Smart Water Meter System

A project report submitted to
Rajiv Gandhi Proudyogiki Vishwavidhyalaya, Bhopal
towards fulfillment of
the degree of
MASTER OF COMPUTER APPLICATION
2020

Guided By:
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INDORE (M.P.)

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Recommendation

The project report entitled **"*Smart Water Meter System*"** submitted by **Ankita Chourasiya, Himanshi Neema, Arvind Rajput** students of MCA final year in the session 2019-2020, towards fulfillment of the degree of **Master of Computer Applications** of Rajiv Gandhi Proudyogiki Vishwavidhyalaya, Bhopal, is a satisfactory account of their work and is recommended for the award of degree**.**

Praveen Singh
Project Guide
Department of Information Technology

Dr. Sunita Verma
Head
Department of Information Technology

SHRI G.S. INSTITUTE OF TECHNOLOGY AND SCIENCE
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Certificate

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Internal Examiner **External Examiner**

Date

Acknowledgement

*We are heartily pleased to acknowledge all those people who have helped us in the successful completion of this project. With great pleasure we express our heartfelt gratitude to our esteemed guide, **Mr. Praveen Singh** Lecturer Department of Computer Technology & Application, S.G.S.I.T.S. Indore. Her persistent encouragement, perpetual motivation, everlasting patience and valuable technical inputs in discussions have enabled the successful completion of this project. Her invaluable help, advice and constant encouragement helped us a lot and provide impetus to the progress of the project. We extend our profound indebtedness to the Head of the department **Ms. Sunita Varma,** the word loose their worth for her invaluable guidance, continuous encouragement and cooperation in every respect.*

We sincerely wish to express our gratitude to all the members of staff of M.C.A. who have extended their cooperation at all times and have contributed in their own way in developing the project. Successful completion of a project is not an individual effort. It is an outcome of the cumulative effort of a number of persons, each having his own importance to the objective. We are thankful to our parents for being a constant source of encouragement in all our endeavors. Indeed it is their support that helps us through the ups and downs of life. The support and suggestion of our friends are worth appreciation and thankfulness. A blend of gratitude, pleasure, great satisfaction and indebtedness is what, we feel to convey to all those who have directly or indirectly contributed to the successful completion of our project work.

Ankita Chourasiya
Himanshi Neema
Arvind Rajput

Abstract

Water scarcity and water stress issues pose a serious threat to the global population. The traditional way of manual meter reading is furthermore inconvenient and time consuming, and it wastes resources. This method is also unable to manage the sustainable water resources effectively since it requires efficient, accurate and reliable monitoring techniques that enable the utilities sector and consumers to know the level of water consumption in real-time. Real-time smart water meters that can be monitored by the user are essential and constitute a key component of the water management system. A smart water-monitoring system will make users mindful of their water consumption and help them to reduce their water usage. At the same time, users will be alerted to abnormal water usage to reduce water loss. This paper introduces the water management system based on wireless sensor networks (WSN). The system uses the IEEE 802.15.4 standard embedded in ContikiOS LibCoAP as an open-source application to create a robust and intelligent system. Visualisation and monitoring of the system is achieved following the development of a web-based system and through Pandora FMS

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Chapter 1

Introduction

Smart water metering refers to a system that measures water consumption or abstraction and communicates that information in an automated fashion for monitoring and billing purposes. Smart meters differ from conventional meters in that they measure consumption in greater detail and transmit that information back to the service provider without the need for manual readings.

Smart metering systems can be configured in many ways, and when broadly defined, the term includes both Automated Meter Reading (AMR) and Advanced Metering Infrastructure (AMI) systems. AMR refers to any system that allows automated collection of meter reads (usually by radio transmission), without the need for physical inspection. AMI is used to describe a system that involves two-way communication with a water meter. That is, water consumption information is transmitted to utilities, whilst utilities can in turn issue commands to water meters to undertake specific functions. Over the last decade, most smart water meter deployments around the world have been AMR systems, however due to their additional functionality, the industry is starting to shift towards AMI and 'smart grid' solutions. Regardless of the configuration, all smart metering systems consist of three main elements:

(a) measurement (b) communication (c) software application.

Smart water metering is experiencing strong growth throughout the industrialized world with annual growth projections varying between 8% and 13% until 2016. By 2014 smart meters are expected to account for 50% of the global water meter market, with a market size of around USD800 million. Thus far smart water metering projects have been undertaken mainly in Europe and North America. According to Pike Research, these two regions account for 89% of the global smart water market in terms of module shipments. Projects vary greatly in size from small rural towns with less than 1000 connections to large cities such as New York and Mumbai which serve up to 1 million connections. Over the past decade Boston, District of Columbia, Cincinnati, Philadelphia, Atlanta, Chicago and Detroit have all undertaken major AMR projects.

Large projects are also currently underway in New York, Kuwait, Malta and Toronto. Whilst smart water meter deployments have been concentrated in developed regions, recent projects in Mumbai and Dar es Salaam indicate developing countries may figure more prominently in the coming years. Similarly, smart metering companies are beginning to tailor products to emerging market needs, such as Elster’s smart standpipe solution.

Smart water metering offers a range of benefits when compared to conventional water metering. These include:

- Faster and more efficient meter reading
- Theft and leak detection
- Greater billing accuracy
- Enabling a flexible tariff structure
- Increased read frequency, resulting in improved debt collection
- Ability to remotely monitor resource use

1.1 Preamble

As water consumption and wastage increases day by day, water scarcity has become a growing concern around the globe. While some irresponsible people are overusing water and wasting it daily, a large population remain deprived of safe drinking water. This problem is caused by the irregular distribution of water.To deal with this, we need a solution that gives data about daily and monthly water consumption of each area and home to the government to enable proper water distribution. Good news is we have the solution now.

In this project, we are going to make a smart water meter that measures our daily water usage and provides live data on our phone that is connected to a database.

1.2 Objective

Smart water metering refers to a system that measures water consumption or abstraction and communicates that information in an automated fashion for monitoring and billing purposes. Smart meters differ from conventional meters in that they measure consumption in greater detail and transmit that information back to the service provider without the need for manual readings.

1.3 Scope

The three pillars of Smart Water Networks:

1. Information: making full use of all data produced by a water utility
2. Integration: utilizing current IT systems to maximize previous investments
3. Innovation: having the flexibility to meet future challenge

1.4 Organisation of report

Chapter1: Introduction

In this chapter, a brief introduction of the proposed system is given. It also includes objective and scope of the project.

Chapter 2: Literature Survey /Conceptual Framework

This chapter contains the conceptual framework needed for implementing the application and explains the basic concept to understand the project and the technology used to accomplish in the project.

Chapter 3: Analysis

This chapter describes the analysis phase of our project. The analysis is carried by doing feasibility study, requirement analysis and specification, along with the system flow diagram of the systems.

Chapter 4: Planning

This section deals with management dexterity. It depicts the software planning process adopted for the system. It describes the scheduling aspect. It specifies the necessary hardware and software required for the project.

Chapter 5: System Design

This chapter deals with the implementation part of the systems. The main classes identified and the testing strategies are described in this chapter

Chapter 6: Conclusion

This chapter covers the final conclusion, limitations which came across while developing of the project and future enhancement of the project.

References

The entire website, text references related to the concepts regarding the project are mentioned.

Chapter 2

Literature Survey/ Conceptual Framework

Smart Metering is defined in the 2014 Review of Smart Metering and Intelligent Water Networks in Australia and New Zealand .The main aim of a smart water management system is to build a reliable relationship between the customer and the utilities sector. Well-implemented and visual application is beneficial to the customer and service provider to detect any flaws that might exist in respect of the service endered. Depicts the entire implemented smart water management system. The developed system enables the mesh networking among the meter interface nodes within a radius of 100m. The gateway collects the data sent by the meter interface node and sends it directly to the server. As an addition to this system, Pandora Flexible Monitoring Software (FMS) is used as a monitoring application, while a web-based visual tool for analysis is developed. A web-based application is also designed to provide more graphical meaning to the collected data, which also can be extended to build a billing system and other services. However the current paper focuses more on the meter interface node and the monitoring application. Smart Water-Monitoring System The developed system consists of three major components; the meter interface node, gateway device and back-end system. the hardware and software architecture of these components, which will be explained in the rest of this section. The meter interface node is attached to the digital meter to collect the meter reading, which will be sent through the gateway device to the back-end system. At the back-end system, the data is processed and archived within the database. A web-based interface is used to provide various kinds of graphs and tools to enable the monitoring and analysis of water usage.

Smart Water Systems (SWS) present a new approach to promote water security with uncertain but significant future risks from population growth, hydrological variability and extreme events, and intensifying water allocation demands across water supply, agriculture, industry and ecosystems.Strategic and transparent water resource decision making is central for water security to be achieved. This is in turn contingent upon the accurate, timely and reliable collection and communication of information relating to water abstractions and use, and the primary resource base. With mobile networks expanding globally across national territories, SWS offer a mechanism to capture and communicate data on water resources through hydro-informatic systems on abstraction from surface water and groundwater, soil moisture content, storage levels and network leaks or theft. Within a new architecture of accurate, integrated and timely water resource data, water risks can be reduced and water security enhanced.

2.1 Technology :

The Internet of Things, or IoT, refers to the billions of physical devices around the world that are now connected to the internet, all collecting and sharing data. Thanks to the arrival of super-cheap computer chips and the ubiquity of wireless networks, it's possible to turn anything, from something as small as a pill to something as big as an aeroplane, into a part of the IoT. Connecting up all these different objects and adding sensors to them adds a level of digital intelligence to devices that would be otherwise dumb, enabling them to communicate real-time data without involving a human being. The Internet of Things is making the fabric of the world around us more smarter and more responsive, merging the digital and physical universes.

As IoT technology has already made itself comfortable in our homes, public spaces, offices and factories, and given the breakneck pace of its development, it seems that the hackneyed IoT phrase ‘anything that can be connected will be connected’ is ever closer to becoming our daily reality.

2.2 Software Requirement: In depth description of the software component used in carrying out this work will also be provided in this subsection.

Arduino IDE: The IDE (Integrated Development Environment) is a special program running on your computer that allows you to write sketches for the Arduino board in a simple language modeled after the processing It is designed to introduce programming to artists and other newcomers unfamiliar with software development. It includes a code editor with features such as syntax highlighting, brace mat A transformer is a static device which transfers electrical energy from one circuit to another through the process of electromagnetic induction.

The basic structure of the Arduino programming language is fairly simple and runs in at least two parts. These two required parts or functions enclose blocks of statements.

```
Void setup()
{
 statements;
}
void loop()
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```

Where setup() is the preparation, while loop() is the execution. Both functions are required for the program to work. The setup function should follow the declaration of any variable at the very beginning of the program. It is the first function to run in the program, it runs only once and is used to set pinMode or initialize serial communication. The loop function follows next and includes the code to be executed continuously – reading inputs, triggering outputs, etc. This function is the core of all Arduino program and does the bulk of the work

3.1 Information Flow Representation

3.1.1 Data Flow Diagram :

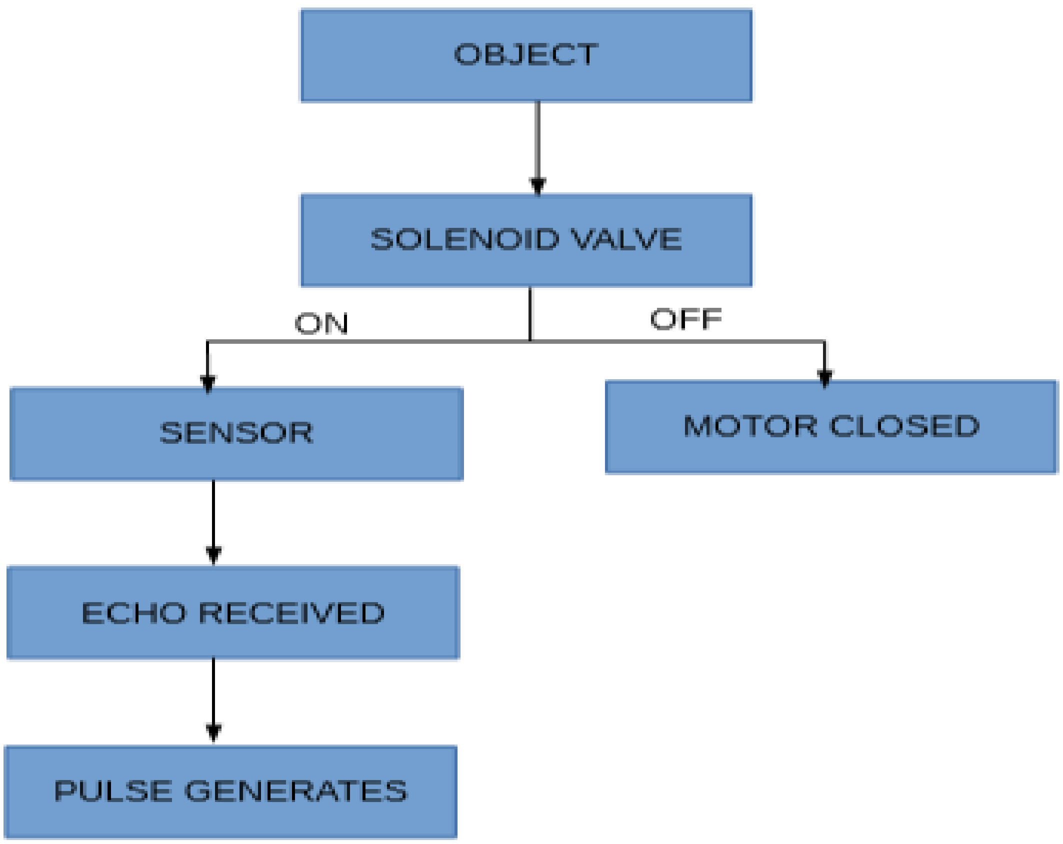

Fig. 3.1.1 Data Flow Diagram For Smart Water Meter System

3.1.2 Control Flow Diagram :

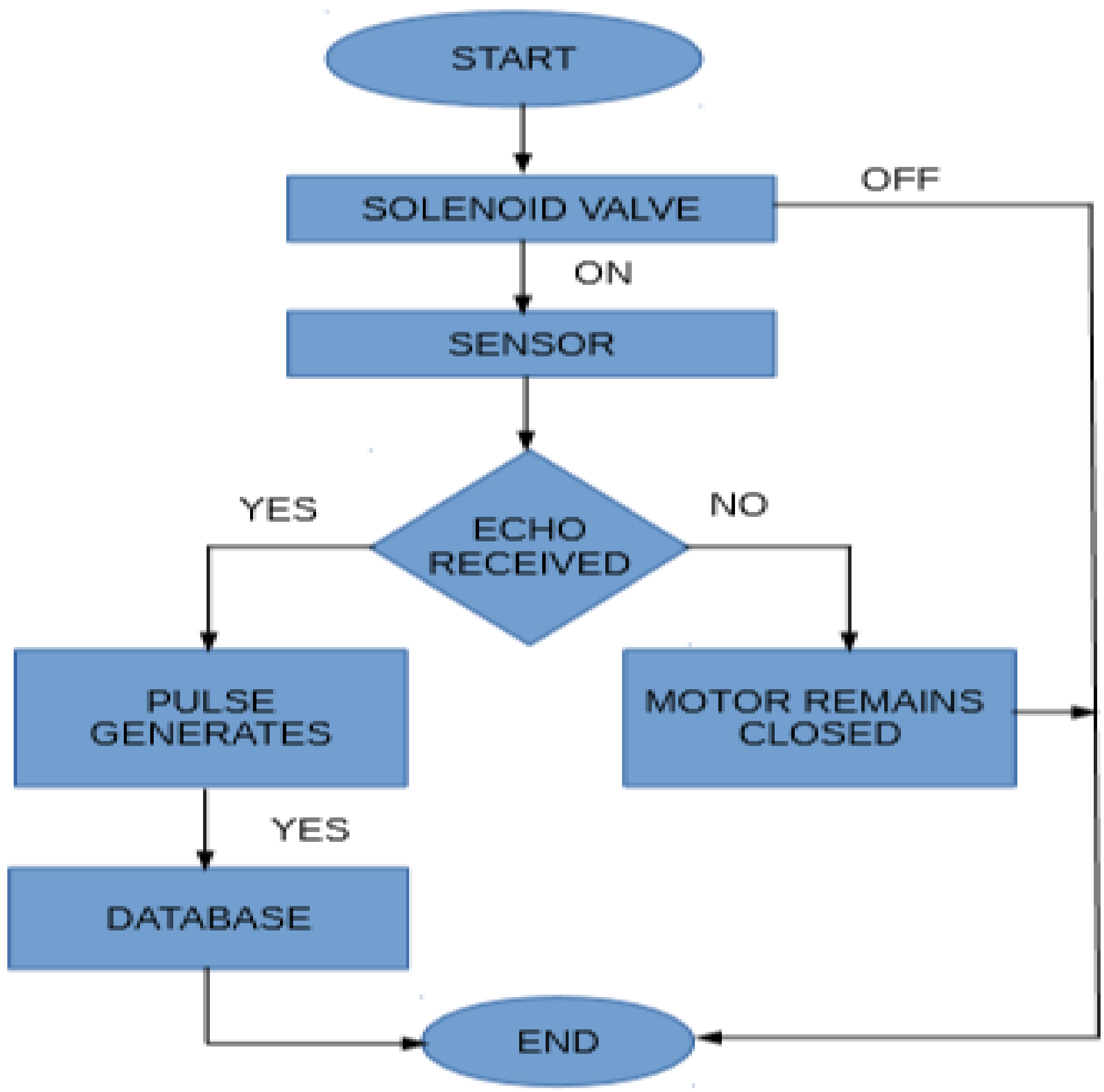

Fig. 3.1.2 Control Flow Diagram For Smart Water Meter System

3.1.3 Usecase Diagram :

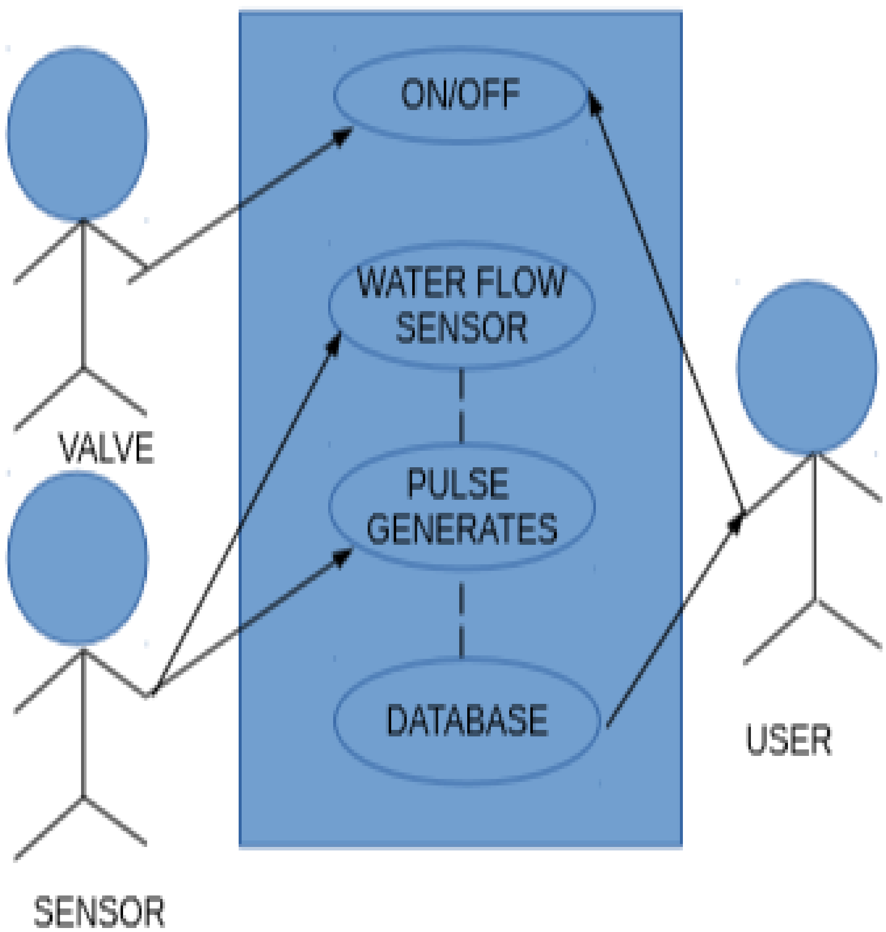

Fig. 3.1.3 Use-Case Diagram For Smart Water Meter System

4.1 Resource planning

4.1.1 Hardware requirement

Detailed description of the hardware components used in carrying out this work will be provided in this subsection.

Common Components

1. **Jumper Wires** : - Jumper wires show in Fig 4.1 are simply wires that have connector pins at each end, allowing them to be used to connect two points to each other without soldering. Jumper wires are typically used with breadboards and other prototyping tools in order to make it easy to change a circuit as needed. Fairly simple. In fact, it doesn't get much more basic than jumper wires.

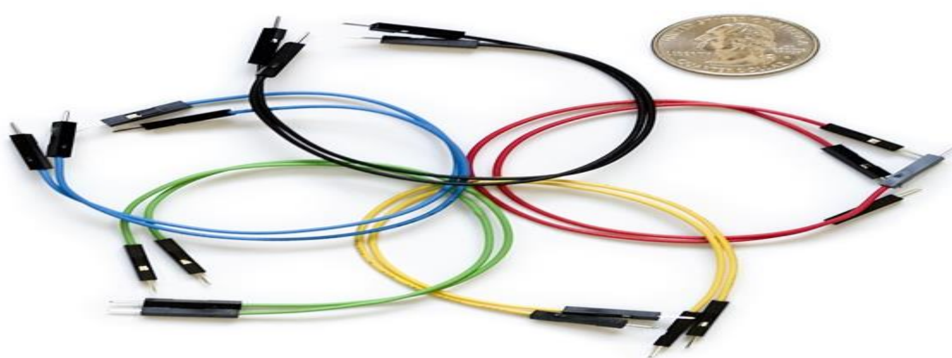

Fig. 4.1 Jumper Wires

2. **Breadboard : -** A breadboard show in Fig 4.2 is a widely used tool to design and test circuit. You do not need to solder wires and components to make a circuit while using a bread board. It is easier to mount components & reuse them. Since, components are

not soldered you can change your circuit design at any point without any hassle. It consist of an array of conductive metal clips encased in a box made of white ABS plastic, where each clip is insulated with another clips. There are a number of holes on the plastic box, arranged in a particular fashion. A typical bread board layout consists of two types of region also called strips. Bus strips and socket strips. Bus strips are usually used to provide power supply to the circuit. It consists of two columns, one for power voltage and other for ground.

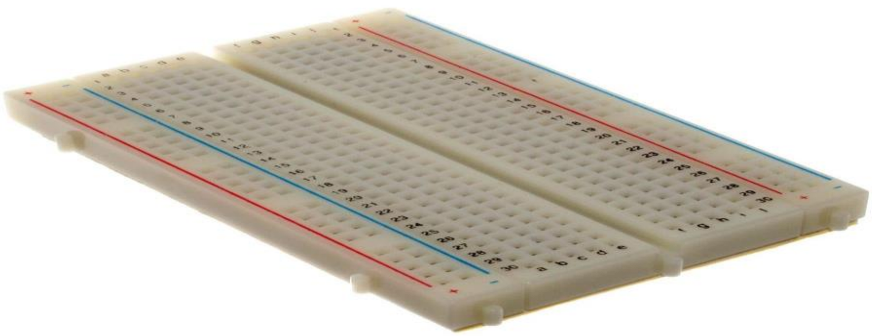

Fig. 4.2 Breadboard

Water Flow Sensor working component.

1. **Water Flow Sensor :** Water flow sensors show in Fig 4.3 are installed at the water source or pipes to measure the rate of flow of water and calculate the amount of water flowed through the pipe. Rate of flow of water is measured as liters per hour or cubic meters.

Fig. 4.3 Water Flow Sensor

2. **NODEMCU ESP8266 :** The Node MCU show in Fig 4.4 is an open source firmware and development kit that helps you to prototype your IoT product with ArduinoIDE or in few Lau script lines.It includes firmware which runs on the ESP8266 Wi-Fi SoC. And hardware which is based on the ESP-12 module. In this tutorial we explain how to use NodeMCU with Arduino IDE.

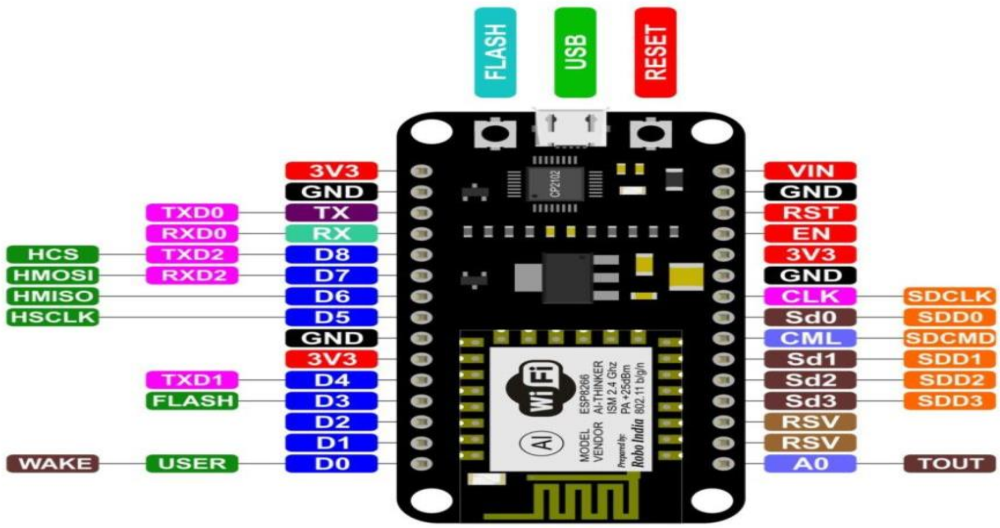

Fig. 4.4 NODEMCU ESP8266

- **How to Connect NodeMCU with Arduino IDE**

1. Open up the Arduino IDE.
2. Go to File → Preferences → Additional
   Boards Manager
   URLs : http://arduino.esp8266.com/stable/package_esp8266com_index.json
   click Ok
3. Close the IDE and open it up again.
4. Go to Tools → Board(where you'd select your version of Arduino) → Boards Manager , find the ESP8266 and click Install. You now should be able to use the ESP8266 as an Arduino.

Solenoid Valve working components

1. **Solenoid Valve** :- The solenoid valve show in Fig 4.5 is an electro-mechanical valve that is commonly employed to control the flow of liquid or gas. There are various solenoid valve types, but the main variants are either pilot operated or direct acting. Pilot operated valves, the most widely used, utilise system line pressure to open and close the main orifice in the valve body.

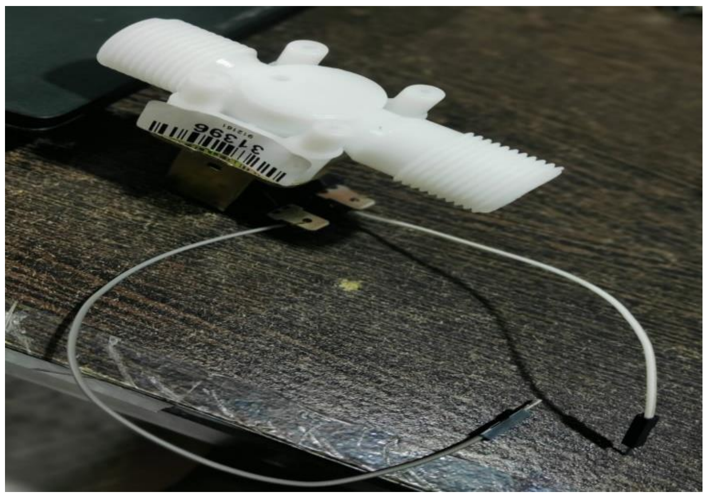

Fig.4.5 Solenoid Valve

2. **Diode :-** Diode show in Fig 4.6 is a specialized electronic component with two electrodes called the anode and the cathode. Most diodes are made with semiconductor materials such as silicon, germanium, or selenium.

Fig.4.6 Diode

3. **Relay :-** A relay show in Fig 4.7 is classified into many types, a standard and generally used relay is made up of electromagnets which in general used as a switch. Dictionary says that relay means the act of passing something from one thing to another.

Fig.4.7 Relay

4. **12V Adapter :-** An **adapter** show in Fig 4.8 is a device that allows a specific type of hardware to work with another device that would otherwise be incompatible. An electrical **adapter**, for instance, may convert the incoming voltage from 120V to **12V**, which is suitable for a radio or other small electronic device.

Fig.4.8 12V Adapter

5. **Arduino UNO** :- Arduino show in Fig 4.9 is a small microcontroller board with a USB plug to connect to computer. It has number of connection sockets that can be wired up to external electronics, such as motors, relays, light sensors etc. They can either be powered through the USB (universal serial box) connection from the computer or from a 9V battery. They can be controlled from the computer or programmed by the computer and then disconnected and allowed to work independently. The Arduino Uno is a microcontroller board based on the ATmega168. It has 14 digital input/output pins (of which 6 can be used as PWM (pulse width modulation) outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP (in-circuit serial programming) header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or a battery to get started [6]. Figure 7 above depicts a typical Arduino UNO board.

Fig.4.9 Arduino UNO

6. **Button** : A push button show in Fig 4.10 is a simple type of switch that controls an action in a machine or some type of process. Most of the time, the buttons are plastic or metal. The shape of the push button may conform to fingers or hands for easy use, or they may simply be flat. It all depends on the individual design. The push button can be normally open or normally closed.

Fig.4.10 Button

7. **1K Ohm Resistor :** The resistor show in Fig 4.11 is a passive electrical component to create resistance in the flow of electric current. In almost all electrical networks and electronic circuits they can be found. The resistance is measured in ohms. An ohm is the resistance that occurs when a current of one ampere passes through a resistor with a one volt drop across its terminals. The current is proportional to the voltage across the terminal ends. This ratio is represented by Ohm's law:

$$R = \frac{V}{I}$$

Fig.4.11 1K Ohm Resistor

Inverter working components

1. **Transformer(9-0-9):** A transformer show in Fig 4.12 is a static device which transfers electrical energy from one circuit to another through the process of electromagnetic induction. It is most commonly used to increase ('step up') or decrease ('step down') voltage levels between circuits.

   According to Faraday's law of electromagnetic induction, there will be an EMF induced in the second winding. If the circuit of this secondary winding is closed, then a current will flow through it. This is the basic working principle of a transformer. Let us use electrical symbols to help visualize this. The winding which receives electrical power from the source is known as the 'primary winding'.

   9-0-9 Step down Transformer 1A is a general purpose chassis mounting mains transformer. Transformer has 240 V primary windings and centre tapped secondary winding.

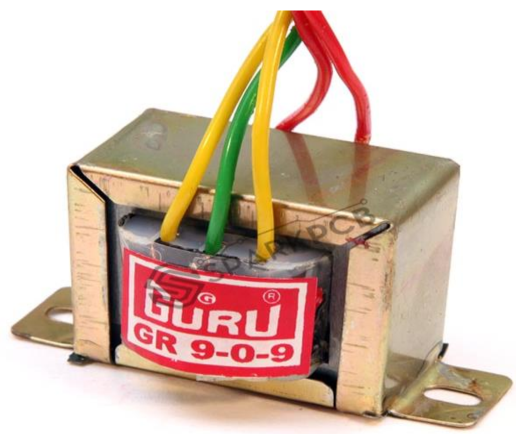

Fig. 4.12 Transformer(9-0-9)

The transformer has flying colored insulated connecting leads (Approx 100 mm long). The Transformer act as step down transformer reducing AC - 240V to AC - 9V.The Transformer gives two outputs of 9V, 9V and 0V.

2. **Transister (TIP41) :-** Transistor is a semiconductor device that can both conduct and insulate. A transistor can act as a switch and an amplifier. It converts audio waves into electronic waves and resistor, controlling electronic current. Transistors have very long life, smaller in size, can operate on lower voltage supplies for greater safety and required no filament current. The first transistor was fabricated with germanium. A transistor performs the same function as a vacuum tube triode, but using semiconductor junctions instead of heated electrodes in a vacuum chamber. It is the fundamental building block of modern electronic devices and found everywhere in modern electronic system.

Fig.4.13 Transister (TIP41)

4.1.2 Software Requirement: In depth description of the software component used in carrying out this work will also be provided in this subsection.

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It is most commonly used to increase (‘step up’) or decrease (‘step down’) voltage levels between circuits. ching, and automatic indentation, and is also capable of compiling and uploading programs to the board with a single click. A program or code written for Arduino is called a sketch. Arduino programs are written in C or C++. The Arduino IDE comes with a software library called “Wiring” from the original Wiring project, which makes many common input/output operations much easier. The basic structure of the Arduino programming language is fairly simple and runs in at least two parts. These two required parts or functions enclose blocks of statements.

```
Void setup()
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 statements;
}
void loop()
{
statements;
}
```

Where setup() is the preparation, while loop() is the execution. Both functions are required for the program to work. The setup function should follow the declaration of any variable at the very beginning of the program. It is the first function to run in the program, it runs only once and is used to set pinMode or initialize serial communication. The loop function follows next and includes the code to be executed continuously – reading inputs, triggering outputs, etc. This function is the core of all Arduino program and does the bulk of the work

5.1. Architectural Design

5.1.1 Architechture of Water Flow Sensor with NodeMCU ESP8266 Connection.

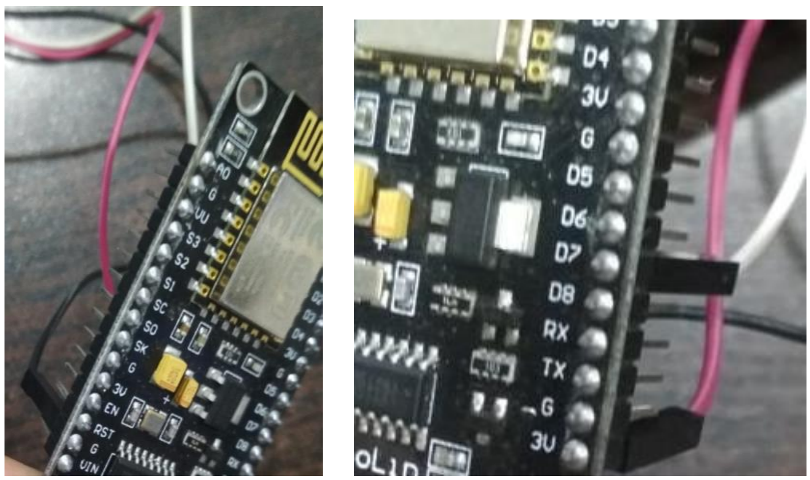


Fig.5.1.1 Connection of Water Flow Sensor with NodeMCU

5.1.2 Architechture of Solenoid Valve with Arduino UNO and Relay Connection.

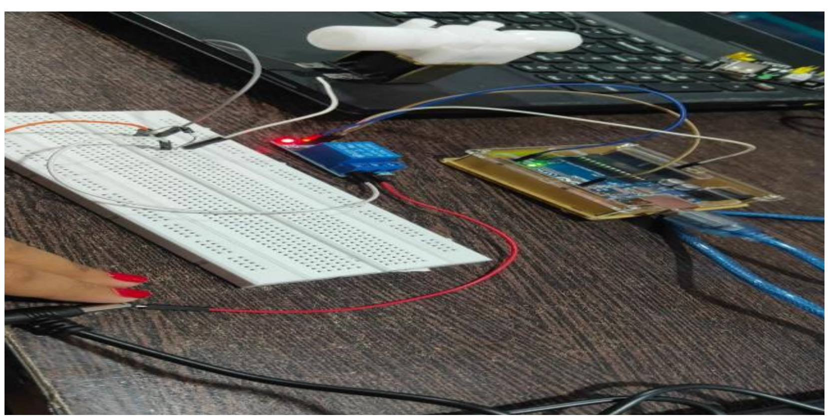


Fig.5.1.2(A) Connection of Solenoid Valve with Arduino UNO and Relay

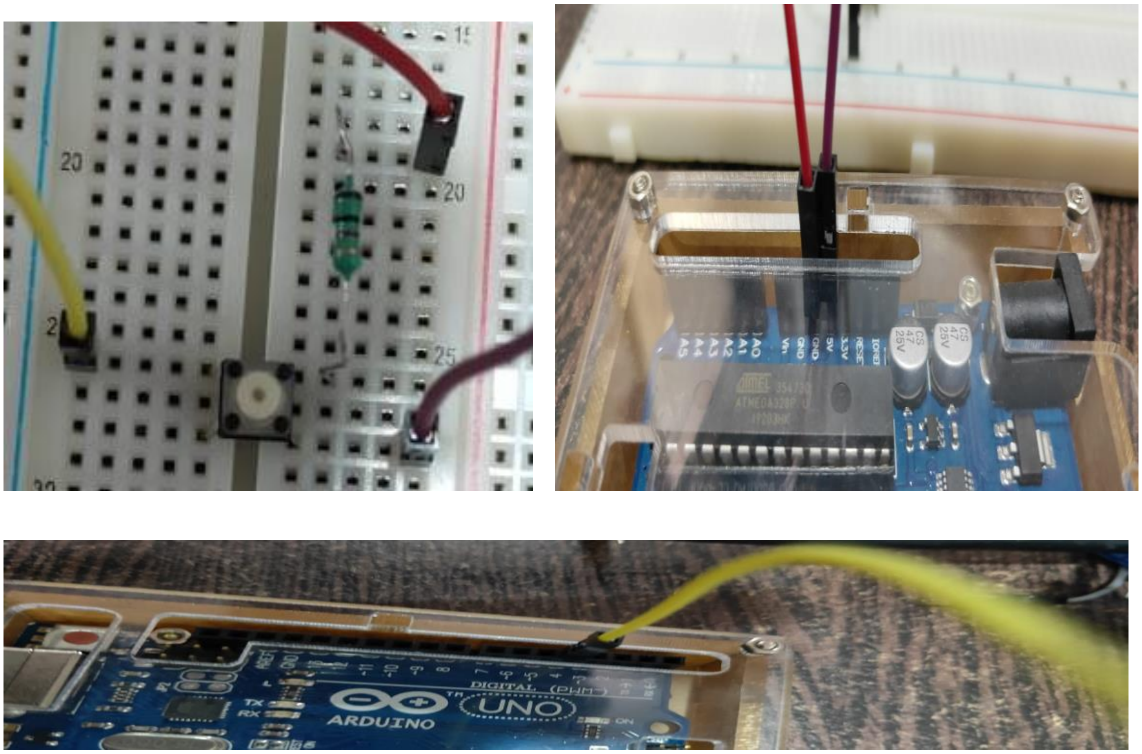


Fig.5.1.2(B)

5.1.3 Architechture of Inverter :

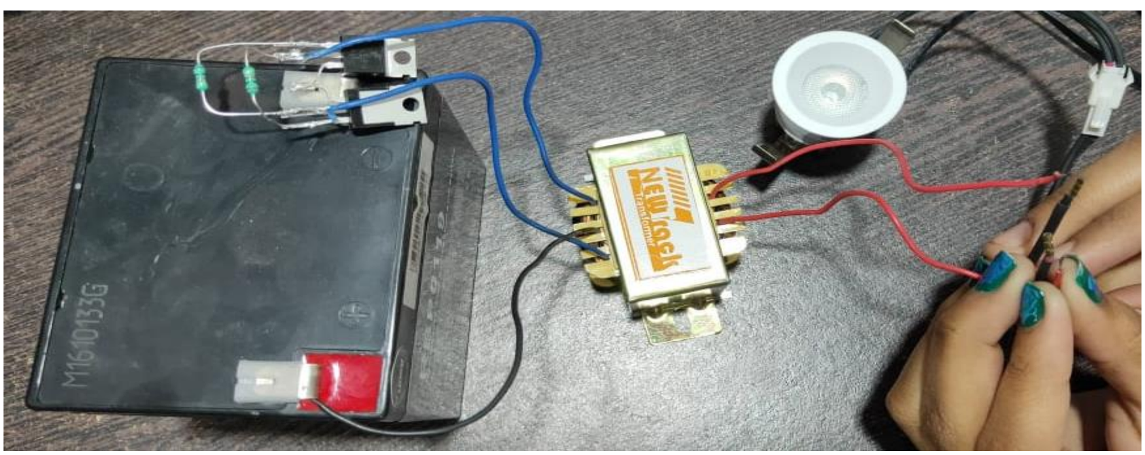


Fig. 5.1.3 Connection of Inverter

5.2 Connections

5.2.1 Connection of water flow sensor with nodeMCUESP8266 :

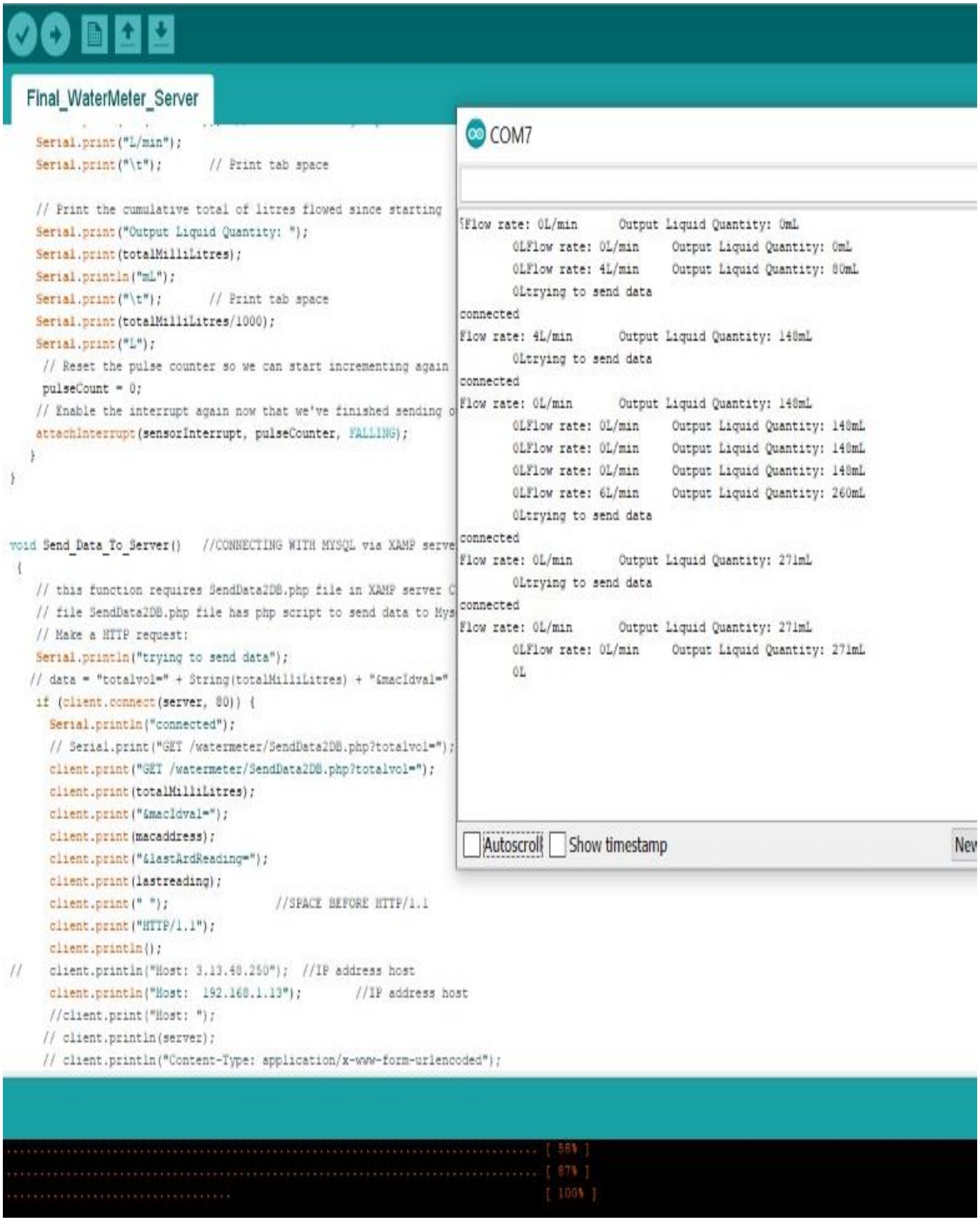
Water Flow Sensor	NodeMCuESP826
Black (GND)	GND
Red (VCC)	3V
Yellow(Output)	D7

5.2.2 Connection of Solenoid Valve with Arduino UNO and Relay :

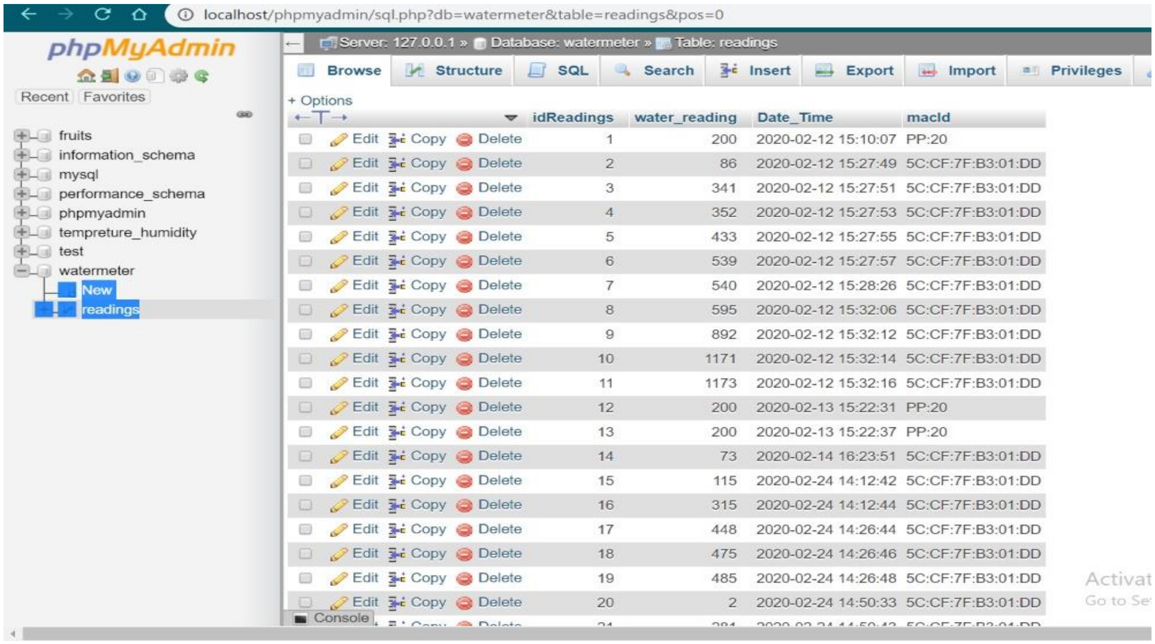
Arduino UNO	Relay	Adapter	Diode	Solenoid valve
GND	GND	-	-	-
5V	VCC	-	-	-
2PIN	IN	-	-	-
-	COM	+ive	-	-
-	NO (Normally open)	-	-ive	-
-	-	-ive	+ive	-
-	-	-	+ive	-ive
-	-	-	-ive	+ive

1. Wifi Connection :

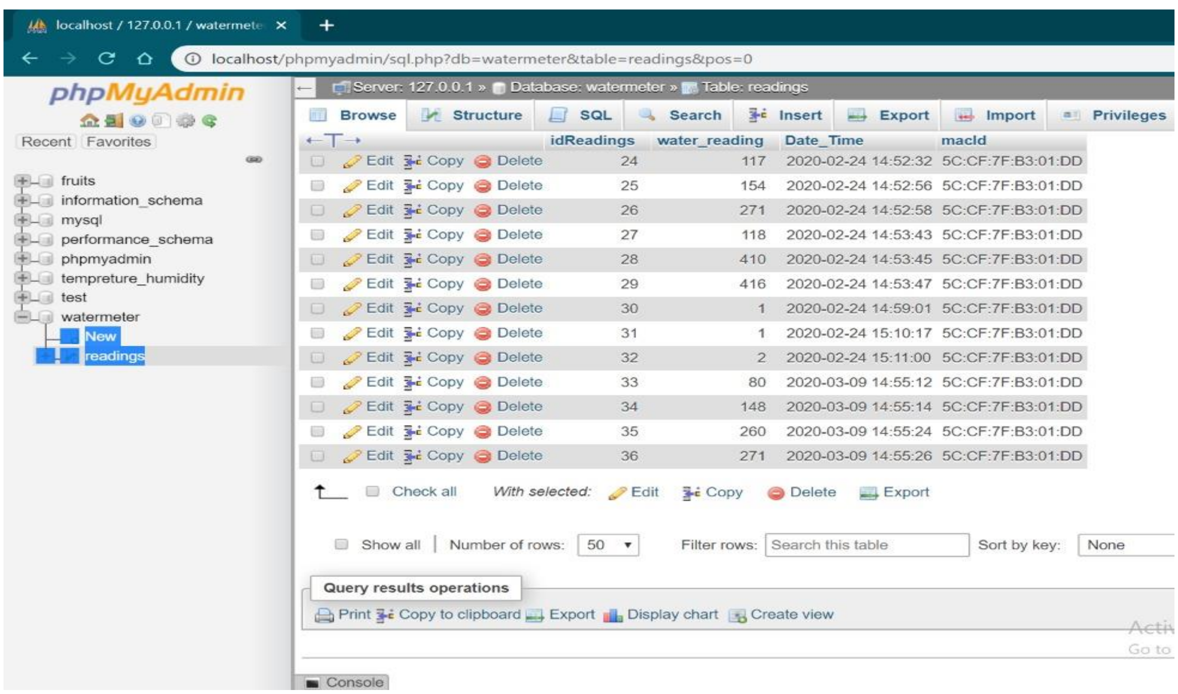
2. Water Flow Sensor Reading :



3. Reading Store in Database :



	idReadings	water_reading	Date_Time	macId
Edit Copy Delete	1	200	2020-02-12 15:10:07	PP:20
Edit Copy Delete	2	86	2020-02-12 15:27:49	5C:CF:7F:B3:01:DD
Edit Copy Delete	3	341	2020-02-12 15:27:51	5C:CF:7F:B3:01:DD
Edit Copy Delete	4	352	2020-02-12 15:27:53	5C:CF:7F:B3:01:DD
Edit Copy Delete	5	433	2020-02-12 15:27:55	5C:CF:7F:B3:01:DD
Edit Copy Delete	6	539	2020-02-12 15:27:57	5C:CF:7F:B3:01:DD
Edit Copy Delete	7	540	2020-02-12 15:28:26	5C:CF:7F:B3:01:DD
Edit Copy Delete	8	595	2020-02-12 15:32:06	5C:CF:7F:B3:01:DD
Edit Copy Delete	9	892	2020-02-12 15:32:12	5C:CF:7F:B3:01:DD
Edit Copy Delete	10	1171	2020-02-12 15:32:14	5C:CF:7F:B3:01:DD
Edit Copy Delete	11	1173	2020-02-12 15:32:16	5C:CF:7F:B3:01:DD
Edit Copy Delete	12	200	2020-02-13 15:22:31	PP:20
Edit Copy Delete	13	200	2020-02-13 15:22:37	PP:20
Edit Copy Delete	14	73	2020-02-14 16:23:51	5C:CF:7F:B3:01:DD
Edit Copy Delete	15	115	2020-02-24 14:12:42	5C:CF:7F:B3:01:DD
Edit Copy Delete	16	315	2020-02-24 14:12:44	5C:CF:7F:B3:01:DD
Edit Copy Delete	17	448	2020-02-24 14:26:44	5C:CF:7F:B3:01:DD
Edit Copy Delete	18	475	2020-02-24 14:26:46	5C:CF:7F:B3:01:DD
Edit Copy Delete	19	485	2020-02-24 14:26:48	5C:CF:7F:B3:01:DD
Edit Copy Delete	20	2	2020-02-24 14:50:33	5C:CF:7F:B3:01:DD



	idReadings	water_reading	Date_Time	macId
Edit Copy Delete	24	117	2020-02-24 14:52:32	5C:CF:7F:B3:01:DD
Edit Copy Delete	25	154	2020-02-24 14:52:56	5C:CF:7F:B3:01:DD
Edit Copy Delete	26	271	2020-02-24 14:52:58	5C:CF:7F:B3:01:DD
Edit Copy Delete	27	118	2020-02-24 14:53:43	5C:CF:7F:B3:01:DD
Edit Copy Delete	28	410	2020-02-24 14:53:45	5C:CF:7F:B3:01:DD
Edit Copy Delete	29	416	2020-02-24 14:53:47	5C:CF:7F:B3:01:DD
Edit Copy Delete	30	1	2020-02-24 14:59:01	5C:CF:7F:B3:01:DD
Edit Copy Delete	31	1	2020-02-24 15:10:17	5C:CF:7F:B3:01:DD
Edit Copy Delete	32	2	2020-02-24 15:11:00	5C:CF:7F:B3:01:DD
Edit Copy Delete	33	80	2020-03-09 14:55:12	5C:CF:7F:B3:01:DD
Edit Copy Delete	34	148	2020-03-09 14:55:14	5C:CF:7F:B3:01:DD
Edit Copy Delete	35	260	2020-03-09 14:55:24	5C:CF:7F:B3:01:DD
Edit Copy Delete	36	271	2020-03-09 14:55:26	5C:CF:7F:B3:01:DD

4. Solenoid Valve :

Chapter 6

Conclusion

7.1 **Conclusion :** A meter interface node was developed that makes use of open source tools. This enables the user to modify the source code to suit the own needs or those of the service provider. The developed system provides the user with a real-time monitoring system for water consumption, but it can also be used for other services such as leakage detection and localisation. The system provides a short-range communication of 100m, though with more households using the same system, the coverage range will be increased since the system supports mesh network topology. Tools used for visualisation are open-source, which makes them cheap to develop and integrate. A web-based interface is also developed that visualises real-time and historical water consumption. Moreover, the monitoring system can serve to help users change their water usage and reduce water consumption, as well as to identify and fix abnormal water consumption.

7.2 Limitations :

1. Require Power supply
2. Electronic components are more vulnerable to damage.
3. Repairs require skilled technician and specialized equipment.
4. Pipe wall needs to be fairly clean and free of rust and irregularities for getting better result.

7.3 **Future Enhancements :** As IoT is growing every day with new technologies involved, new challenges arise. The IoT has encouraged people to connect to devices using the internet and the increase in the use of IoT devices motivated people to use smart technologies. The water quality in the distribution system is a serious factor that affects public health and smart water system provides a user-friendly interface to monitor the water quality in houses and take remedial measurements if necessary.

One of the main challenges in smart water system is managing the cost, energy and efficiency required for water distribution system. The selection of water quality, quantity and topological parameters is another challenge in the smart water system. So there is in need of research about these challenges to provide a new cost and energy efficient solution to the smart water system. The future work will focus on developing an IoT architecture in water distribution system with integration of new technologies such as cloud, energy harvesting etc As IoT is growing every day with new technologies involved, new challenges arise. The IoT has encouraged people to connect to devices using the internet and the increase in the use of IoT devices motivated people to use smart technologies. The water quality in the distribution system is a serious factor that affects public health and smart water system.

References

[1] Wifi Connection :
https://www.instructables.com/id/IoT-ESP8266-Series-1-Connect-to-WIFI-Router/
https://roboindia.com/tutorials/nodemcu-connecting-internet-arduino/
https://nodemcu.readthedocs.io/en/master/modules/wifi/

[2] Water Flow Sensor :
https://www.electroschematics.com/working-with-water-flow-sensors-arduino/475b18b16
https://circuitdigest.com/microcontroller-projects/arduino-based-water-flow-sensor

[3] DataBase Connectivity:
https://www.w3schools.com/php/php_mysql_connect.asp
https://www.php.net/manual/en/function.mysql-connect.php

[4] Inverter :
https://www.youtube.com/watch?v=NHJEsYdVw7s

[5] Solenoid Valve:
https://www.bc-robotics.com/tutorials/controlling-a-solenoid-valve-with-arduino/
https://electronics.stackexchange.com/questions/296930/choosing-a-relay-to-operate-solenoid-valve
https://circuitdigest.com/microcontroller-projects/how-to-control-solenoid-valve-using-arduino

[6] Button Connection:
https://www.arduino.cc/en/tutorial/button