Smart Water Flow Monitoring and Controlling System using HC-05 Bluetooth Module

Dhanamjayulu C, Shaily Pandey, NamrataSarraf, Sanskriti, Vandan Agrawal, Arunkumar G

Abstract*: *Water scarcity has become the most inexorable problem these days. In urban areas, most people live in flats, apartments where they need to get water from the corporation and then they ought to supply for each flat and apartments. Supplying water in normal ways consist of a greater number of technical problems and is difficultto access on a regular basis. In this project, we have built a working prototype to solve these problems. Our model contains two small mini-sub water tanks and one Main water tank. Each node (tank) can function automatically based on the tank and measuring groundwater levels or for other problems. And we will get real time information on smart phone via Bluetooth. In this project we will be using Arduino UNO as microcontroller.

Index Terms*: *Water tank, Bluetooth module, Solenoid valve, Water pump, Arduino UNO

I. INTRODUCTION

Water Scarcity is term that has been loosely used, not just by our generation, but also by Generation X, as evident from Kyoto Protocol and other water conservation runs during the 90's & 80's. But the real implications of these two words, have hit us now as the city of Cape Town, South Africa has declared that it would run out of water by the 22nd of April, 2018, marking it the Zero Day. This has happened in spite of implementing harsh rules for water usage, like slashing the use of water by 50% of what is used to be earlier. So, where did we go wrong? Were our plans for water conservation ineffective? Partially, yes, since the time we started talks about water conservation, we have focused on saving water at the foundation; we wanted to make people save rain water, build dams, irrigation channels and other such efficient methods have been developed. But where we failed was in the lower ring of implementation that is the end user. Irrespective of how much ever is conserved at the source, if the end user decides to waste it, or is not in control of his water usage, all our efforts are ultimately rendered void. So, we as a team came up with an idea to tackle this issue.

Our project in essence helps people be aware of how much water is needed. Also, it does not require a human monitoring system, as it automatically operates the motors in the absence of human operations. Therefore, only human supervision may be required. This replaces a lot of careless human errors. This project can also be implemented in hydro projects like dams to resolve water crisis like the ones between Tamil Nadu and Karnataka. A system like this, when implemented on a larger scale, will essentially, efficiently manage the water needs between the states without wasting the water. Necessary amount of water can be let out into the secondary state, after which the dam closes off automatically. This can largely resolve water dispute, in a lot of areas.

Revised Manuscript Received on April 07, 2019.

Dhanamjayulu C, EEE, VIT, Vellore, India.
Shaily Pandey, Electricals and Electronics Engineering, VIT University, Vellore, Tamil Nadu, India
NamrataSarraf,, Electricals and Electronics Engineering,VIT University, Vellore, Tamil Nadu, India
Vandan Agrawal, Electricals and Electronics Engineering,VIT University, Vellore, Tamil Nadu, India
Sanskriti Electricals and Electronics Engineering,VIT University, Vellore, Tamil Nadu, India
Arunkumar G Electricals and Electronics Engineering,VIT University, Vellore, Tamil Nadu, India

II. LITERATURE SURVEY

The possible new things and works that could be developed in the smart water monitoring. They also give some easy solutions to monitor the in-pipe water quality using the Internet of Things Technique with an efficient power usage. For this they developed a model that was test the sample water and then the data which was collected are uploaded to the internet using the IoT (Internet of Things).[1]

'How to use Smart Water Flow in the water management area'. Communication technology and information technology plays a big role in the world. But this Smart Water Grid is connecting those two things in a water management system. Finally, they concluded this paper with, how to integrate these things to smart water grid and make the best water management platform for future. [2]The needs and uses of Smart Water Grid with a research. How it is combines the two technologies that is communication and information in a single system and how it is efficiently monitor the monitors the water supply and how it also used to detect the climate change all these things are explained in this paper. [3]In this paper they are telling about a system called WaterWiSe. Because the old water distribution systems are not efficient nowadays because of the increased frequency. So there is a need for a system that had an integrated system which also monitors the water flow, the available percentage of water and quality of water all this things. Because a Smart Water Grid means it should monitor the leakage of water and control the leakage, and it should optimize the operation. WaterWiSe is a perfect platform which is having an integrated and real-time monitoring. So by this way they are monitoring the Water Grid in Singapore in a Smart and an efficient way. [4]

III. SMART WATER DISTRIBUTION SYSTEM

Due to vast increase in population globally and also because of climatic changes the water resource is under stress. A smart water distribution system would with flow sensors and other devices would continuously monitor the distribution system. Many different parameters like pressure flow rate, temperature etc. can be monitored. The existing water distribution system includes large amount of leakage rates.Locating/ finding illegal connections are very difficult. Changing the current basic infrastructure can be very expensive. The quality of the water transferred from the source supply is important to regulate. When such a smart monitoring system is integrated with natural resources like rivers climatic conditions like forest fires, floods comes into picture. Five major key aspect of the smart water system like asset management, demand management, water quality monitoring, waste water management and rain water harvesting as discussed.

A. Asset Management

Since the system infrastructure grows more appropriate asset management system is required. The total lifespan of this pipelines is also limited which leads to potential point of failures. Vast amount of underground pipelines needs to be put in place. So, the lifespan of the existing pipelines needs to be optimized and preempt the failure of critical pipelines. As the pipelines are buried underground, they are more prone to corrosion. Advanced technological enhancement is required in the design of the pipelines.

B. Demand Management

In the case of demand management, the water supply department should know the region with highest demand for water. Simply increasing the water pressure when there is no demand would lead to pipe burst. This would in turn increase the total revenue of the management system. Based on the requirement of the demand, the water pressure can be optimized according to the demand and head losses. This also has the advantage that energy consumption is reduced for pumping the water, while still meeting minimum pressure and water quality objectives.

C. Water Quality Monitoring

The water quality monitoring is required so that we could minimize the impact on the health of consumers. Water quality parameters like pH, turbidity etc. can be taken into account. Smart sensor array could be placed in the network system which provides real time monitoring of the water.

D. Water Wastage Management

In the case of overflow of water from the tank due to fault in the water level detection system, pipes will be directly connected from the tank to the gardens of the apartment. This will help in waste water management, and further it will be beneficial in environmental prospects.

E. Rain Water Harvesting

It is a technique through which the rain water is collected and filtered, which can be used for household work. In the smart water management, rain water can be taken as a factor to make the system efficient and eco-friendly. The outlet of the collected water will be connected to a water filtering system, which will be directly attached to the tanks.

IV. PROPOSED SYSTEM

Our initial idea of the project was to monitor the level of water by an app and switch on the motor from any place through the app. For this to happen we need to use internet. On searching the internet for a week we got the idea of using IOT (Internet Of Things) so that the information can be accessed from any place at any point of time. We discovered an app called blynk in Google play store with its own cloud. The first part of our idea is to upload water level values to the cloud from where it can be accessed through internet but we face the challenge of uploading these values. This small module enables microcontrollers to interface with a Wi-Fi system. So with its help we are able to monitor the level of water in centimeters. We got the solution to upload the values into the cloud, but now the question of getting the values occur. This is done with the help of ultrasonic sensor. An Ultrasonic sensor is a device that can quantify the separation to a protest by utilizing sound waves. It allows separation by sending a sound wave at a particular recurrence and tuning in for that sound wave to skip back. By recording the time passed between the sound wave being created and the sound wave skipping back, we can figure the separation between the sonar sensor and the water level. The last thing in our project is to monitor and switch on the motor through the app Blynk. The level monitor is set as an analog meter and a switch is placed in the app. This was the idea of our project initially and then it led to one and another, finally we have planned to take our project to next level by designing a water smart grid project. Finally, we have designed our project in such a way to measure the level of water in the sub tanks, a main tank and ground water level from where water is pumped. At first level in the sub tanks are measured when it shows the solenoid valve of respective tank opens and water flows from main tanks to it. Then water level in the main tank is measured and when it is less, motor is switched on with the help of switch in app. Whether the motor switches off or on depends on the level of water in both the tank and the ground water level at that region.

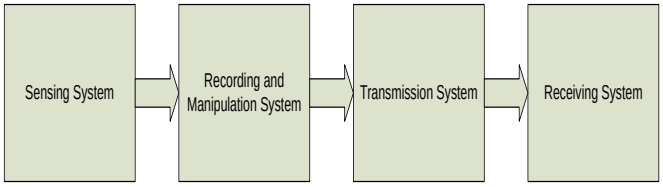

Fig 1.a: Block diagram of the project

A. Sensing System:

The ultrasonic sensor would be fit to the cap of each tanks, namely MWT and MST, this sensor would calculate the distance or the water level of the water in the tank in cms. And return to the Arduino. This process will be continued in an infinite loop. This Ultrasonic Sensor constitutes a set of ultrasonic powered receiver and transmitter which operate at equal frequencies. The ultrasonic transmitter is built with 2 NAND gates, which are wired as inverters and they form a multi vibrator, the output of this drives the actuator.

B. Recording and Manipulating system

The Water level readings from the ultrasonic sensors are fed to the digital Pins of the Arduino UNO board through jumper wires. The threshold for water level for MWT and MST are defined using the Arduino S/W which is used to code in the embedded C language to further manipulate the readings and send the actuators the signal.

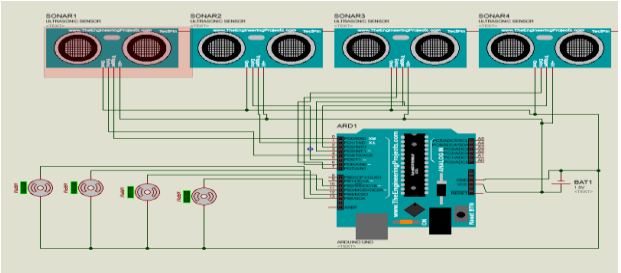

Fig 1.b: Circuit diagram of Project (Proteus)

C. Transmission System

A Bluetooth Module is used for Transmission system from Arduino Board to the Blynk app in the phone. The Bluetooth Serial Port Protocol module HC-05 is used to design transparent wireless serial connection setup. This module is fully qualified Bluetooth and supports Enhanced Data Rate 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. . It is used between the Arduino and Water pumps.Relay module is used as a buffer Transmission System. The relay is an electromagnetic switch which is operated by a very less electric current that can turn on or off a much larger electric current.

D. *Receiving System:*

The receiving system is the Blynk App on the user's cellular phone. It shows the water level of the various tanks on the phone making it handy to monitor the Water levels in the taks. The water Pumps receive signal from the relay modules and work accordingly. The main principal behind the working of every water pressure booster pump for home is the conversion of energy into mechanical energy and using it for providing the required pressure for pumping the water. The input energy is the 5V supply provided by the Microcontroller.

V. FLOW DIAGRAM

This system works automatically to refill the main and the sub tanks when the water level goes down below a threshold value. And on filling the water back, once the water reaches the brim of the tank it stops flowing into the tanks because another limiting value is set for so as to stop the supply of water once the tank gets loaded in order to avoid overflow of water from the tanks.

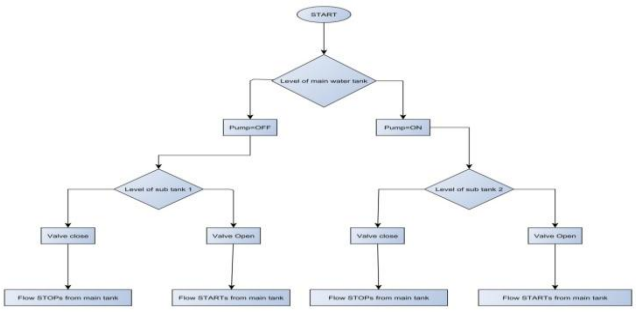

Fig. 2 Flow diagram to explain the working of system

If in case, there is a shortage or no presence of water even in the underground source, the motor wouldn't even start to supply waters so as prevent the motor from malfunctioning and causing any harm. Only if there is sufficient amount of water in the Underground source wills the motor start working in order to supply the water to the main tank and thereby to the other two sub tanks. This is mainly controlled through an internet host which connects both the sensor modules and the reception through a mobile or any other internet accessible device. Only if the ground water is high would the pump be switched on, if it is found that the ground water is less from the ultrasonic sensor then the pump wouldn't be switched on. Alternatively, if and only if the main tank's water level is low would the pump be switched on which on then receiving the required amount of water would then transfer it to the other two sub tanks which will be controlled by a valve that can controlled by us or it automatically opens when the sub tank is empty and closes when it is full. A Wi-Fi module has been set in each sub tanks & the main tank so as to send the signals to the control system that is to the host and the operational module which in turn starts recognizing either the shortage or surplus of water which would be prevented from happening.

VI. OPERATION AND CONTROL

This system works automatically to refill the main and the sub tanks when the water level goes down below a threshold value. And on filling the water back, once the water reaches the brim of the tank it stops flowing into the tanks because another limiting value is set for so as to stop the supply of water once the tank gets loaded in order to avoid overflow of water from the tanks. If in case, there is a shortage or no presence of water even in the underground source, the motor wouldn't even start to supply waters so as prevent the motor from malfunctioning and causing any harm. Only if there is sufficient amount of water in the Underground source wills the motor start working in order to supply the water to the main tank and thereby to the other two sub tanks. This is mainly controlled through an internet host which connects both the sensor modules and the reception through a mobile or any other internet accessible device. Only if the ground water is high would the pump be switched on, if it is found that the ground water is less from the ultrasonic sensor then the pump wouldn't be switched on. Alternatively, if and only if the main tank's water level is low would the pump be switched on which on then receiving the required amount of water would then transfer it to the other two sub tanks which will be controlled by a valve that can controlled by us or it automatically opens when the sub tank is empty and closes when it is full. A wifi module has been set in each sub tanks & the main tank so as to send the signals to the control system i.e to the host and the operational module which in turn starts recognizing either the shortage or surplus of water which would be prevented from happening. All such controls and operations can be monitored and also controlled from anywhere through the one thing which would be always with us which is our hand-held devices or our mobile phones or laptops through which we can access the internet and by that be able to see these operations.

A. Circuit diagram and working

Main-tank is used to feed water into the sub-tanks around it. To feed water its water level is to be checked beforehand so that the water is available for sub tanks. Water to the main tank is pumped with the help of water pump from the ground. As precautionary measure ground water level is also measured so that the water pump does not get switched on. Ground water level is measured using sensor. When the water level in the main tank is measured using ultrasonic sensor and it is low water ground level is checked and when this is measured to be low nothing changes but if it is measured high water pump is switched on.

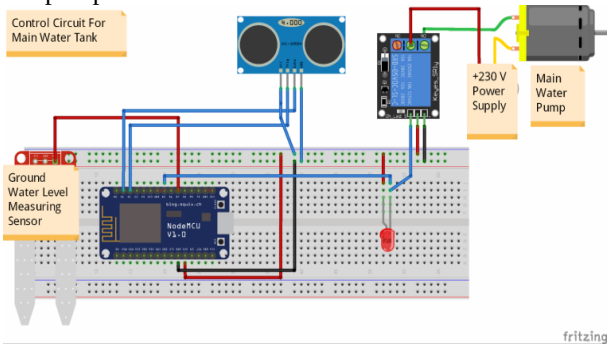

Fig. 2.2(a) Main water tank circuit diagram

Main Tank is connected to the Sub Tank through a pipe with an electrically operated solenoid valve. Water is initially stored in main tank. Water level in the sub tank is measured using ultrasonic sensor and if it is found to be low the solenoid valve is electrically opened .When the water level is high the solenoid valve is electrically switched off.

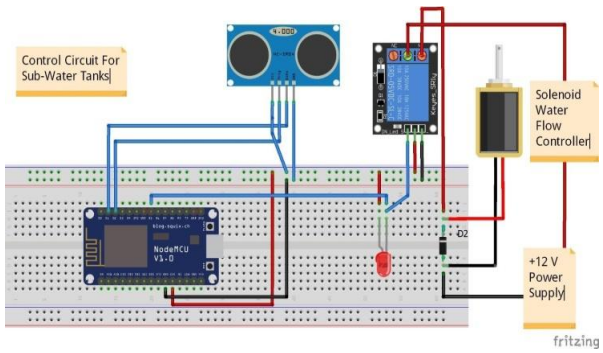

Fig 2.2(b) Sub water tank circuit diagram

VII. RESULTS

The problem of Water Scarcity can be limited by realizing this project of ours in either a small scale or even for a large-scale area or locality. The main maxim of our project was to reduce water consumption by monitoring the amount of water utilized in each area and with reference to the data obtained shall regulate just the required amount of water to that area or sector. Neither more nor less. And by bringing about this smart water grid to the real world, to our metropolitan cities and towns shall make the life of people more convenient by letting them control and see the water level at their home or office or any other place from anywhere and anytime. They can also control the motor even through the internet because the project is mainly based on IOT. The user would be able to see the amount of water available or left in real time without any delay.

When there is a paucity of water in the sub tanks or the tank, which can be found by the ultrasonic sensor attached to all the three tanks and also to the underground water source, a signal is sent from the system indicating that there is a deficit of water. And hence, thereby the system works automatically to refill the main and the sub tanks when the water level goes down below a threshold value. And on filling back the water, once the water reaches the brim of the tank it stops flowing into the tanks because another limiting value is set for so as to stop the supply of water once the tank gets loaded in order to avoid overflow of water from the tanks.

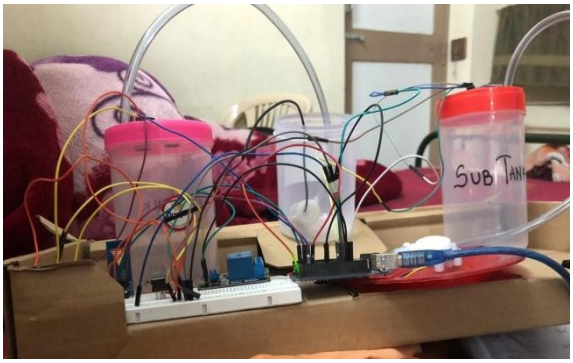

Fig 2.3(a) Depiction of main tank and sub tank

If in case, there is a shortage or no presence of water even in the underground source, the motor wouldn't even start to supply waters so as prevent the motor from malfunctioning and causing any harm. Only if there is sufficient amount of water in the Underground source will the motor start working in order to supply the water to the main tank and thereby to the other two sub tanks.

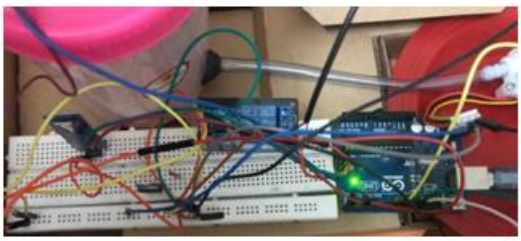

Fig 2.3(b) Connection of real-time circuit

On working this prototype, it has been found that all the systems are working perfectly and the desired output is obtained, which is the live relay of the amount of water available and also the controllability of the each sub tanks and tanks valves so as to supply water even to the individual tanks with just a touch of the finger from anywhere. So if at all, a person thinks that it's going to be a very hot summer and there is an imminent danger for water, he/she can choose so as to accumulate the desired amount of water for their use with the help of our Smart Water Grid. And by implementing this project to vast metropolitan cities, it is possible to control water shortage to a certain level and in the process save water up to a certain extent. Which in itself would serve as a result and success of this imperative project for the generations to come

VIII. FUTURE

The future of the project introduced in this paper is manifold. It can be incorporated as a construction mandate in Huge apartments as it will not only give the user control of the water tank flow but the owner of the complex will get to know the exact flat which is consuming water more than required. A pump from the main tank can also be monitored and controlled wherein any extra water in the MST will be forwarded to the gardens and therefore the water will be put to the best use. The MST's water pump can also be controlled by the end user and the supplier as when required. The app can also be have features like Notification sending mechanism to notify the user if the MST's water level is above a threshold value.

IX. CONCLUSION

Our project can be used to build a water efficient society. It is very helpful in saving water, electricity and more importantly man power. To make it possible sub-tanks are installed for a smaller region, main-tanks are installed in a place with high ground water level so that it may be used to feed water to these sub-tanks. The beauty of this system is, it can be operated manually and also automatically. Man may make mistakes sometimes so it is programmed to work automatically but still the water levels in the tanks can be monitored from any place and can be controlled if wanted. This form of automated water grid is not only energy efficient but also convenient and safe for practical applications.

ACKNOWLEDGMENT

This report acknowledges a number ofsupervision, guidance, stimulation and much inspirationfrom numerous people. Itis our privilege to express our sincerest regards to our project guide Prof. DhanamjayuluP. forhis valuableinputs, able guidance,encouragement, whole-heartedcooperation and constructive criticism throughout the duration of our project.

REFERENCES

1. Internet of things enabled real time water quality monitoring system, S. Geetha* and S. Gouthami
2. Smart water grid: the future water management platform, Seung Won Lee, SarperSarp, Dong Jin Jeon, Joon Ha Kim*
3. Researches on Smart Water Grid Author(s): CHOI, GyeWoon
4. Smart Water Grids for Smart Cities: a Sustainable Prototype Demonstrator. Authors: Roberto Gavazzi, Leonardo Gabrielli, MircoPizzichini, Susanna Spinsante, Stefano Squartini,
5. Need of Smart Water Systems In India, Aditya Gupta, Sudhir Mishra, NeerajBokde, Kishore Kulat

AUTHORS PROFILE

Dhanamjayulu C is a faculty and a member of control and automation department in School of electrical engineering, Vellore Institute of Technology,Vellore, India. He has received the PhD degree in electronics engineering from Vellore Institute of Technology,Vellore, India, theM.Techin control and instrumentation systems from Indian Institute of Technology, Madras, India and theB.Tech degree in electronics and communication engineering from JNTU University, Hyderabad, India. He is also an Assistant Professor Senior with the School of Electrical Engineering, Vellore Institute of Technology, Vellore, India. Since 2010, he has been a Assistant professor senior at Vellore Institute of Technology,Vellore, India. His research activities are in the area of multilevel inverters, power converters, and active power filters and power quality.

Shaily Pandey is B. Tech EE student in the school of electricals Engineering, VIT University, Vellore, Tamil Nadu, India

NamrataSarrafis B. Tech EE student in the school Electricals Engineering, VIT University, Vellore, Tamil Nadu, India

Vandan Agrawal is B. Tech EE student in the school Electricals Engineering, VIT University, Vellore, Tamil Nadu, India ia

Sanskritiis B. Tech EE student in the school Electricals Engineering, VIT University, Vellore, Tamil Nadu, India

Arunkumar G has received the Bachelor Degree in Electrical and Electronics Engineering in 2002 and Master Degree (Power Electronics) in 2005. He completed his Ph.D. Degree at Anna university, Tamil nadu, India on 2015. Since 2015, he is working as an Associate Professor in the School of Electrical Engineering, VIT University, Vellore.

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication