BACHELOR OF ENGINEERING

Project Report

on

Web-Development for IoT

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Web-Development for IoT – EC250: Project Report

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Acknowledgements

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Certificate

It is certified that the work contained in this report titled **"Smart Farming System"** is the original work done by **Kunaal Kiran Kumar** and has been carried out under supervision of

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Introduction

This project is an IoT Solution designed as a developing prototype completed on 30th November 2021. The basic overview of the project is as given below. Software codes, project video, etc. is on the GitHub link: https://github.com/Kunaalkk1/smart-farm.git.

Farms and similar properties require extensive care to protect them from natural occurrences such as extreme temperatures, floods, droughts, etc. These problems can be very difficult to solve without being able to monitor the premises 24/7 because natural occurrences can be seen anytime.

The following solution, not only monitors the parameters of the farm but also acts in accordance with the parameters. The three parameters measured are: Temperature, Humidity, and Water Level.

The water motor acts according to the parameters and its conditions are given as per the theoretical solutions mentioned above to water the farm or to remove excess water.

There are two segments of the project. The hardware that monitors the entire setup and acts according to the given parameters, and the website allows the user to view the values in real time.

HARDWARE COMPONENTS:

1. ESP32
2. DHT11
3. Ultrasonic Sensor (HC SR04)
4. PCB, RESISTORS AND WIRING
5. 12V DC Adapter, 12V DC Water Motor with pipe
6. Relay Module

SOFTWARE AND OTHER API's:

1. Arduino IDE
2. VS Code
3. Xampp
4. Web Browser
5. Google Sheets
6. Google Firebase

Problem Statement

Farms and similar properties require extensive care to protect them from natural occurrences such as extreme temperatures, floods, droughts, etc.

These problems can be very difficult to solve without being able to monitor the premises 24/7 because natural occurrences can be faced anytime.

Theoretical Solution

Natural occurrences of different types can be overcome in different ways.

a. Extreme Temperatures

1. Heat

Extreme heat can be overcome by sprinkling of water. It can reduce the temperature so that the crops don't get destroyed due to heat.

2. Cold

Extreme cold can turn the water inside the soil into ice, hence freezing the roots. This problem is solved by smoothly flooding the entire farm with water. The flooding during extreme colds can be really helpful for saving the crop roots from freezing due to **anomalous expansion of water***.

b. Floods

Natural floods can be really destructive for the crops. It is very important to release the water as and when required so that:

1. Water can be stored and harvested
2. Damage due to floods can be minimized.

c. Droughts

Droughts can be caused due to constant high temperatures and low humidity for a long period of time. It requires water to be supplied to the crops so they don't die due to starvation.

d. Other occurrences

The other occurrences can include: Pest infestations and insect outbreaks that are not covered in the following solution.

Prior Art Research

The following links provide solutions for Smart Farm Monitoring System

1. https://ieeexplore.ieee.org/document/8081906
2. https://www.ijert.org/iot-based-smart-agriculture-monitoring-and-irrigation-system
3. https://www.hindawi.com/journals/sp/2021/7101983/

Meaning of the words or phrases in bold are mentioned in the glossary on page 6

Solution Definition

The following solution, is an upgraded version of its prior art, not only monitors the parameters of the farm but also acts in accordance with the parameters. The three parameters measured are:

1. Temperature
2. Humidity
3. Water Level

The water motor acts according to the parameters and its conditions are given as per the theoretical solutions mentioned above to water the farm or to remove excess water. As of now, it is done manually using buttons from the webpage that control it.

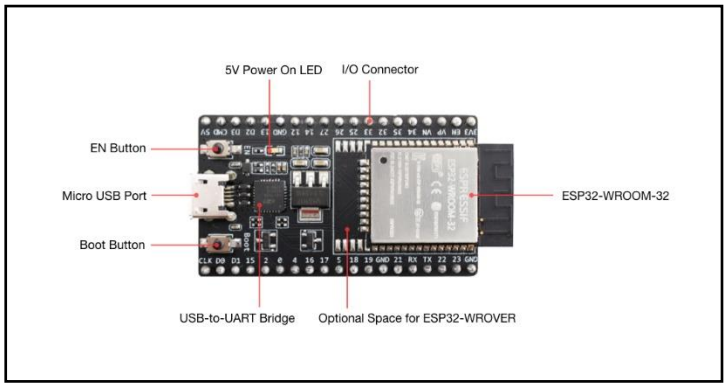
Solution Description

There are two segments of the project. The hardware that monitors the entire setup and acts according to the given parameters, and the software that allows the user to view the setup in real time. Following are the components used, both hardware and software. Each of the components and their working is explained.

a. HARDWARE

1. ESP32

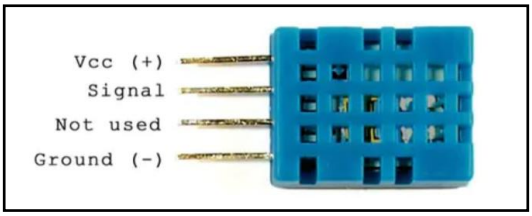
Espressif ESP32 is a module that includes a microcontroller and provides internet connectivity for providing IoT solutions. In layman language, it is the brain of the circuit. It controls all input, output and decision-making features of the hardware circuit.



Find the ESP32 Complete Data sheet from the manufacturer (Espressif):
https://www.espressif.com/sites/default/files/documentation/esp32_datasheet_en.pdf

2. DHT11

It is a sensor used to measure temperature and humidity of the atmosphere.



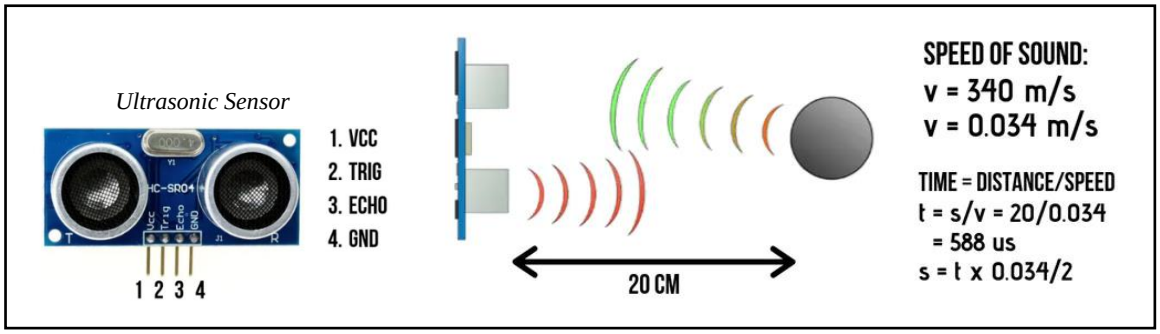
Humidity Sensor - Working
The humidity sensing capacitor has two electrodes with a moisture holding substrate as a dielectric between them. Change in the capacitance value occurs with the change in humidity levels. The IC measure, process this changed resistance values and change them into digital form.

Temperature Sensor - Working
For measuring temperature this sensor uses a Negative Temperature coefficient thermistor, which causes a decrease in its resistance value with increase in temperature. To get larger resistance value even for the smallest change in temperature, this sensor is usually made up of semiconductor ceramics or polymers.

The complete information about the module is provided in the datasheet:
https://www.mouser.com/datasheet/2/758/DHT11-Technical-Data-Sheet-Translated-Version-1143054.pdf
Refer the datasheet for more information about the same module.

3. Ultrasonic Sensor (HC SR04)

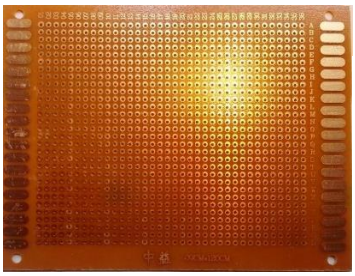
This is a sensor used for measuring the distance. In this particular project, it is used to measure water level from the ground.

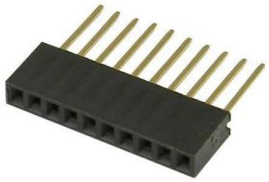


The working is as explained in the above image. The complete datasheet is as given below:
https://cdn.sparkfun.com/datasheets/Sensors/Proximity/HCSR04.pdf
Refer the datasheet for more information about the same module.

4. PCB, RESISTORS AND WIRING

These are significant components to make connections on a prototype circuit. There are different values of resistances and three different types of connecting and jumper wires that can be used (M2M, M2F, F2F). This project uses M2M Jumper Wires, 10k Resistor, a General-Purpose PCB (Printed Circuit Board), Female Headers, and Soldered using a Soldering Iron and a Solder Wire.





1. Jumper Wires
2. General Purpose PCB
3. Female Headers

1 2 3

5. 12V DC Adapter, 12V DC Water Motor with pipe

The 12V DC Adapter is used to supply power to the water motor. It is connected with a 5V input relay module to allow controlling when the water is to be pumped to the farm. The 12V DC Water Motor is used to pump water from and to the farm.

This is connected with an adapter for input and a relay module to control it. The pipe is used as a medium for the same. If the farm needs to be watered, the water works in forward mode, and in case of flood, we can make it work in reverse mode.

6. Relay Module

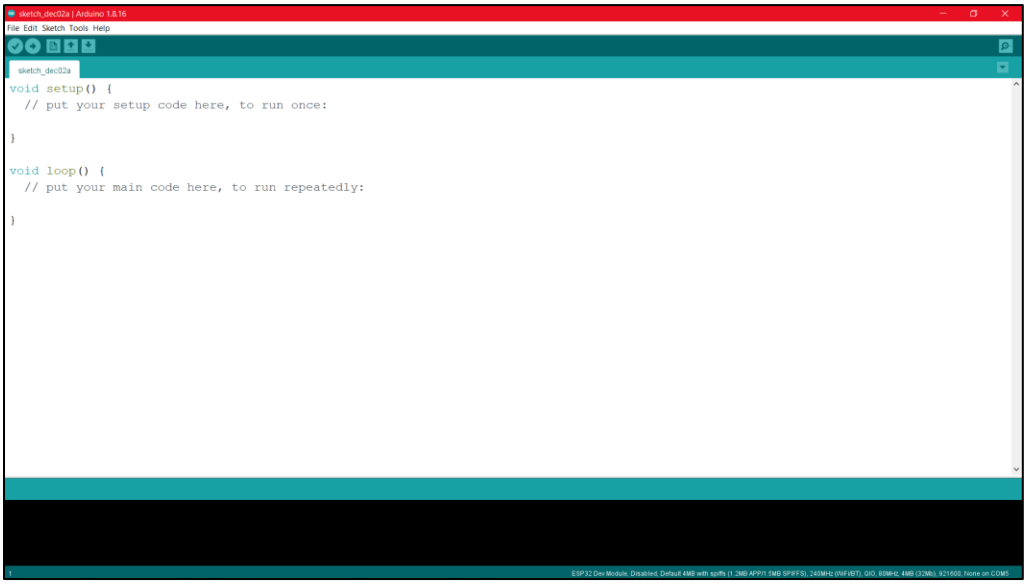
The **relay** module is a module used for controlling the power supply of the DC Water Motor.

1. DC Water Pump
2. Water Pipe
3. 2 Channel Relay
4. 12V Adapter

b. Software

1. Arduino IDE

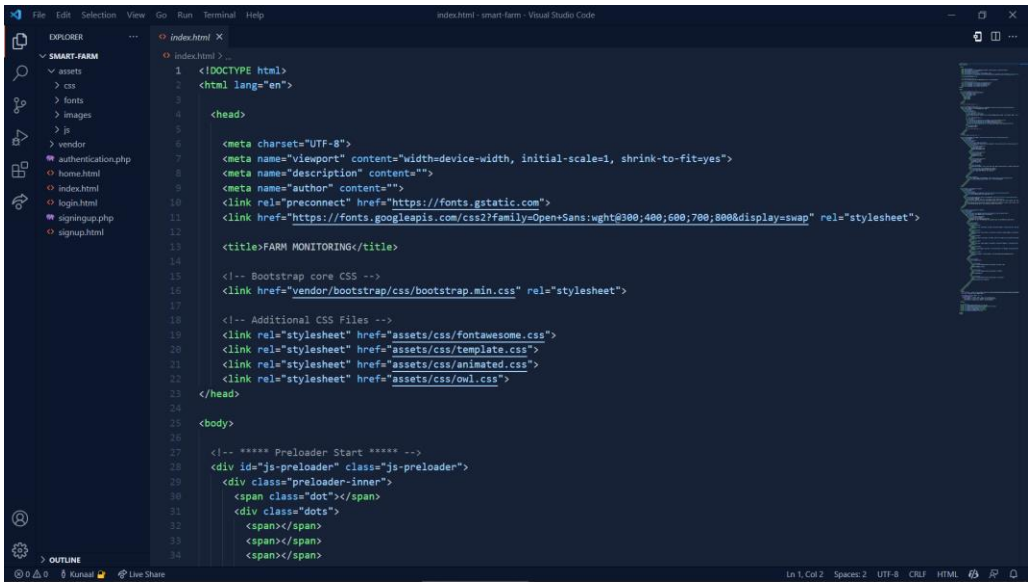
It is a programming software used to upload the driver code for the ESP32 and view live updation on a **serial monitor** during testing and **prototyping**.



Arduino IDE

2. VS Code

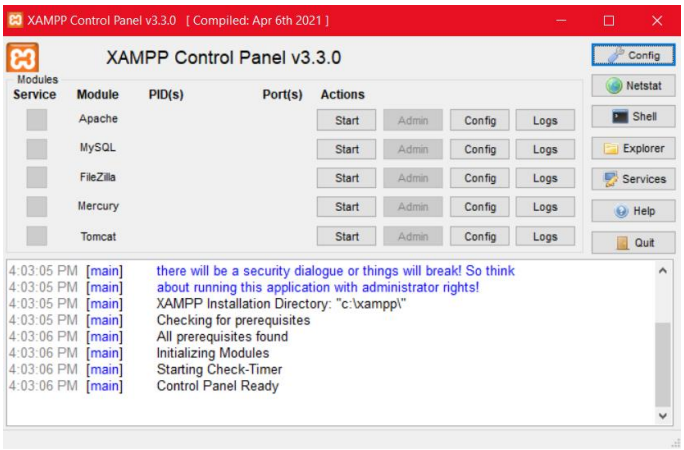
It is used to design the website using HTML, CSS, JavaScript, Bootstrap, and PHP for the backend.



VS Code

3. XAMPP

It allows connectivity with **localhost** server using **Apache**, and a **MySQL Database** server that is locally hosted on 127.0.0.1, visible on PhpMyAdmin on the XAMPP dashboard. In the project, it is used to authenticate and login to the webpage.



XAMPP Control Panel

4. Web Browser

It's used to view the website and other active pages like PHP database, Google firebase, etc. Google Chrome is generally used as the web browser. In this project as well, Google Chrome is used.

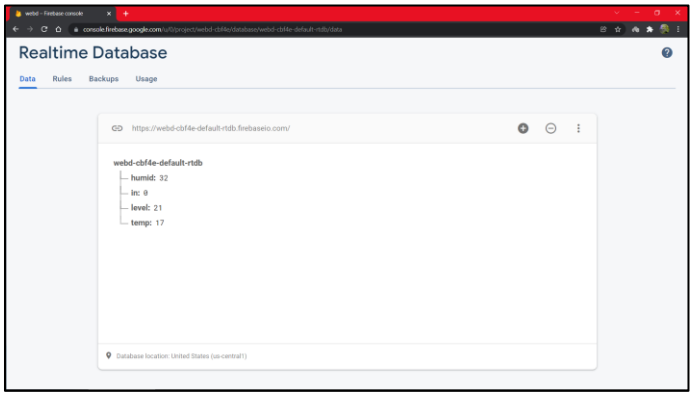
c. Other API's and Services

1. Google Sheets

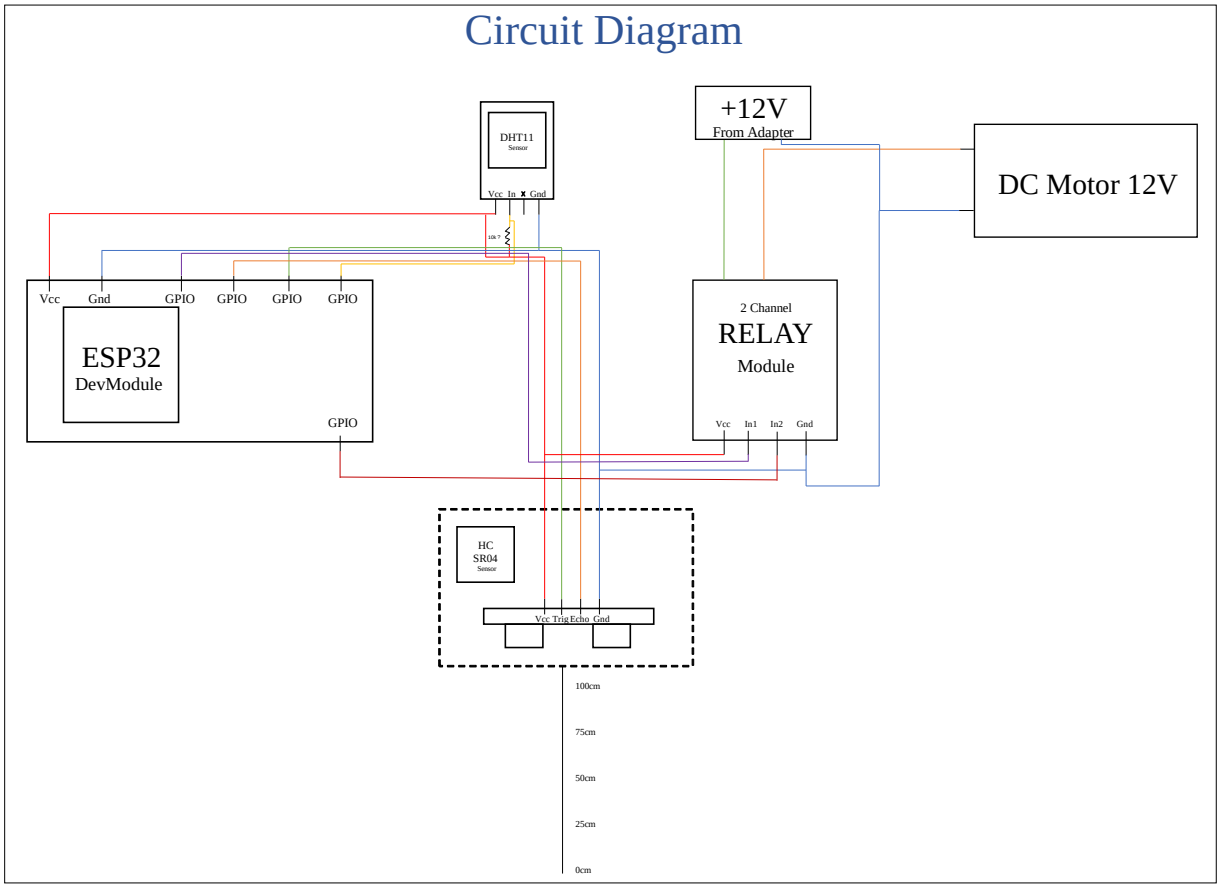
User contact information that they fill in the form is stored in a Google Spreadsheet by using Google AppsScript programming and API key. The functioning is explained in the video uploaded to the **GitHub repository** of the project, link for which is given in the introduction.

2. Google Firebase

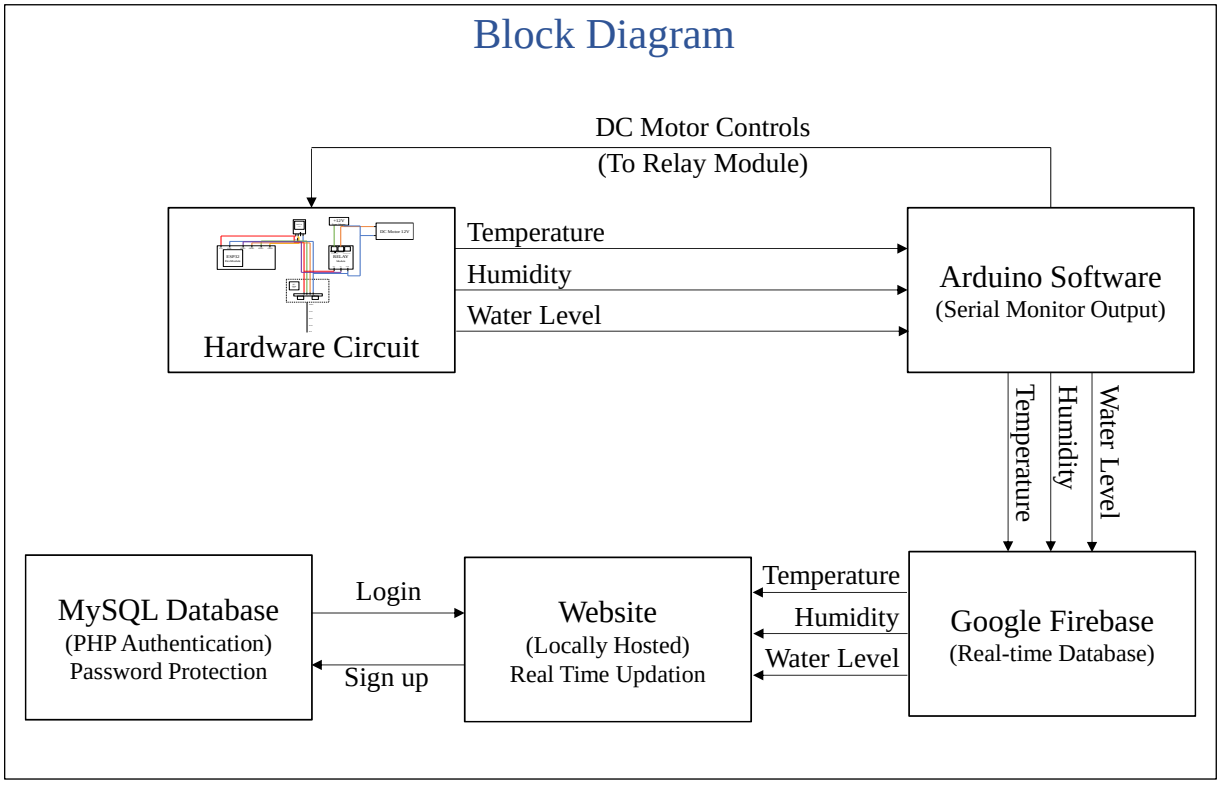
It is an online developer tool for frontend and backend that provides a **real-time database**. The advantage of using real-time database is that the updation of values to and from the circuit and the webpage happens in real time.



Circuit Diagram



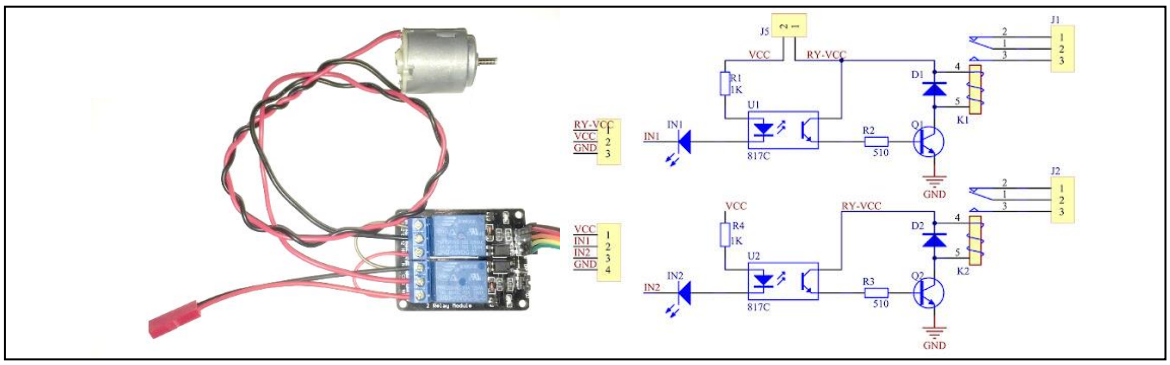
Block Diagram



Glossary

1. **Anomalous expansion of water (Page 1):** The abnormal expansion of water from 4ºC to 0ºC is known as anomalous expansion. It causes only the top layer of water to freeze during extreme winters, and the water below it remains in liquid state, which saves the roots of the crops from freezing.

2. **Relay (Page 5):** The Relay module works in modes: Normally Open (OFF) and Normally Closed (ON). On giving input high, it completes the circuit between the power source and destination to operate accordingly. For reversing the polarity, we use a circuit as shown below. The image shows connection with the regular DC Motor, which is replaced by the DC Water Motor in this project.



3. **Serial Monitor (Page 5):** Serial Monitor is one of the tools in Arduino IDE. It is used for two purposes: Microcontroller → PC: Receives data from Arduino and display data on screen. This is usually used for debugging and monitoring. PC → Microcontroller: It can give the inputs to the microcontroller. It is also used for testing conditions during debugging.

4. **Prototyping (Page 5):** Prototyping is an experimental process where design teams implement ideas into tangible forms from paper to digital. Teams build prototypes of varying degrees of fidelity to capture design concepts and test on users. With prototypes, you can refine and validate your designs so your brand can release the right products.

5. **Localhost (Page 6):** It hosts the website on a local network, which means, the website is not accessible anywhere outside the local area network. It is usually hosted on the IP (Internet Protocol) Address of 127.0.0.1.

6. **Apache (Page 6):** It is a service enabled on XAMPP that allows us to use our desktop as a web-server for hosting the website on a local network.

7. **MySQL Database (Page 6):** The Database is a tabular structure that allows us to store values on the server, in this case, Temperature, Humidity and Water-Level. MySQL is a framework that allows us to program the database using Structured Query Language (SQL).

8. **GitHub repository (Page 6):** GitHub Repository is an online repository where you can find all source files related to a particular project,

9. **Real-time database (Page 6):** The real-time database is a database that updates the values of a variable in real time, but without the use of tables, which means, only the latest value is stored. In this case, we have used a cloud-based platform, Google Firebase.

Conclusion

Smart Farming System is an effective method for remotely monitoring your farm, controlling irrigation/ water supply, and it is a very effective solution to monitor a farm in adverse conditions as well.

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