to measure the water content in the range of 0 to 1023 which is converted to percentage moisture level by using a map function in an arduino whose value can also be shown on the screen.
- I have made one application using MIT app inventor which is to be connected to the arduino using bluetooth module HC-05 or through wifi. The main advantage of HC- 05 module is that it can send and also can receive data at same time.
- The application connected with bluetooth will show you real time data of moisture content in the soil and also it has ON and OFF buttons.
- Thus when the moisture content is less than the prescribed or already installed value the farmer can start the submersible pump with the help of ON button to give water to the crops from distant places. And if he knows that there is going to be rain and he doesn't want to give water he can press OFF button.
- The pump will automatically stop after the water level reaches the certain fixed value.

3.4 Analysis & Future Aspects

CROP	%Water Requirement (taking 3000mm as 100%)
Rice	30% - 83%
Sugarcane	50% - 83%
Banana	40% - 73%
Cotton, Citrus, Grape	25% - 40%
Tomato, Maize	20% - 27%
Potato, Groundnut	17% - 23%
Wheat, Tobacco, Sorghum	15% - 22%
Cabbage	13% - 18%
Onion, Pea, Sunflower	12% - 17

Table - 3.1 Analysis of Different Crops

- Thus as seen from the above table it states that we can set our threshold value for starting the pump according to moisture content required by that crop so that yield is better.

- Another thing we can do is that after the code is built/established in the arduino we need a battery for the usage of a submersible pump but instead we can use a solar panel and external battery. Where solar panels will generate electricity from the sun which can also be stored in an external battery and can be used for working of submersible pumps.

4 Problems faced & resolved during project

4.1 Hardware Side

1)

Problem: Why must the Rx, Tx of bluetooth should not be connected to the Arduino when the code is uploaded?

Solution: The reason is that if the bluetooth is already connected to +5V it will send a charge to the TX and RX cables causing the Arduino to stop mid-upload and report an error.

2)

Problem : When testing the bluetooth with a connected device it was not working properly?

Solution: Because it only works if it is connected in an app, not if it's just simply paired.

3)

Problem : How to convert the analog reading ranging from 0 to 1023 into a percentage that varies from 0 – 100%?

Solution: Basically we wanted discrete values ranging from 0 to 100 to show real time percentage moisture content. For this problem we create a mapping function which generally mapped the analog reading to discrete values(i.e Normalization into 1 to 100).

4)

Problem: Connecting Rx to Rx pin of bluetooth and Tx to Tx pin of bluetooth didn't work?

Solution: While testing we came to know that they're opposite because the Bluetooth chip is sending on TX, so the Arduino receives that on a RX pin.

5)

Problem : HC-06 bluetooth will not work if we include commands same as HC-05 ?

Solution: HC-06 AT commands have no line endings at the end and no spaces between the command name and the input. It's AT+NAMEYOUR_NAME, not AT+NAME YOUR_NAME.

6)

Problem : Mit app Inventor doesn’t get the data from the module.

Solution: The baud rate should be kept low(9600) for the same.

7)

Problem : The bluetooth does not pair with the app immediately the first time.

Solution: First make sure the bluetooth of the phone is turned on and second the HC-05 device has been paired with the phone at least once before.

5 Summary & Conclusion

5.1 Summary

- We have discussed what is the importance and need of IoT in agriculture, how smart farming can be useful to farmers to increase the crops productivity. It also includes how the application made can ease the work of the farmer and give proper suggestions so the healthy crop is cultivated.

5.2 Conclusion

- From this we can conclude that using this setup of arduino we can reduce the effort of farmers as well as at the same time we can increase the production of the crop in the same period of time and with the same number of resources.
- Likewise, it must be remembered that the space for blunder in a 'smart framework' is very less than that in a conventional setup. But, a mechanical disappointment or a system obstacle can have genuine consequences.

References

1) Sundmaeker, H., et al., Internet of Food and Farm 2020, in Digitising the Industry O. Vermesan, Friess, Peter, Editor. 2016, River Publishers. p. 129-150.

2) Pérez-Freire, L., et al.,Smart Farming and Food Safety Internet of Things Applications – Challenges for Large Scale Implementations. 2015, AIOTI WG06. p.49.

3) Sellitto, C.; Burgess, S.; Hawking, P., Information quality attributes associated with RFID-derived benefits in the retail supply chain, International Journal of Retail & Distribution Management,2007, 35 (1), pp. 69-87.

4) Karuna Chandraul, Archana Singh,"An agriculture application research on cloud computing", International Journal of Current Engineering and Technology, volume 3, No.5, pp. 2084-2087, October 2010.

5) Kiruthika M, Shweta T, Mritunjay O, Kavita S, "Parameter Monitoring for the Precision Agriculture", International Journal of the Research and Scientific Innovation 2015

6) Pamidi Srinivasulu , R Venkat , M. Sarath Babu , K Rajesh " Cloud Service Oriented Architecture (CSoA) for agriculture through Internet of Things (IoT) and Big Data", 2017 International Conference on Electrical, Instrumentation and Communication Engineering (ICEICE2017)

7) Suraj Pandharinath Takekar , Sanket Pandharinath Takekar , "Plant And Taste to Reap with Internet Of Things", International conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud) (I-SMAC 2017)