Water Flow and level monitoring device using IoT.

A Dissertation Submitted for the Partial Fulfillment of the Requirements for the award of the Degree of

Master of Computer Application

Submitted by

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CERTIFICATE

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The dissertation is the result of his efforts and endeavors. The dissertation is found worthy of acceptance for the award of the degree of **Master of Computer Application.**

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Abstract

This paper presents the design and implementation of an Internet of Things (IoT)-enabled water flow and level monitoring device aimed at enhancing water management systems. The escalating demand for water resources coupled with the increasing concerns about water scarcity necessitate the development of efficient and intelligent monitoring solutions. Our proposed device integrates sensor technologies with IoT capabilities to provide real-time data on water flow rates and levels, contributing to a more sustainable and responsive water management infrastructure.

The device employs ultrasonic sensors for accurate water level measurements in water tank and water pump control unit to pump water flow in pipelines or channels. These sensors are connected to a microcontroller that processes the data and transmits it wirelessly to another unit.

Key features of the device include low power consumption, ensuring long-term operation with minimal maintenance. The device's scalability and adaptability make it suitable for a variety of water management applications, from domestic water systems to industrial settings.

PENYA-TABA-22MCA216-PROJECT-SUBMISSION-1

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I 1. INTRODUCTION 1.1 Project Definition The project aims to design a Water flow And Level monitoring Device Using IoT. Water flow and Level Monitoring Device is a automated system which is designed by the combination of electronics, electrical and computer science Knowledge which is used to monitor the level of water in water storage tanks and wirelessly transmit signal to ground unit start the Water pump to fill up the tank if water level goes down. 1.2 Problem Definition Filling up the water tank is one of the most is one of the most common water wastage problems in towns and Cities. And filling up the tank is very time consuming for the human to observed to stop the water pump after filling up the tank. Therefore, an automated solution is needed to perform all this activity by itself which minimum the human observation time and wastage of water. 1.3 Project objective 1. Developed an automated solution capable of sensing the water level in water tank. 2. Transmit the signal in long range. 3. Solution can work on low power. 4. Handle the high volage water pump with low voltage ground controller. 5. Automate the whole process. II 2. RESEARCH The Ultra Sonic HC-12 emits ultrasound at 40,000Hz that

propagates in space. If there is an object or obstacle in its path 4

, then it strikes and returns to the Ultra Sonic module. The formula: distance = speed*time Speed of Sound: The speed of sound is the rate at which sound waves propagate through a medium, such as air. The speed of sound in vacuum at room temperature (around 20°C or 68°F) is approximately 343 meters per second (m/s) or 34300 centimeters per second (cm/s). We can use this value as a constant in Our calculations. Time: The time represents the round-trip time it takes for an ultrasonic signal to travel from the sensor to an object and bounce back to the sensor. This time is measured in seconds. Divide by 2: You divide the product of the speed of sound and time by 2 because the time measurement accounts for the total time it takes for the sound to travel to the object and return. To find the one-way distance, you need to halve this time. So, the Formula will be. Distance= (Speed of Sound*Time)/2 III 3. COMPONENTS OF SYSTEM 3.1 Hardware Components

1. Arduino Uno Board: Arduino Uno is an open-source microcontroller developed by 3

ARDUINO.CC

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CHAPTER 1: INTRODUCTION

1.1 Project Definition

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1. To develop an automated solution capable of sensing the water level in water tank.
2. Transmit the signal in long range.
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4. Handle the high volage water pump with low voltage ground controller.
5. Automate the whole process.

CHAPTER 2: WORKING CONCEPT

The Ultra Sonic HC-12 emits ultrasound at 40,000Hz that propagates in space. If there is an object or obstacle in its path, then it strikes and returns to the Ultra Sonic module.

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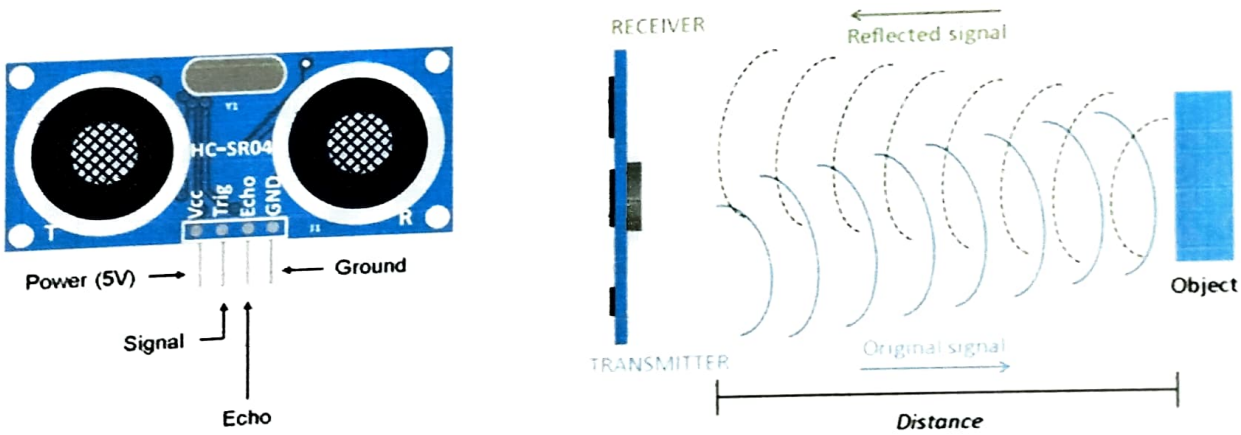

Fig 1: working of ultra sonic sensor.

CHAPTER 3: COMPONENTS OF SYSTEM

3.1 Hardware Components

1. **Arduino Uno Board:** Arduino Uno is an open-source microcontroller developed by ARDUINO.CC. It serves as the main microcontroller which will used in both sensing unit as well as in the ground unit. It will process the sense data from the water tank and transmit it over wirelessly to the ground unit which control the water pump.
2. **HC-12 Transceiver:** HC-12 is a transceiver which work as a transmitter as well as receiver. It uses radio wave to transmit data and the range of the HC-12 is up to 1km in default setting and up to 3km in max setting. It is the communication medium between the sensing module and the ground unit.
3. **Ultra Sonic Sensor:** Ultra Sonic Sensor is a Sensor which is used to measure the distance by ultra sonic waves. It is the Sensor which is used to measure the water level between the water and the trigger point up to which the water will overflow.
4. **Relay Module:** A relay module is a electrical component which is used as a switch to start the water pump via low voltage signal from Arduino. It can handle high voltage current of 220V.
5. **Jumper Wires:** Jumper wires are used for connecting the components with the Arduino.

3.2 Software Components

1. **Code:** A C++ code is used to program the Arduino UNO board

CHAPTER 5: SPECIFIC REQUIREMENTS

Specific requirements are organized by use case and functional hierarchy so that the main functions of the system will be understandable.

5.1 Functional Requirement

Since the sytem has three major parts: Senseing Module , Transmitting module and Water Pump Control Unit. Functional requirement will be examined into three approaches.

5.1.1 Arduino Uno at Sensing Module

1. **Arduino Uno**
    1. Sensing the water level in taking at a regular interval.
    2. Process the collected data in Arduino UNO itself.
    3. Eslablising Communication link between ground Unit.
    4. Transmit signal to ground unit.

5.1.2 Arduino Uno at Ground Module

1. Establishing communication link between sensing module
2. Receiving data from the sensing module.
3. Switch ON the water pump if sensing module cammand via Relay.
4. Switch OFF the water pump if sensing module cammand via Relay.

CHAPTER 6: METHODOLOGIES IMPLEMENTED

6.1 Arduino Board in IoT

This projects implements functionalities using a Arduino Uno board. Arduino Uno is an open-source microcontroller board that provides a platform for controlling and interacting with various hardware components in a IoT system. It acts as the "brain" of the Module in this project. It executes the programmed instructions and controlls the sensors and actuators.

Here are some of the key functions of the Arduino Uno in this project:

1. **Motor Control:** The Arduino Uno board sends appropriate signals to the Ground unit controlling water pump. It allows the module to ON and OFF the water pump.
2. **Sensor Integration:** The Arduino Uno board interfaces with ultra sonic sensors to gather information about the level of water in water tank. The data from the Ultra sonic sensors is processed by the Arduino board to make decisions about the start and stop the water pump motor.
3. **Control Logic:** The Arduino Uno board runs a program that implements the control logic for the robot. The program is written in Arduino programming language which is a subset of C/C++. If defines the cammand and function of all the component in the modules
4. **Communication:** The Arduino Uno boards communicates via HC-12 transciever for sending and receiving of data in both module.

6.2 Serial Communication

Serial communication between the Sensing mdoule and the ground unit serves as a fundamental methodology implemented in this project. This vital component enables seamless data exchange and coordination between the two devices, contributing to the overall functionality of the automated system developed.

The following steps outline the process of communication:

1. Sending Cammands: After the sensor sense the water level if tank need to be filled

   It send signal to ground Module.
2. Receiving Cammands: the Ground mdoule will receive the signal transmitted by the Sensing Module via wirelss communictaion channel.

CHAPTER 7: BLOCK DIAGRAM

A block diagram is a visual representation of system in which blocks are used to represent the parts, steps, entities, one or multiple items and the process of a system which is connected by lines. This shows the relationship between one or multiple entities.

7.1.1 Block Diagram of Sensing Module

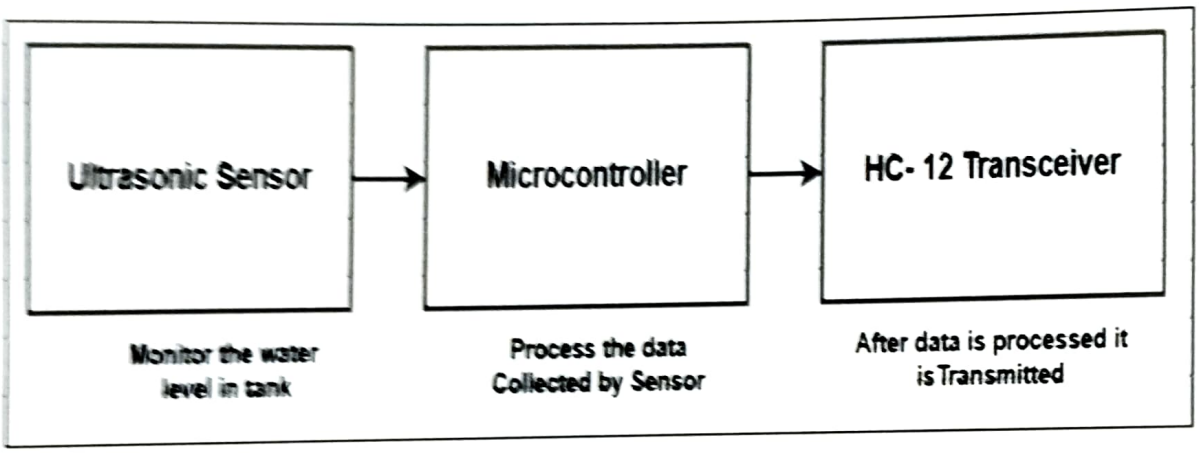

Fig 2: Block Diagram of sensing Unit with transmitter

7.1.2 Block Diagram of Ground Module

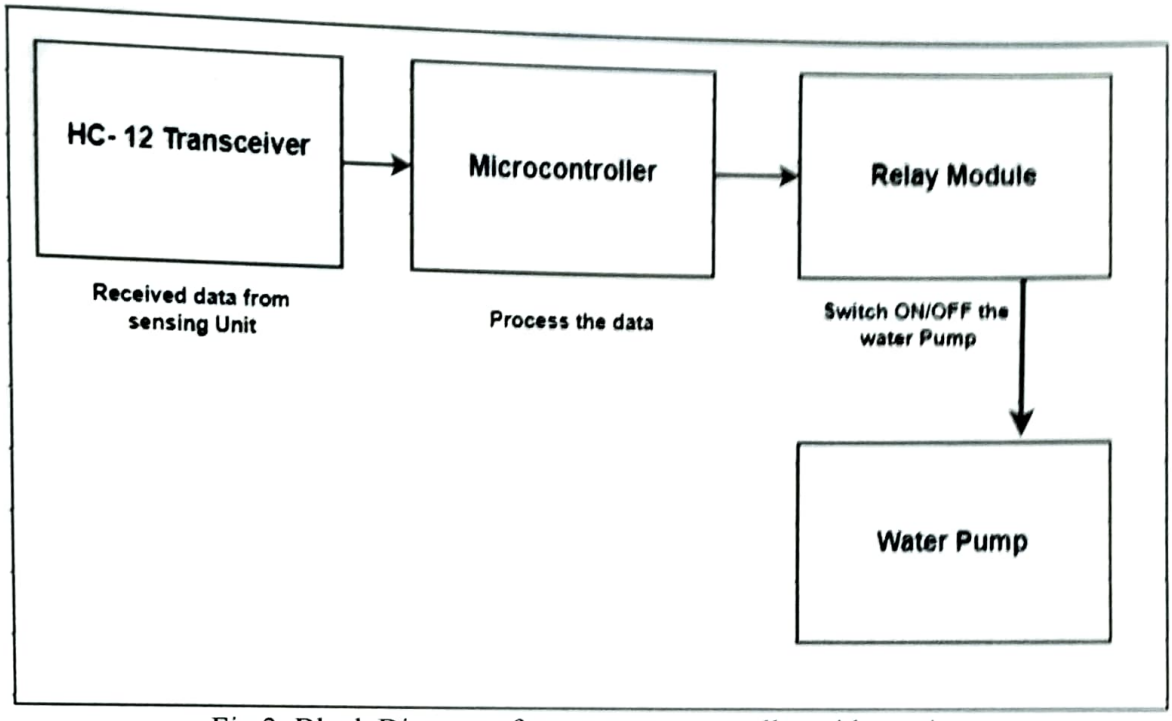

Fig 3: Block Diagram of water pump controller with receiver

CHAPTER 8: FLOW CHART

A flowchart is a diagram that is used to represent a workflow or process of the system . It is defined as a graphical representation of an algorithm or process which is a step-by-step approach to solving a problem. It is preffered by engineer, researcher and Designer to understand the algorithms and working , thus it is used to find issues in algorithm and design. The control logic for the system is shown in a flowchart.

Some conventions of flowchart:

1. Terminal: This box is of oval shape and indicates the start or the end of the program.
2. Data: This is represented by a parallelogram-shaped box inside which input or are written. This depicts the information that is entering or exiting the system.
3. Process: Processess are represented by rectangular boxes. This is the main course of action or the logic of the algorithm.
4. Descision: This is a rhombus-shaped box. This contains control statemets like if-else, or etc.
5. Flow: An arrow line represents the flow of the system or the process.

FLOW CHART OF THE SYSTEM

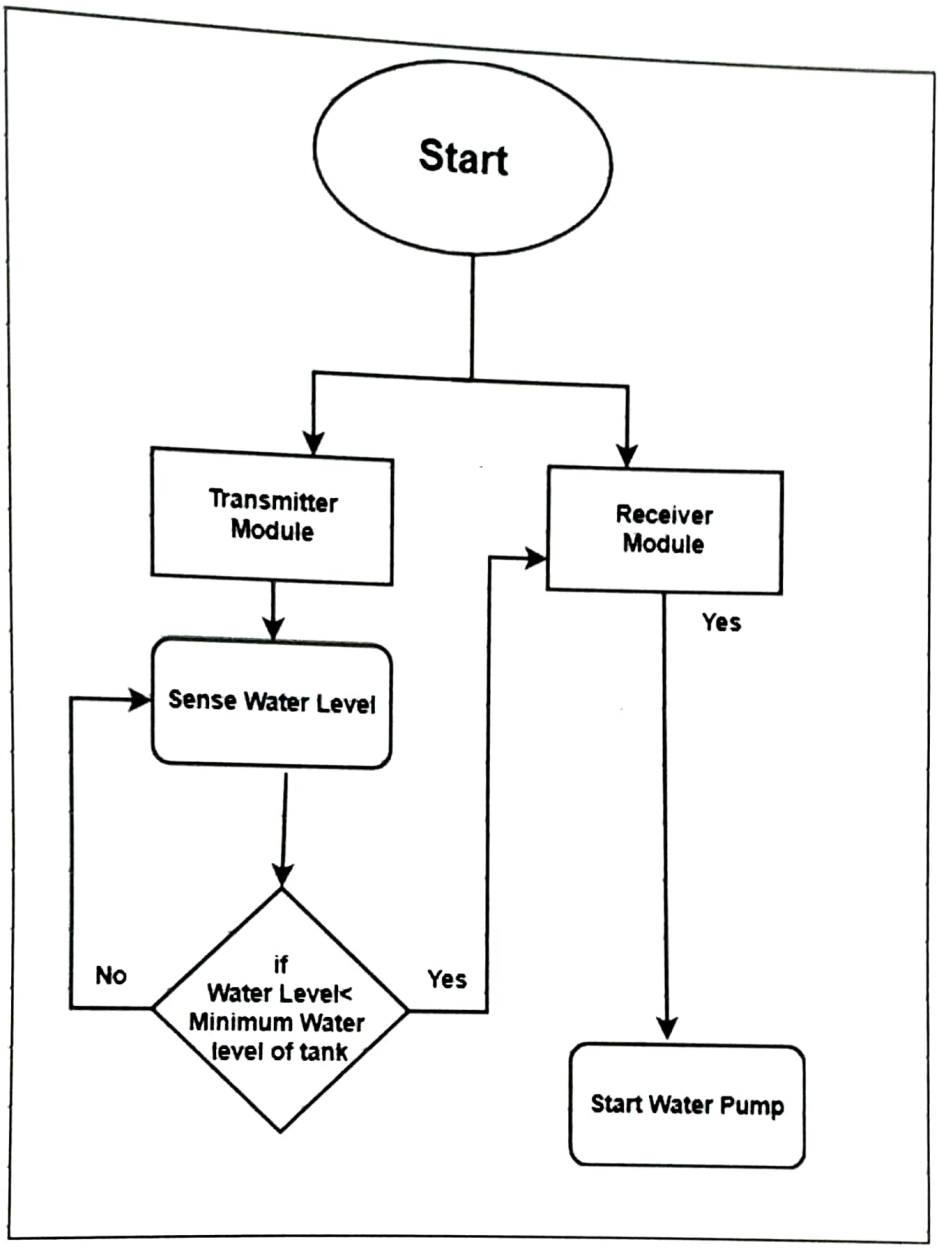

Fig. 4 Flow Chart of Entire System

CHAPTER 9: CIRCUIT DESIGN

9.1.1 Circuit Design of Sensing with transmitter Module

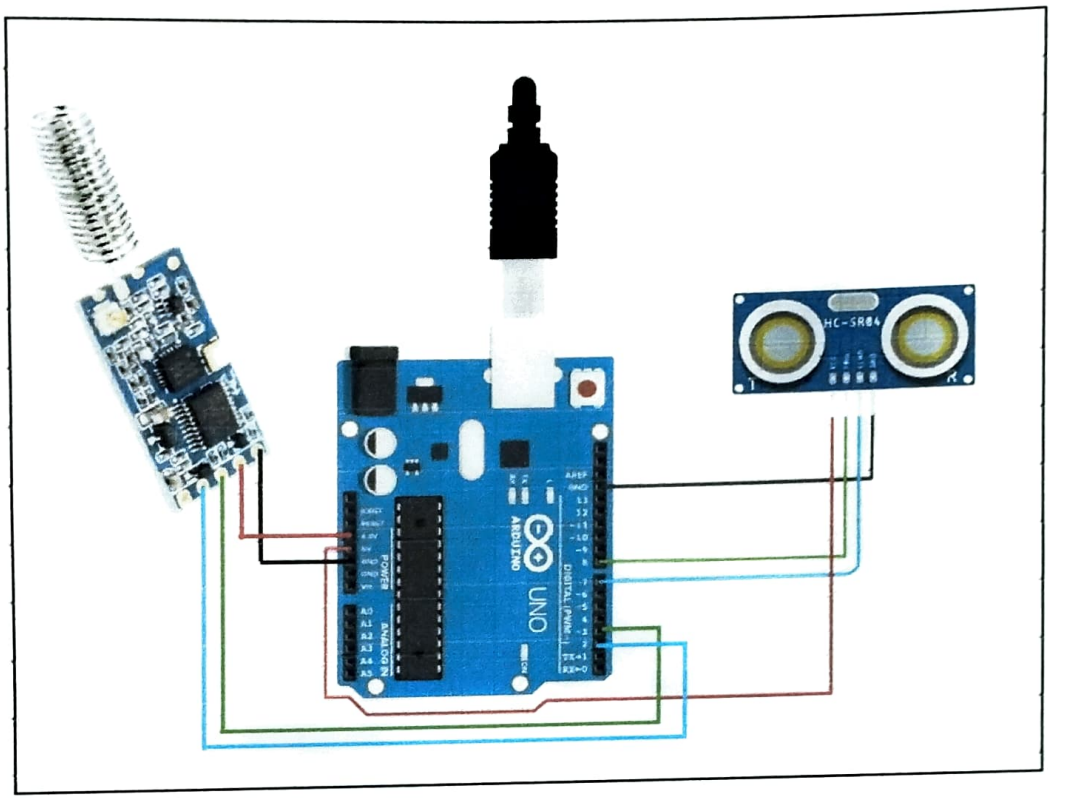

Fig 5: Sensing module with transmitter

9.1.2 Water pump control with Receiving Module

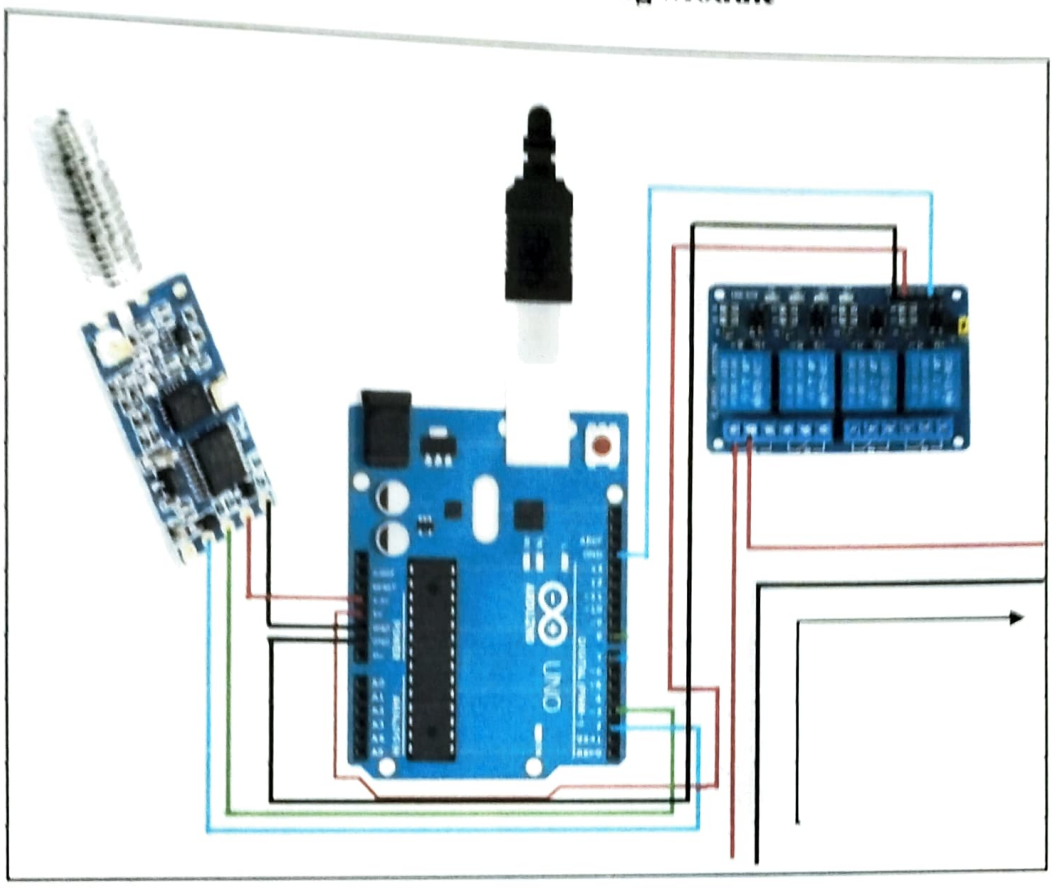

Fig 5: water pump control with Receiving Module

CHAPTER 10: TESTING

10.1 Unit Testing

Unit testing is a system testing module which is proposed to test every single unit of the model. Since the model is made up of different type of unit and model, detecting error and bugs in these unit is very easy, simple and less time consuming, as the entities are small. It is possible that output of one unit can be input for another unit then it can also give wrong output. And if the sensors and actuator and not connected they produced wrong output. To stop all this errors and bugs we performed unit testing.

10.1.1 Test case for Sensing Module

Sl No.	Test Case	Action
1	Empty Tank	0 water level is transmitted to ground Module
2	Full Tank	Level Full data is transmitted to ground Module
3	Sensing Module without Ultrasonic Sensor	Error Message is Send to Ground Module
4	Sensing Module without HC-12 Sensor	No data is transmitted

Table 1: unit Testing test case for Sensing unit and transmitter

10.1.2 Test Case for Ground Module

Sl No.	Test Case	Action
1	Received Signal: Error	No Reaction
2	Received Signal: Water level low	Switch ON the Relay module
3	Received Signal: Tank is full	Switch OFF the Relay Module
4	Ground Module without HC-12 Sensor	No Transmission
5	Ground Module without Relay Module	Unable to Switch ONN/ OFF the water pump

Table 2: Unit Testing test case for water pump controller with receiver

CHAPTER 11: RESULT

After all the process of identifying the problem, resource gathering, working on the concept, understanding the working of sensor and actuators, transmission medium, assembly of the components, coding, and testing, finally I came with the Result from my project.

1. When Water is full in the water tank the transmitter will not send any data to the receiver of water pump control unit.
2. When water is completely empty in water tank the ultrasonic sensor while sensing the water tank will send data to microcontroller in which that data is processed and then the data is transmitted to the receiver which is connected to the water pump control unit which will send a 5v to the relay module which will switch on the Water pump.
3. The water pump will pump water unit the level of water in water tank reaches its threshold point set by user.
4. When water is half or bellow then half in water tank it will repeat the same process above.

CHAPTER 12: PROJECT TIMELINE

A project timeline is used to graphically represent the date with project progress via a chart named Gantt Chart. It helps in managing the time and the progress of the project.

12.1 Gantt Chart

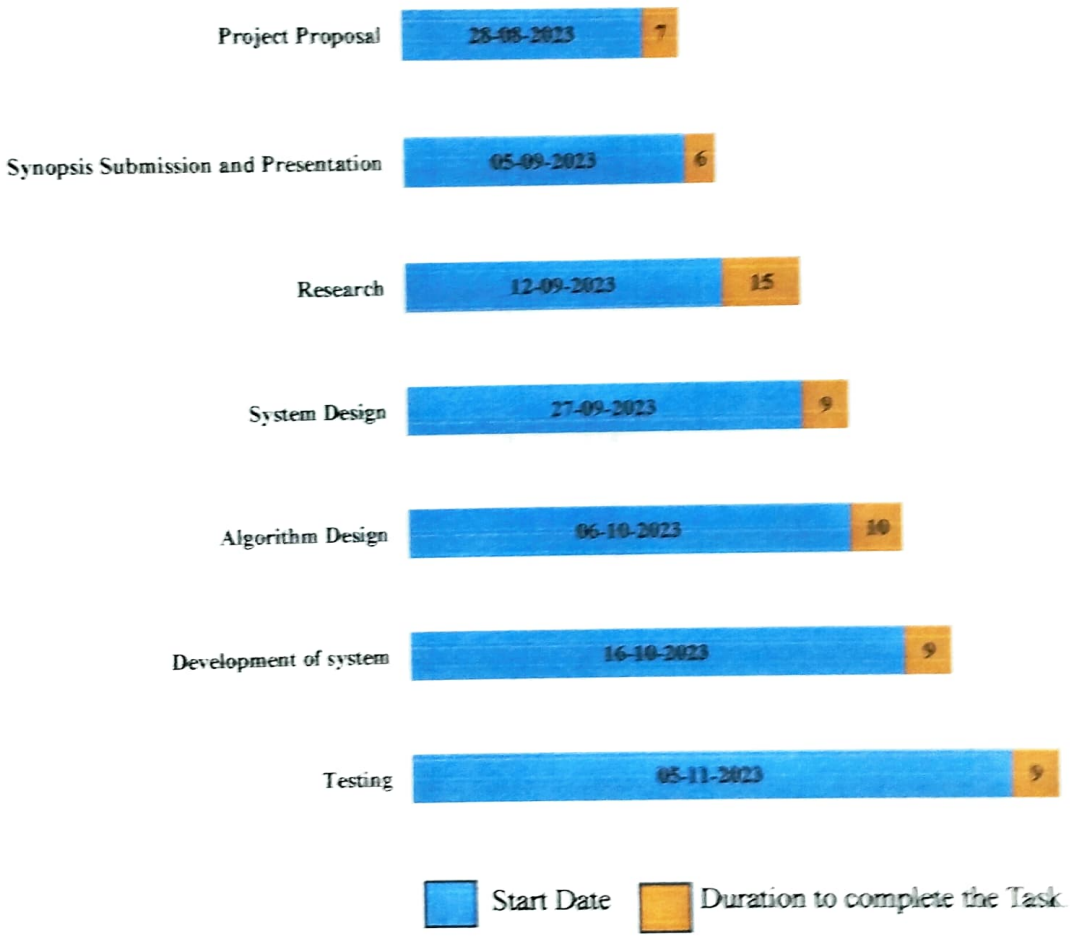

Fig. 6: Gantt Chart Representing Project Timeline

CHAPTER 13: SUMMARY

The Water flow and monitoring system Using IoT is a smart and automated solution for the household, industries, agriculture activities which will make the controlling of water in tank very easy and minimize the wastage of water occur in these activities. The water flow and monitoring system is a device which is made up of combination of electronics, electrical and Knowledge of computer science in which sensor, actuators and micro controller is assembled in such a way it captures data, processed this data in microcontroller and transmit signal. The transmission is done by the radio waves. The sensing unit will constantly monitor the water tank with the help of sensors, and it will process that data and transmitted to the ground unit. The ground unit then received that data and according to that data it will switch on/off the relay module which will on/ off the water pump. Although the system has been implemented successfully, there is always a scope for improvement. One can always bring in better hardwares, better control logic of controller , adding extra functionalites etc, making system efficent for other related activites in same domain.

CHAPTER 14: CONCLUSION AND FUTURE SCOPE

14.1 Conclusion

From the observations of the obtained results from the different processes by sensing module trasmitter, reciever and pump control uit we can conclute that Water level monitoring and flow control system using Iot is an automated device which can by very useful for the town, cities and agricIture activites which can reduced the wastage of water while filliing up the tank and minimize the human effort. It can aslo be very useful in remoted places to pump water to the tank which can save time

14.2 Future Scope

1. Develop a mobile application which will intregrat with the whole system so the user can constantly monitor it.
2. Use better communication channels and better devices for communication so we can entend the range.
3. Intregrat all the sesnor and actuator in one board so it can consume less power.
4. Adding of renewal source of enery to the system prevent the requirment of power thorough conventional source.

CHAPTER 15: REFERENCE

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