Belgaum, Karnataka-590 018

A Project Report on

"Smart Water Management"

Project Report submitted in partial fulfillment of the requirement for the award of the degree of

Bachelor of Engineering

In

Electrical & Electronics Engineering

Submitted by

Asjad Riyan Khan	**USN:1CR15EE016**
Md.Faizul Islam	**USN:1CR16EE409**
Vinayak Dubey	**USN:1CR15EE089**
Imteyaz Ansari	**USN:1CR16EE407**

Under the Guidance of

S.Poornima Gayathri
Assistant Professor,
Department of Electrical & Electronics Engineering

SMART WATER MANAGEMENT

CMR Institute of Technology

CMR Institute of Technology, Bengaluru-560 037

Department of Electrical & Electronics Engineering

2019-2020

SMART WATER MANAGEMENT

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

AECS Layout, Bengaluru-560 037

Certificate

Certified that the project work entitled **"Smart Water Management"** carried out by Mr.Asjad Riyan Khan, USN:1CR15EE016; Mr.Md.Faizul Islam,USN:1CR16EE409; Mr.Vinayak Dubey,USN:1CR15EE089; Mr.Imteyaz Ansari,USN:1CR16EE407;are bonafied students of CMR Institute of Technology, Bengaluru, in partial fulfillment for the award of Bachelor of Engineering in Electrical & Electronics Engineering of the Visvesvaraya Technological University, Belgaum, during the year 2019-2020. It is certified that all corrections/suggestions indicated for Internal Assessment have been incorporated in the Report deposited in the departmental library.

The project report has been approved as it satisfies the academic requirements in respect of Project work prescribed for the said Degree.

Signature of the Guide	*Signature of the HOD*	*Signature of the Principal*
	--------------------------	--------------------------
Ms.Poornima Gayathri Assistant professor EEE Department, CMRIT, Bengaluru	Dr. K. Chitra Professor & HOD EEE Department, CMRIT, Bengaluru	Dr. Sanjay Jain Principal, CMRIT, Bengaluru

External Viva

Name of the Examiners	Signature & Date
1.	
2.	

CMR INSTITUTE OF TECHNOLOY

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

AECS Layout, Bengaluru-560 037

DECLARATION

We, [Mr.Asjad Riyan Khan,(USN:1CR15EE016),Mr.Md.Faizul Islam(USN:1CR16EE409),Mr.Vinayak Dubey(USN:1CR15EE089), Mr.Imteyaz Ansari(USN:1CR16EE407)], hereby declare that the report entitled **"Smart Water Management"** has been carried out by us under the guidance of **Ms.Poornima Gayathri,** Assistant Professor, Department of Electrical & Electronics Engineering, CMR Institute of Technology, Bengaluru, in partial fulfillment of the requirement for the degree of **BACHELOR OF ENGINEERING in ELECTRICAL & ELECTRONICS ENGINEERING**, of Visveswaraya Technological University, Belagaum during the academic year 2019-20. The work done in this report is original and it has not been submitted for any other degree in any university.

Place: Bengaluru Date:

Mr.Asjad Riyan Khan

(1CR15EE016)

Mr.Md.Faizul Islam1CR16EE409)

Mr.Vinayak Dubey (1CR15EE089)

Mr.Imteyaz Ansari(1CR16EE407)

Abstract

In Today's world the available drinking water is decreasing day by day by irregular wastage of water. The foremost interest of developing this kind of project or prototype is that to help our society deal with such issue and also to help the society by saving water for them thereby important steps to be taken to solve this issue but an uttermost important step apart from implementing this kind of technology is creating awareness among the people and also educating people about the need of the hour and also getting along with NGO and also Government organizations to help and benefit each other.

Certainly, people need to limit their usage of water where they think they could use less quantity compared to the one their using.

Then water for bathing and other domestic purposes should be calculated and used rather than lavishly wasting it. The government bodies should also have a quick response at sites of water pipeline damage in order to save water and not to have interruptions of the pipeline. Lastly, the public also should be aware of the do's and don't's with the water supply provided by the government. We must try as much as possible to save water.

Acknowledgement

The satisfaction and euphoria that accompany the successful completion of any task would be incomplete without the mention of people, who are responsible for the completion of the project and who made it possible, because success is outcome of hard work and perseverance, but stead fast of all is encouraging guidance. So with gratitude we acknowledge all those whose guidance and encouragement served us to motivate towards the success of the project work.

*We take great pleasure in expressing our sincere thanks to **Dr. Sanjay Jain**, **Principal, CMR Institute of Technology, Bengaluru** for providing an excellent academic environment in the college and for his continuous motivation towards a dynamic career. We would like to profoundly thank **Dr. B Narasimha Murthy**, Vice-principal of CMR Institute of Technology and the whole **Management** for providing such a healthy environment for the successful completion of the project work.*

*We would like to convey our sincere gratitude to **Dr. K Chitra**, **Head of Electrical and Electronics Engineering Department, CMR Institute of Technology, Bengaluru** for her invaluable guidance and encouragement and for providing good facilities to carry out this project work.*

*We would like to express our deep sense of gratitude to **S.Poornima Gayathri, Assistant Professor, Electrical and Electronics Engineering, CMR Institute of Technology, Bengaluru** for his/her exemplary guidance, valuable suggestions, expert advice and encouragement to pursue this project work.*

*We are thankful to all the faculties and laboratory staffs of **Electrical and Electronics Engineering Department, CMR Institute of Technology, Bengaluru** for helping us in all possible manners during the entire period.*

Finally, we acknowledge the people who mean a lot to us, our parents, for their inspiration, unconditional love, support, and faith for carrying out this work to the finishing line. We want to give special thanks to all our friends who went through hard times together, cheered us on, helped us a lot, and celebrated each accomplishment.

SMART WATER MANAGEMENT

CONTENTS

LIST OF FIGURES

LIST OF TABLES

viii

LIST OF ABBREVIATIONS AND SYMBOLS

PWM -Pulse width modulation.

ADC- Analog to digital conversion.

NO-Normally Closed.

NC-Normally Open.

I/P-Input.

O/P-Output.

CHAPTER 1 :- INTRODUCTION

Smart Water Management is basically a problem solver for the problem that has been running since long time ago,this would not be the only solution, as there should awareness created among-st the general masses so there would effective utilization of water.

On the technical part in system water being distributed is measured and its flow is recorded in real time, the motored regulators installed in the respective houses decides the water to be allotted to the house.

These regulators cause efficient allotment of water to respective houses.

In case of extra allotment of water, with help of AI and other web service public could request the some more water allotment.With this Enough water could be saved.

1.1 Existing Water Supply System in Bangalore.

Existing Water Supply System Scenario

Till the year 1896, unfiltered water was supplied to Bangalore city in the Kalyani system from a number of tanks such as Dharmambudhi, Sampangi, Ulsoor, Sankey etc., supplemented by local wells and stepped ponds. The supply was inadequate from these tanks, hence, Arkavathi river was identified as the first large reliable source in the year 1884 and filtered water supply was started in the year 1896. Due to the continuous expansion of the city and the rapid growth of population, it became necessary to find and develop new sources. Cauvery River was identified for water supply and allocation of water from Cauvery river was done by Government of Karnataka (GoK). Since 1974, the Cauvery source has been developed in stages for water supply. This chapter discusses the schemes of river Arkavathi and River Cauvery which are the present sources of water.

To supply filtered water to Bangalore City, Arkavathi source was identified in the year 1884. A reservoir was created at Hessarghatta about 18 kms to the North West of the city. An open masonry duct, 7 km long conveyed 29.5 Mld of raw water from source to Tarabanahalli and Soladevanahalli. From Tarabanahalli 7 Mld of water is supplied to Military. From Soladevanahalli 22.5 Mld water was pumped to city at a head of 125 m through, two 375 mm CI rising mains to Combined Jewel Filters (CJF), Malleshwaram where the water was treated. Treated water was first supplied after completing treatment plants at CJF on 7th August 1896.

Modification took place at Hessarghatta source by replacing masonry duct by 1050 mm diameter RCC Hume Pipe with a carrying capacity of about 36 Mld. One more rising main of 375 mm diameter was laid from Soladevanahalli. These three pipelines can carry 22.5 Mld water under normal conditions, out of which 13.5 Mld was supplied to the city and the balance water was supplied to enroute industries. Due to failure of monsoon, there is scarcity of water at source, only about 4 mld of water available was supplied to Military and Industries enroute in Peenya layout. This water is supplied as raw water because the treatment plant at CJF is not functioning and the receiving units such as HMT, Peenya layout and Defence establishments are having their own treatment facilities to treat this raw water. However, no water is being drawn at present from this source.

Thippagondanahalli (T.G.Halli)

With the growth of the city the supply fell short of demand hence a new reservoir 'Chamaraja Sagar' near Thippagondanahalli (TG halli) was constructed in the year 1933 across the river Arkavathi, downstream of Hessarghatta reservoir about 26 km to the west of Bangalore. Water Treatment Plant is situated at the foot of the dam at T G halli. The first phase of the scheme was completed during March 1933 to augment the then supply by about 28 Mld. Subsequently, the abstraction was increased to 149 Mld by providing additional infrastructure such as increasing the capacity of the dam, providing additional treatment and pumping facility.

This improvement is done by providing two stage pumping, the pumping head being 158 m at T G Halli and 168 m at Tavarekere which is the intermediate pumping station. Transmission system consists of 3 pumping mains of 600, 675 and 900 mm diameter CI pipes from T.G.Halli to CJF. Due to failure of monsoons and constraints in the existing pumping system only about 117 Mld is available most of the times and is supplied to West of Chord Road, Beggars Colony, Kethamaranahalli (KMH) and CJF after implementation of Cauvery stage III project. Due to continuous failure of monsoon, the reservoir last got filled in the year 1988. Presently there is no flow available. Because of these reasons Arkavathi zone reservoirs are also being fed with Cauvery water.

Cauvery Water Supply Scheme

A total supply of about 185 mld from the Arkavathi scheme was grossly inadequate to meet the demand of about 16 lakh population in the late sixties. Due to the continuous expansion of the city and the rapid growth of population it was necessary to identify new water supply sources. Cauvery River, which is about 86 km South of the city, is perennial and Government of Karnataka (GoK) allocated drinking water to BWSSB. Cauvery source is being developed in stages since 1974. Cauvery water supply scheme (CWSS) stage-I was commissioned in the year 1974 to augment the supply by 135 Mld. CWSS Stage-II followed and was commissioned in 1982 to further augment the supply by 135 Mld. CWSS Stage-III was commissioned in 1994-95, this stage augmented supplies by 270 mld. Cauvery water supply scheme (CWSS) stage-IV Phase I was commissioned in 2002 to augment supply by 270 Mld. CWSS Stage- IV Phase II followed and was commissioned in 2012 to further augment supply by 500 Mld.

The salient features of the complete water supply system is shown in the tables below:

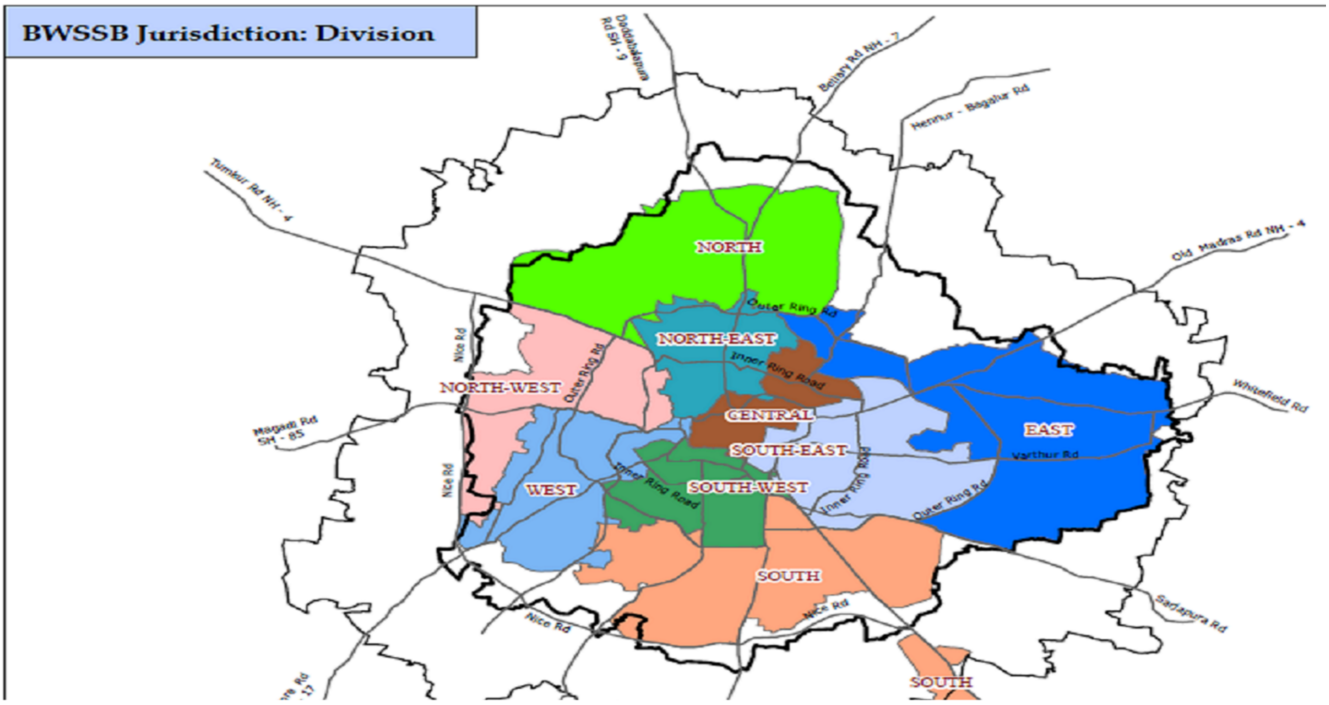

Figure 1 :-Water Network in Bangalore City.

Table 1: Water supply System

Present Supply from Cauvery source	1440 MLD
Present population served	8.5 Millions
Area of water supply served	570 sq. kms
House service connections	8.65 lakhs
Total length of water supply pipelines	10287.8 kms
Pipe diameters' range	100 to 2200 mm
Number of Ground Level Reservoirs	57 (885 ML)
Number of Over Head Tanks	36 (33 ML)
Booster pumping stations	62 nos
Public taps providing free water	7,477 nos
Water tanker lorries	62 nos
Quantity of water supplied/month	42,200 ML
Average per capita consumption	65 L/day
Average cost of water	28 Rs/kL

Table 1:-Water supply system in Bangalore city by water from cauvery and other source

1.2 How propose model is better than the existing system.

There are lot of loopholes in the existing system which are either being triggered are encountered in some are the different ways but these are not the long-term benefit for the problem. Also, not much zeal to work by the employees at times, contributes to a bad structural organization which does not allow efficient distribution and supply of the water. In accordance of the proposed model the efficient distribution of water could be considered a to be a effective system that could help in monitoring and allocating to the respective houses depending upon the requirement and the amount of supply what is present in our stock. Today it is a Grave concern that we don't have enough water available in resources each and every government organization is tending to search for new resources of water so as to make it available for the people to consume so along with research and development and exact implementation of this kind of systems this could make effective distribution and a lot of water could be saved and saving a good amount of water could have better impact.

With available proposed model only retrofitting could help a lot of in effective distribution and allocation of water retrofitting the existing pipelines could help the government organizations to monitor the exact water that would be moving through the entire network of pipelines and also the monitored water could be stored in the real-time with the help of data acquisition system and in their server. With the amount of consumed water and distributed water, the count of whatever is used and whatever is remaining is known. with such kind of monitoring system, we could not only distribute but also detect faults and flaws in the pipeline network so as to prevent from water losses and also helps in new structural piping for various other purposes example auxiliary pipes.

Note:-Further about the model will be discussed in the report.

CHAPTER 2 :- LITERATURE REVIEW

2.1 Newspaper articles

There were a lot of newspaper articles published in the recent times and also been published now regarding the scarcity problem that is running around in the city and also in various parts of the country this made the authors curious how to develop something so as to have effective distribution and supply system which would save as well as a record and monitor data regarding water and help the government organizations as well as the society to cope up with the problem, not to a greater extent but cope up with the problem and come out of it.

Note:- newspaper articles link are given in the reference section.

2.2 Public Interaction.

Inconvenience faced by government organizations at times of water crisis that were published on several social media platforms regarding Water leakage both internal and external and irregular water distribution provided by the government bodies that posed a problem both to the public as well as to the government bodies which was discussed on several social media platforms which made the author get something for the situation.

Chapter 3: -BLOCK DIAGRAM & EQUIPMENT USED

3.1 Block diagram

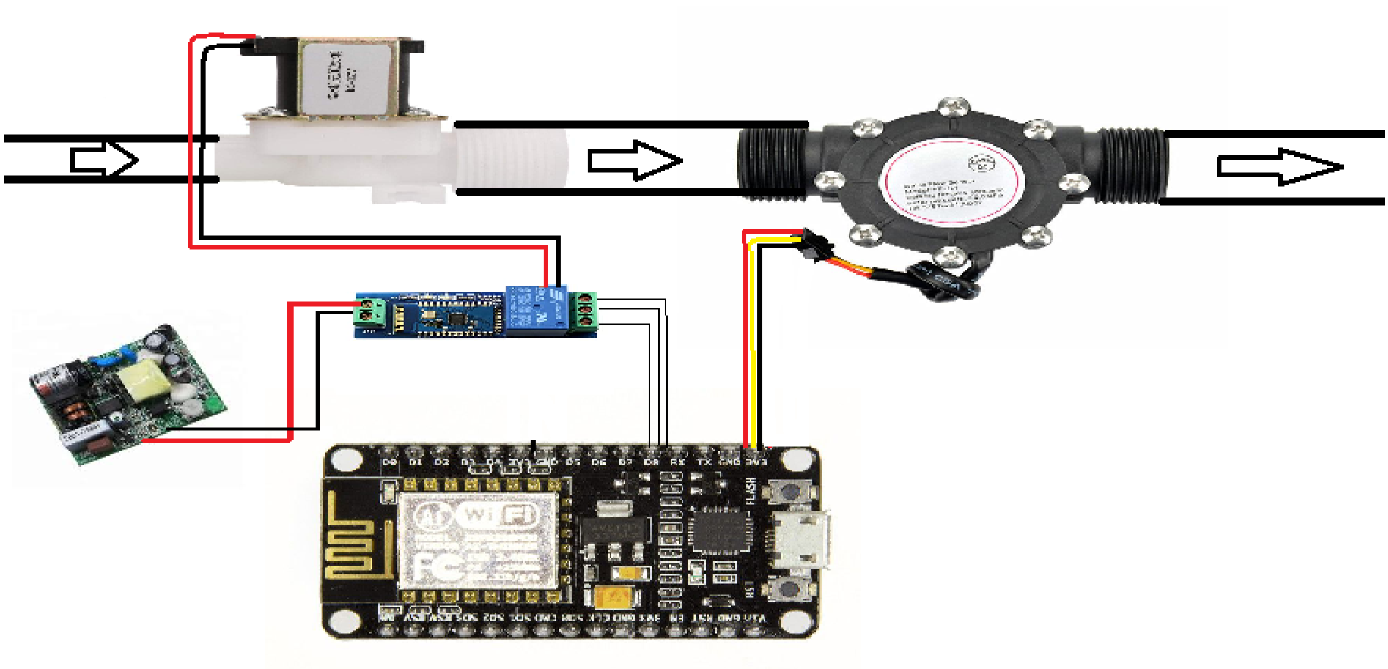

Figure 2:-Block Diagram of proposed model.

As depicted in the block diagram the water flowing through the flow metre flows towards the solenoid valve and stop on by the solenoid valve once the flow is detected by the flow metre the solenoid valve is command to open via single channel relay which is in turn powered by 12 volt SMPS ,the microcontroller which controls the entire to and fro moment from sensing toopening and closing of valves is Arduino/esp8266.

Note:- further working will be explained in the working section.

3.2 EQUIPMENT USED

Arduino mega

The **Arduino Mega 2560** is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset buttn. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Mega 2560 board is compatible with most shields designed for the Uno and the former boards Duemilanove or Diecimila.

The Mega 2560 is an update to the Arduino Mega, which it replaces.

Description about Arduino

- Microcontroller: Microchip ATmega328P [7]
- Operating Voltage: 5 Volts

- Input Voltage: 7 to 20 Volts
- Digital I/O Pins: 14 (of which 6 can provide PWM output)
- Analog Input Pins: 6
- DC Current per I/O Pin: 20 mA
- DC Current for 3.3V Pin: 50 mA
- Flash Memory: 32 KB of which 0.5 KB used by bootloader
- SRAM: 2 KB
- EEPROM: 1 KB
- Clock Speed: 16 MHz
- Length: 68.6 mm
- Width: 53.4 mm
- Weight: 25 g

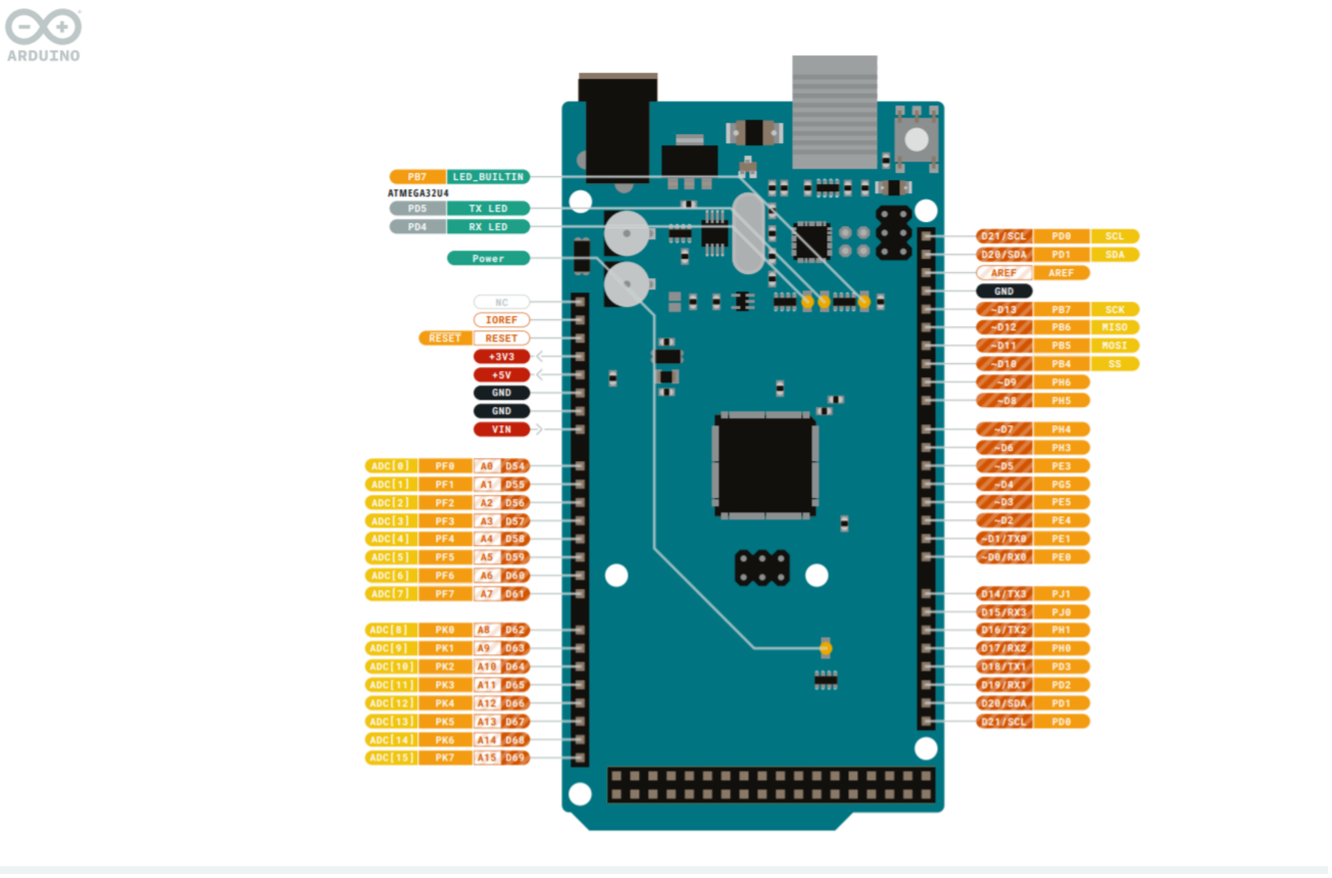

Figure 3:-Architecture of Arduino mega

Solenoid valve

A **solenoid valve** is an electromechanically operated valve.

Solenoid valves differ in the characteristics of the electric current they use, the strength of the magnetic field they generate, the mechanism they use to regulate the fluid, and the type and characteristics of fluid they control. The mechanism varies from linear action, plunger-type actuators to pivoted-armature actuators and rocker actuators. The valve can use a two-port design to regulate a flow or use a three or more port design to switch flows between ports. Multiple solenoid valves can be placed together on a manifold.

Solenoid valves are the most frequently used control elements in fluidics. Their tasks are to shut off, release, dose, distribute or mix fluids. They are found in many application areas. Solenoids offer fast and safe switching, high reliability, long service life, good medium compatibility of the materials used, low control power and compact design.

Figure 4:-Solenoid valve

There are many valve design variations. Ordinary valves can have many ports and fluid paths. A 2-way valve, for example, has 2 ports; if the valve is **open**, then the two ports are connected and fluid may flow between the ports; if the valve is **closed**, then ports are isolated. If the valve is open when the solenoid is not energized, then the valve is termed **normally open** (N.O.). Similarly, if the valve is closed when the solenoid is not energized, then the valve is termed **normally closed**.[1] There are also 3-way and more complicated designs.[2] A 3-way valve has 3 ports; it connects one port to either of the two other ports (typically a supply port and an exhaust port).

Solenoid valves are also characterized by how they operate. A small solenoid can generate a limited force. If that force is sufficient to open and close the valve, then a **direct acting** solenoid valve is possible. An approximate relationship between the required solenoid force F_s, the fluid pressure P, and the orifice area A for a direct acting solenoid valve is:[3]

$$F_s = PA = P\pi d^2/4$$

Where d is the orifice diameter. A typical solenoid force might be 15 N (3.4 lb_f). An application might be a low pressure (e.g., 10 psi (69 kPa)) gas with a small orifice diameter (e.g., ⅜ in (9.5 mm) for an orifice area of 0.11 in^2 (7.1×10^{-5} m^2) and approximate force of 1.1 lbf (4.9 N)).

When high pressures and large orifices are encountered, then high forces are required. To generate those forces, an **internally piloted** solenoid valve design may be possible.[1] In such a design, the line pressure is used to generate the high valve forces; a small solenoid controls how the line pressure is used. Internally piloted valves are used in dishwashers and irrigation systems where the fluid is water, the pressure might be 80 psi (550 kPa) and the orifice diameter might be ¾ in (19 mm).

In some solenoid valves the solenoid acts directly on the main valve. Others use a small, complete solenoid valve, known as a pilot, to actuate a larger valve. While the second type is actually a solenoid valve combined with a pneumatically actuated valve, they are sold and packaged as a single unit referred to as a solenoid valve. Piloted valves require much less power to control, but they are noticeably slower. Piloted solenoids usually need full power at all times to open and stay open, where a direct acting solenoid may only need full power for a short period of time to open it, and only low power to hold it.

A direct acting solenoid valve typically operates in 5 to 10 milliseconds. The operation time of a piloted valve depends on its size; typical values are 15 to 150 milliseconds.[2]

Power consumption and supply requirements of the solenoid vary with application, being primarily determined by fluid pressure and line diameter. For example, a popular 3/4" 150 psi sprinkler valve, intended for 24 VAC (50 - 60 Hz) residential systems, has a momentary inrush of 7.2 VA, and a holding power requirement of 4.6 VA.[4] Comparatively, an industrial 1/2" 10000 psi valve, intended for 12, 24, or 120 VAC systems in high pressure fluid and cryogenic applications, has an inrush of 300 VA and a holding power of 22 VA.[5] Neither valve lists a minimum pressure required to remain closed in the un-powered state.

Water flow sensor

Water flow sensors 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.

Working Principle

Water flow sensor consists of a plastic valve from which water can pass. A water rotor along with a hall effect sensor is present the sense and measure the water flow.

When water flows through the valve it rotates the rotor. By this, the change can be observed in the speed of the motor. This change is calculated as output as a pulse signal by the hall effect sensor. Thus, the rate of flow of water can be measured.

The main working principle behind the working of this sensor is the Hall effect. According to this principle, in this sensor, a voltage difference is induced in the conductor due to the rotation of the rotor. This induced voltage difference is transverse to the electric current

Figure 5:-Water Flow Meter.

When the moving fan is rotated due to the flow of water, it rotates the rotor which induces the voltage. This induced voltage is measured by the hall effect sensor and displayed on the LCD display.

The water flow sensor can be used with hot waters, cold waters, warm waters, clean water, and dirty water also. These sensors are available in different diameters, with different flow rate ranges.

These sensors can be easily interfaced with microcontrollers like Arduino. For this, an Arduino microcontroller board for processing, a Hall effect water flow sensor, a 16×2 LCD display, and Breadboard connecting wires are required. The sensor is placed at the water source inlet or at the opening of the pipe.

The sensor contains three wires. Red wire to connect with supply voltage. Black wire to connect to ground and a yellow wire to collect output from Hall effect sensor. For supply voltage 5V to 18V of DC is required

Applications of Water Flow Sensor

Water flow sensors can measure the rate of flow of water either by measuring velocity or displacement. These sensors can also measure the flow of water like fluids such as measuring milk in a dairy industry etc…

There are various types of water flow sensors available based on their diameter and method of measuring. A cost-effective and most commonly used water flow sensor is Paddlewheel sensor. It can be used with water-like fluids.

For the type of applications where a straight pipe is not available for inlet, Positive displacement flow meter is used. This type of water flow sensor can be used for viscous liquids also.

For working with dirty water and wastewater which may be conductive, Magnetic flow meter is used. For applications such as sewage water, slurries, and other dirty liquids Ultrasonic flow meters are used.

The LCD display is used to display the measurements. The magnetic hall effect water flow sensor outputs a pulse of every revolution of the rotor. The hall effect sensor present in the device is sealed from water to keep it safe and dry.

Single channel relay

A relay is an electrically operated device. It has a control system and (also called input circuit or input contactor) and controlled system (also called output circuit or output cont actor). It is frequently used in automatic control circuit. To put it simply, it is an automatic switch to controlling a high-current circuit with a low-current signal.

The advantages of a relay lie in its lower inertia of the moving, stability, long-term reliability and small volume. It is widely adopted in devices of power protection, automation technology, sport, remote control, reconnaissance and communication, as well as in devices of electromechanics and power electronics. Generally speaking, a relay contains an induction part which can reflect input variable like current, voltage, power, resistance, frequency, temperature, pressure, speed and light etc. It also contains an actuator module (output) which can energize or de-energize the connection of controlled circuit. There is an intermediary part between input part and output part that is used to coupling and isolate input current, as well as actuate the output. When the rated value of input (voltage, current and temperature etc.) is above the critical value, the controlled output circuit of relay will be energized or de-energized.

NB: input into a relay can be divided into two categories: electrical quantities (including current, voltage, frequency, power etc.) and non- electrical quantities(including temperature, pressure, speed, etc.

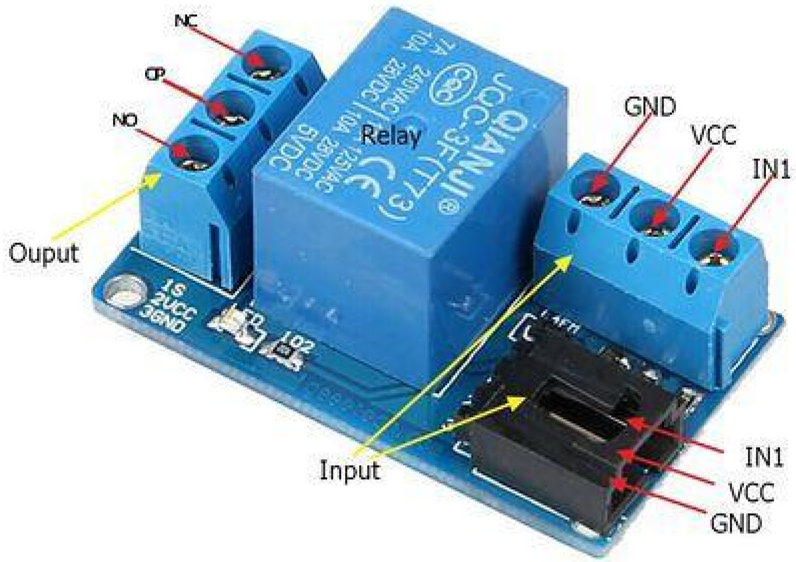

Figure 6:-Single channel relay board

Features

The features of 1-Channel Relay module are as follow:

1) Good in safety. In power system and high voltage system, the lower current can control the higher one.

2) 1-channel high voltage system output, meeting the needs of single channel control

3) Wide range of controllable voltage.

4) Being able to control high load current, which can reach 240V, 10A

5) With a normally-open (NO) contact and a normally-closed (NC) contact

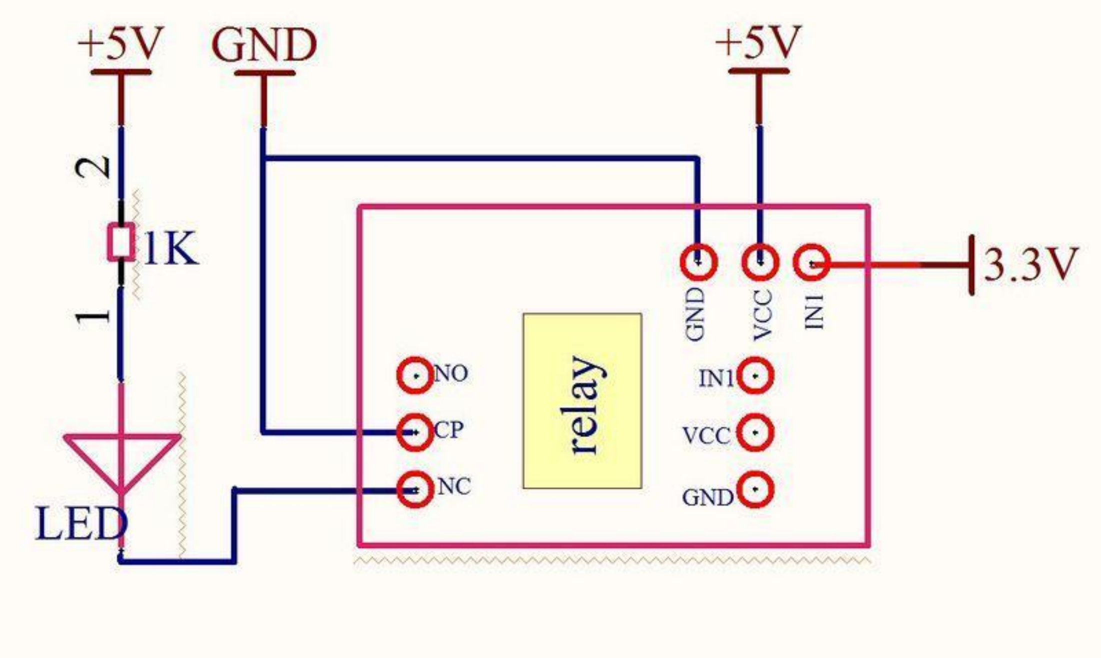

Figure 7 :-Circuit Diagram of relay.

SMPS

A **switched-mode power supply** (**switching-mode power supply**, **switch-mode power supply**, **switched power supply**, **SMPS**, or **switcher**) is an electronic power supply that incorporates a switching regulator to convert electrical power efficiently. Like other power supplies, an SMPS transfers power from a DC or AC source (often mains power) to DC loads, such as a personal computer, while converting voltage and current characteristics. Unlike a linear power supply, the pass transistor of a switching-mode supply continually switches between low-dissipation, full-on and full-off states, and spends very little time in the high dissipation transitions, which minimizes wasted energy. A hypothetical ideal switched-mode power supply dissipates no power. Voltage regulation is achieved by varying the ratio of on-to-off time (also known as *duty cycles*). In contrast, a linear power supply regulates the output voltage by continually dissipating power in the pass transistor. This higher power conversion efficiency is an important advantage of a switched-mode power supply. Switched-mode power supplies may also be substantially smaller and lighter than a linear supply due to the smaller transformer size and weight.

Switching regulators are used as replacements for linear regulators when higher efficiency, smaller size or lighter weight are required. They are, however, more complicated; their switching currents can cause electrical noise problems if not carefully suppressed, and simple designs may have a poor power factor.

Advantages and disadvantages

The main advantage of the switching power supply is greater efficiency (up to 96%) than linear regulators because the switching transistor dissipates little power when acting as a switch.

Other advantages include smaller size, lower noise, and lighter weight from the elimination of heavy line-frequency transformers, and comparable heat generation. Standby power loss is often much less than transformers. The transformer in a switching power supply is also smaller than a traditional line frequency (50 Hz or 60 Hz depending on region) transformer, and therefore requires smaller amounts of expensive raw materials, like copper.

Disadvantages include greater complexity, the generation of high-amplitude, high-frequency energy that the low-pass filter must block to avoid electromagnetic interference (EMI), a ripple voltage at the switching frequency and the harmonic frequencies thereof.

Very low cost SMPSs may couple electrical switching noise back onto the mains power line, causing interference with devices connected to the same phase, such as A/V equipment. Non-power-factor-corrected SMPSs also cause harmonic distortion.

Chapter 4: - MODEL DEVELOPED & CODE USED.

4.1 Operating Principle:-

It is based on the simple operating working principle which is the water flow is detected by the water flow sensor where is the flow detection is calculated by the microprocessor, which accordingly on the basis of pre-installed threshold value open the solenoid valve for the water to flow out. Once the said quantity flows out the microprocessor-based on the collected data, with help of single-channel relay module close the valve the opening and in closing the valve is performed by a single channel relay the power source used is 12-volt dc switch-mode protection supply (SMPS).

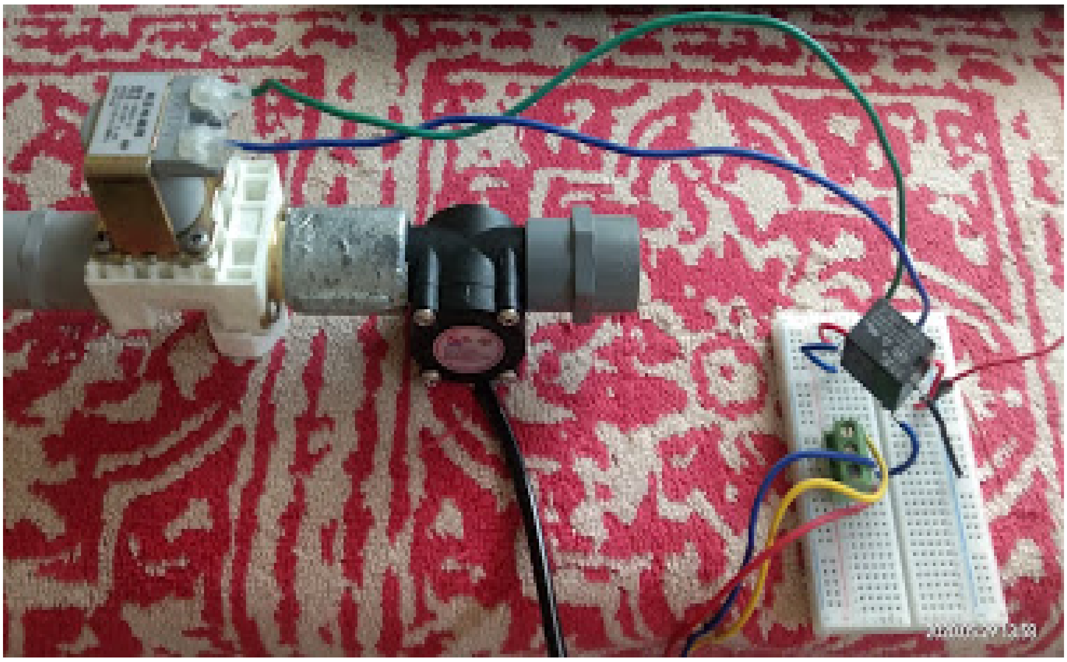

Figure 8:-Assembly of developed model while testing.

As depicted in the model water firstly enter the flow metre and the flow is detected whether the water is present or not this again is based upon the principle of hall effect water flow sensor which detects the flow of water, when the rotor of the Hall effect sensor rotates and it induces a voltage in it and which is measured, and then based upon the code on detection of water flow by the microprocessor gives input to, solenoid valve which is normally closed to open and once the normal normally closed solenoid valve opens the water is allowed to flow out through the other end of the solenoid valve and this is how the flow of water happens to the developed model.

In this, the microprocessor plays a very important role receiving collecting data matching the parameters and then reacting accordingly to it to allow it to open the valve and simultaneously when there is not much flow of water or no flow of water then reacting to it and closing it. When the said amount of water is to be supplied to a particular house the quantity is recorded with the help of the flow metre and after the said quantity supplied the microprocessor acts accordingly to close the valve with the help of this kind of a system we could not only monitor and allocate water with respect to the requirement but also detect a fault in the existing pipeline systems it should be further discussed in the working mechanism.

4.2 Working:-

Firstly the water enters the flowmeter and the flow is detected, the flow of the water rotates the rotor of the flowmeter which detects the presence of water flowing through it which in turn gives the signal to the Arduino as we are aware how the flow metre works in the previous section of the flow metre, water in the flow metre rotor rotates and cuts the hall effect sensor and induces a voltage and this is sensed by Arduino thereby and after ADC conversion data is received and the flow is predicted based on the code so when the water flows through the flow metre, flow metre detect the flow of the water and gives signal to Arduino and the processing of the code happens receive data from the flow metre is compared with input threshold value which is 1 litre per minute, why this certain value is chosen because it consists of good pressure flow of water so when existing value threshold value is cross-checked by the microprocessor it should be either more or equal to this value for the microprocessor to actuate the solenoid valve. Once the values are satisfied the microprocessor then command the single-channel relay board to actuate and open the solenoid valve, as we have known earlier that the solenoid valve used in the proposed model is normally closed we can know the different types of the valves from the solenoid valve sections mentioned earlier. Single-channel relay board only consists of a relay and some diode circuit. The solenoid valve is an important part of the proposed model the solenoid valve is powered by 12-volt dc SMPS.

Figure 9 :-Actual model while working.

SMPS is nothing but rectifier circuit with the Transformer and diodes in it. Now when we move on to the actual working of the model we know as the water flows through the flow metre and the solenoid valve is triggered and opened for the water to flow out of the pipeline, if we assume the other end of the solenoid valve consists of a house so when a threshold quantity is included in the code to allocate this much amount of water to the house the water after pumped to the house via built model and once the entire quantity is satisfied, the flowmeter should close the valve automatically the way it opened it while sensing the flow of the water in the earlier situation so when the said amount of water is provided to the respective houses the valve should automatically close and the amount of water that has been provided to the house is recorded in the Arduino and is displayed on the LCD screen of the serial monitor if the availability of extra water arrives the excess water can be provided by a similar procedure. And the amount of water provided can be recorded, stored, displayed

How can this system in detecting a fault in the pipeline?

As we know that if two flow metres in an ideal situation are present at the two ends of the pipeline so in ideal situations and certain practical situations we know that the input flow should be equal to output flow so input flow was not equal to outflow then there must be some damage in the pipeline. If there is damage in the upper section of the pipeline the water oozes out from the ground and we know that there is damage in the pipeline but whenever there is inner or lower segment of the pipeline is damaged we don't know there is damage but there is the loss of water so with the help of this kind of system we could detect the damage in the lower portion as well as the upper portion of the pipeline and avoid water loss by the above-mentioned phenomenon.

4.3 Code Used:-

```
/*
Measure the liquid/water flow rate using this code.
Connect Vcc and Gnd of sensor to arduino, and the
signal line to arduino digital pin 2.
 */
 #define relayPin 7
byte statusLed    = 13;
byte sensorInterrupt = 0;  // 0 = digital pin 2
byte sensorPin       = 2;

// The hall-effect flow sensor outputs approximately 4.5 pulses per second per
// litre/minute of flow.
float calibrationFactor = 4.5;
volatile byte pulseCount;
float flowRate;
unsigned int flowMilliLitres;
unsigned long totalMilliLitres;
unsigned long oldTime;
void setup()
```

```
{
  // Initialize a serial connection for reporting values to the host
  Serial.begin(38400);
  // Set up the status LED line as an output
  pinMode(statusLed, OUTPUT);
  digitalWrite(statusLed, HIGH);  // We have an active-low LED attached
  pinMode ( relayPin , OUTPUT );
  digitalWrite ( relayPin , LOW);
  pinMode(sensorPin, INPUT);
  digitalWrite(sensorPin, HIGH);
  pulseCount        = 0;
  flowRate          = 0.0;
  flowMilliLitres   = 0;
  totalMilliLitres  = 0;
  oldTime           = 0;

  // The Hall-effect sensor is connected to pin 2 which uses interrupt 0.
  // Configured to trigger on a FALLING state change (transition from HIGH
  // state to LOW state)
  attachInterrupt(sensorInterrupt, pulseCounter, FALLING);
}
/**
 * Main program loop
 */
```

```
void loop()
{
  if((millis() - oldTime) > 1000)    // Only process counters once per second
  {
    // Disable the interrupt while calculating flow rate and sending the value to
    // the host
        detachInterrupt(sensorInterrupt);

    // Because this loop may not complete in exactly 1 second intervals we calculate
    // the number of milliseconds that have passed since the last execution and use
    // that to scale the output. We also apply the calibrationFactor to scale the output
    // based on the number of pulses per second per units of measure (litres/minute in
    // this case) coming from the sensor.
    flowRate = ((1000.0 / (millis() - oldTime)) * pulseCount) / calibrationFactor;

    // Note the time this processing pass was executed. Note that because we've
    // disabled interrupts the millis() function won't actually be incrementing right
    // at this point, but it will still return the value it was set to just before
    // interrupts went away.
    oldTime = millis();

    // Divide the flow rate in litres/minute by 60 to determine how many litres have
    // passed through the sensor in this 1 second interval, then multiply by 1000 to
    // convert to millilitres.
```

```
  flowMilliLitres = (flowRate / 60) * 1000;


  // Add the millilitres passed in this second to the cumulative total
  totalMilliLitres += flowMilliLitres;


  if  (flowRate > 10.00 ){
   digitalWrite(relayPin , HIGH );
       Serial.println("Relay Pin High");
}
 else {
   digitalWrite (relayPin , LOW );
   Serial.println("Relay Pin LOW");
  }
  if (totalMilliLitres >= 25000) {
     digitalWrite(relayPin , LOW);
   Serial.println("Relay Pin LOW total > 10000");
  }
  unsigned int frac;
  // Print the flow rate for this second in litres / minute
  Serial.print("Flow rate: ");
  Serial.print(int(flowRate));  // Print the integer part of the variable
  Serial.print(".");             // Print the decimal point
  // Determine the fractional part. The 10 multiplier gives us 1 decimal place.
  frac = (flowRate - int(flowRate)) * 10;
```

```
    Serial.print(frac, DEC) ;      // Print the fractional part of the variable
    Serial.print("L/min");
    // Print the number of litres flowed in this second
    Serial.print("  Current Liquid Flowing: ");             // Output separator
    Serial.print(flowMilliLitres);
    Serial.print("mL/Sec");


    // Print the cumulative total of litres flowed since starting


Serial.print("  Output Liquid Quantity: ");             // Output separator
    Serial.print(totalMilliLitres);
    Serial.println("mL");
//
//    digitalWrite(relayPin, LOW);
//    Serial.println("Relay Pin LOW");
    // Reset the pulse counter so we can start incrementing again
    pulseCount = 0;
    // Enable the interrupt again now that we've finished sending output
    attachInterrupt(sensorInterrupt, pulseCounter, FALLING);
  }
}
/*
Insterrupt Service Routine
 */
```

```
void pulseCounter()
{
  // Increment the pulse counter
  pulseCount++;
}
```

Output:-

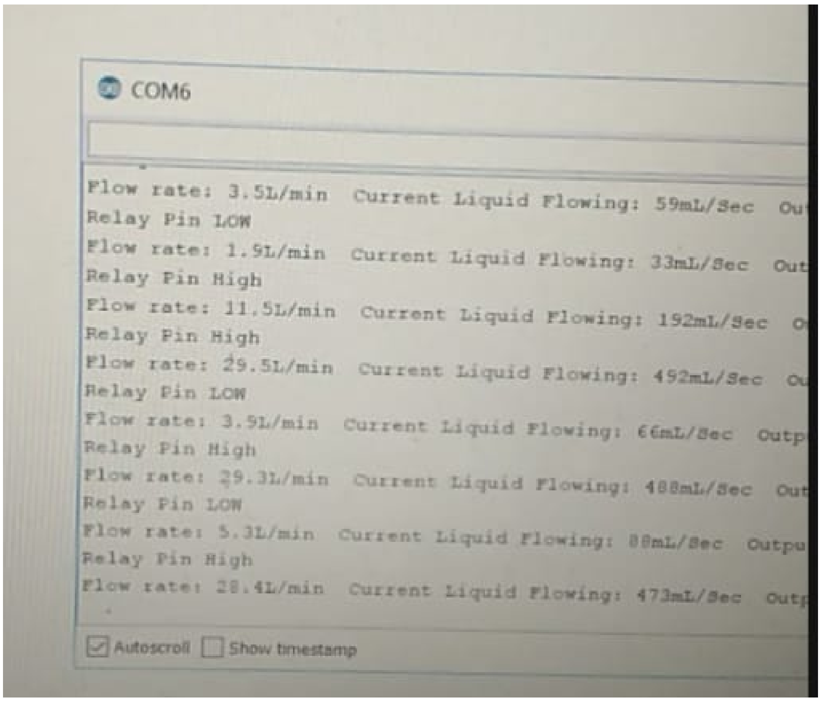

Figure 10:-Output Display of the working model.

Chapter 5: -RESULTS AND DISCUSSIONS

The proposed model is able to detect the flow of water and also actuate the solenoid valve so when the water flows through the flow metre it is detected very well the flow of the water is also displayed on serial monitor and the solenoid valve on triggering flow of water get opened and once the set quantity of water is read through the flow metre it does not allow extra litre of water to flow through it. SMPS is also delivering 12 volt constant supply without interruption and also the current consumed with the solenoid valve is 0.3 ampere.

The code developed in C programming which is further build-in Arduino, the base code can be altered manipulated to perform other functions like detecting fault between the pipelines. With available code for allocation, we can monitor in real-time flow and quantity of water, in real-time with the help of code using serial monitor it can also display the condition of the relay as well as the solenoid valve i.e whether it is either open or closed depending on the presence of water in the assembly in our model whenever there is water present the relay closes such that it closes the circuit and the solenoid valve opens for water to easily pass through it. In the code, we can set the amount of water to be provided and also so the threshold for the flow metre to open and close the valve as mentioned earlier.

This kind of systems is very much necessary in today's world where we have a lot of shortage of water and when we are facing acute problems of underground water tables getting dried up. where we need to save water instead of wasting it lavishly since there many people in different parts of India where they have to walk miles together to get only drinking water.

By developing this kind of system we, not only aim in making living conditions better but also to make it easy for the people to reach out for water and save it as well. This kind of products could also serve a very potential business product to gain good potential profit. Lastly to save a lot of water.

Chapter 6:-CONCLUSIONS AND FUTURE DIRECTIONS

This project gave us great exposure to the importance of water. About the do's and don't to save water. While doing this project the information source helped a lot to understand the problem, and also how to and how not to make a clear solution and also how to and how not implement it in the best way possible. The people in government also helped us well to make us understand the water network of the city and present distribution system and also our project guide helped us a lot with support and knowledge while building the model. The part where we had to chose equipment was very difficult since it was the first time we got our hands colored with such kind of equipment because the sense of exact equipment for the required application is a very important job. Once we could finalize the equipment we were able easily coordinate with things.

the most tedious job in building the project was to get hands dirty with the code since we weren't familiar with high-level coding and creating consecutive looping it took time for us all to understand the hierarchy and format of coding for such applications.

Future work

The future work in this kind of projects can be implementing it in a real-life environment and testing it and using it actual ecosystems while getting IoT and wireless communications involved and also this could be done easily with the help new technological advancements.such of one is LORA technology its long-range technology which could be could IOT servers and used send and receive data, control equipment assembly as well.

one more important thing that could do is send E-BILL to consumers directly to their mobile phones.which could make errorless and corruption billing method and easy track of water consumed and delivered and cash due and received could be monitored, stored and recorded in real-time in cloud and servers.

References:-

1. BWSSB:-https://www.bwssb.gov.in/com_content?page=3&info_for=4
2. Wikipedia. https://en.wikipedia.org/wiki/Solenoid_valve
3. https://en.wikipedia.org/wiki/Single_channel_relay_board
4. Arduino-https://store.arduino.cc/usa/mega-2560-r3
5. Newspaper articles by TOI-https://timesofindia.indiatimes.com/topic/save-water
6. (Structured/alterted)-https://www.arduino.cc/en/tutorial/stepperSpeedControl
7. Book-Basic Plumbing Techniques by Robert Wehrman