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Usage of IOT Framework in Water Supply Management for Housing Societies

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ABSTRACT

Due to growing demands of water in the upcoming years and with many areas severely impacted by water crisis today, we might need a more efficient system than traditional techniques of domestic water management. We aim at developing an efficient and cost-effective method of placing an upper limit on the quantity of water used daily and manage the short supply of water. In order to do this, we have embedded an algorithm that integrates functions like data acquisition and data management in a master device that dynamically computes and compares the quantity of water being dispensed through the flow sensor. Alert notifications are sent to the owners about the supply of water. Weekly, monthly and yearly reports also are generated supported based on the reading stored in cloud for predictions of supply.

Keywords: Sensor, Water Management, Internet of Things (IOT), Flow control, Real Time Monitoring

I. INTRODUCTION

Water is the most vital component to sustain any organic structure on our planet. 96.5% of the Earth's water is found in seas and oceans and also the rest 3.5% is found in groundwater, glaciers and ice caps. Out of this 3.5%, only 0.3% is usable. Water is such a scarce resource that approximately 1 billion people lack access to safe drinkable water today. It is estimated that by the year 2030, quite half the planet population will face water-based vulnerability. The world's water problems stem from our failure to fulfil basic human needs, ineffective institutions and management, and our inability to balance human needs with the wants of the natural world. (Dutta and Gopinadha Varma Dontiboyina 2016).

Water management are the policies and techniques employed to preserve, protect and manage water as a sustainable resource which implies ensuring that the present water utilization rate doesn't exceed its natural replenishment rate so that it remains available

for our future generations too. For this there is an instantaneous change is required within the way we plan, manage and utilize our water. Several monitoring systems integrated with water level detection have been introduced within the previous few decades. The prevailing automated method of level detection is not an adequate controlling system because it should sometimes cause to overflow. Moreover, the common methods of level control in domestic households are simply to begin the feed pump at a low level and permit it to run until a next level is reached in a storage water tank. This has major drawbacks like level of water within the tank is not constantly monitored and will sometimes be inaccurate. Also, these systems don't have a correct indication system to notify the users that the water is near to overflow so that they can take some precautions to stop the overflow and curb their excessive water consumption and also analysis and planning of water supply is not included.

We are aiming at developing a tool that may efficiently alert water level and also the amount of water (volume) supplied to the individual flats as per the main water supply. Since there is auto interrupt system of water when the tank gets filled which reduces the water being wasted. The setup features a monitoring system that continuously provides the user with real time data about consumption or the level/volume of water that is being filled.

IoT based water monitoring system for urban societies measures water level in real-time. They are wireless sensor networks: water flow meters installed in all the apartments of the society which can help to control the flow of water to every flat. The sensors installed in tanks collect periodic measurements that are reported in real-time and further action are going to be taken according in step with the reading from the sensors. Even backup reserve is maintained just in case of no supply from the main source.

1.1 Problem statement

To develop water supply monitoring and controlling system for cooperative housing societies in urban area which can help to society administrators and members of society to allow real time water consumption information and controls consumption by distribution of water using statistical information and provide reports over different scenarios using IOT analytics.

1.2 Project Objective

1. To study existing various scenarios of water supply, distribution, monitoring and controlling in cooperative housing societies.
2. To identify suitable sensors for sensing the flow of inlet water from main water supply to building ground reservoir, water levels of elevated water reservoir of the building and ground water reservoir with time stamp.
3. To develop statistical model considering water distribution among all flats of the building using records of available water at source, possibility of main water supply near future, precautionary threshold levels to be maintained for critical situations.
4. To develop and implement a algorithm based on step 3 for proper water distribution, monitoring and controlling system using cloud computing technology.
5. To identify and select appropriate hardware considering fulfillment of appropriate requirements of proposed solutions. (Microcontroller, sensors, drivers, actuators, etc.).
6. To design a electronic circuit based on proposed solution which controls and monitor water supply in society considering automatic pump station, overflow of ground and elevated water reservoirs associated with preset parameters.
7. To design and develop electrical circuit using flow control-based actuators for distribution of water as per statistical model or requested requirements.

8. To develop appropriate communication between designed hardware and cloud for control and monitoring proposed system. (Selection of gateway, protocol, etc.)
9. To provide statistical information regarding water consumptions to the user and society administrator by developing android based mobile application which helps them further control and manage uses of water.
10. To provide statistical information regarding availability of water under building reservoirs, regular basis water supplied by main supplier, critical periods of water consumption and allow to take decisions for future plans by the administrators of the society.
11. To provide graphical reports based on selection of different parameters using analytical tools considering sensed and developed data under cloud database.

The outline of the thesis is as follow. Section 2 discusses regarding the literature review. Section 3 discusses the proposed model. Section 4 discusses on expected results and followed by Section 5 discusses on conclusion.

II. LITERATURE REVIEW

Tanvir Rahman et al(2018) (Rahman, et al. 2018)discuss regarding household water supply monitoring & billing system using arm processor, water level sensors and water flow sensors. The feature of this system is automatic switching of the DC water motor based on the level of water present in reservoir along with display of the amount of water used in each block. Volume of water consumed by each floor is also set and bill will be generated according to the usage. It also helps in saving water by reducing wastage.Anjana et al. (2015) (S, et al. 2015) discuss regarding IPv6 network connected IoT design for real-time water flow metering and quality monitoring using CoAP for monitoring and control approach which supports internet based data collection. The system addresses new challenges in the water sector - ease of billing, fair billing and the need for a study of supply versus consumption of water in order to create awareness to curb water wastage and encourage its conservation. Automatic detection of leakage through any of the outlets is notified to the user. The measurement of quality of water distributed to every household by deploying pH and ORP sensors is discussed. The traditional water metering systems require periodic manual intervention for both metering and maintenance making it inconvenient and often least effective. System is designed to measure the pH and ORP of water supplied to each house and also allows the users to monitor these parameters in real time through a web enabled interface. Shortcomings of the existing models is overcome by CC2538 motes programmed using ContikiOS to monitor the water consumption and communicate the data to a gateway wirelessly. Thinagaran Perumal et al (2015) (Perumal, Sulaiman and C.Y 2015) discuss regarding IoT based water monitoring system that measures water level in real-time. (Dutta and Gopinadha Varma Dontiboyina 2016)This prototype will help to detect flood occurrences especially in disaster prone areas. A water level sensor is used to detect the level if it reaches the limit, the signal will be feed in real time to social networking site like Twitter. A cloud server was configured as data repository. The measurements of the water levels are displayed in remote dashboard. Prachi Dutta et al (2016) (Dutta and Gopinadha Varma Dontiboyina 2016) discuss regarding developing an efficient and cost-effective method of placing an upper limit on the amount of water used daily. The design has two modes of operation: running mode and filling mode and user is pre-alarmed when more than optimum water amount is being dispensed. The design would efficiently reduce the water being wasted by alerting the user through an audio-visual alarm even before the water level is reached. The setup also has a monitoring system that

continuously provides the user with real time data about how much water is being used or the level/volume of water that is being filled. By using above design there was a reduction in the amount of water wasted by 60% in a month.Sharifah H. S. Ariffin et al (2017) (Wireless Water Quality Cloud Monitoring System with Self-healing Algorithm 2017) discuss regarding details of the new platform Favoriot for the Internet of Things (IoT) and cloud database used to develop wireless water quality cloud monitoring system. The software component is divided into two which are the self healing algorithm that is able to recover itself in case of service disruption or disconnection from server; and the online database that manages all data sent by the hardware component. Favoriot is a platform for IoT and machine-to-machine (M2M) development which is used for real time data. This used to display the data in real-time graphs. Srivats S Raghavan et al (2017) (Raghavan, et al. 2017) discuss regarding detecting the contamination levels in water bodies. There are three parameters which have to be taken into consideration: pH, turbidity and temperature. The aim is to develop the system which is wireless, cost effective and also efficient. The data generated can be used for analytics purposes. The system uses combination of sensors which are analog as well as digital type. Measured analog and digital signals from the sensors are sent to the Arduino board to analog/digital pin to which the sensor is being connected. The sensors are connected to the Arduino UNO board. The data is sent from Arduino to a web server. This data is forwarded to Amazon Web Services (AWS) for further analytics. Analytics methods can also be customized based on the end user. This system helps in easy monitoring of contamination levels, making it easier to maintain the purity of water, in a cost-effective manner.C. Miron et al (2018)[7] discuss regarding a solution to the growing need of IOT solutions in the area of renewable energies.The solution is embedded,portable,scalable,dedicated especially for intelligent energy management in smart neighbourhood.P. P. Shah et al (2017) [8] discuss regarding water level monitoring as well as controlling with IoT and android application. Conventional water tanks can neither monitor nor control the water level in tank, leading to large amount of wastage. The need of removal of these short-comings and providing an efficient and economical solution has been the main focus of this paper. In design ESP 8266 is used as microcontroller. The values of maximum and minimum levels are obtained by ESP from Firebase cloud. These values are set from the android app. The current level of water is obtained from the ultrasonic sensor. Depending upon these values, the motor is turned ON / OFF.A. Jamaluddin et al(2016) [9] discuss regarding a wireless data acquisition system was developed for wireless water flow monitoring (WWFM) in a closed channel pipeline system using android Smartphone. ATMEGA 328 single chip microcontroller (Arduino Uno Prototyping Platform) with a Bluetooth module, Near Field Communication - NFC tag, Smartphone with NFC reader, and G1- ½ water flow sensor are applied in this design. The frequency input to the microcontroller was the pulse train which transferred from the G1- ½ hall-effect water flow sensor. Then, the data from the microcontroller was transferred to an Android Smartphone using Bluetooth wireless serial communication. In addition, the NFC-tag is used as water flow sensor identification and location. Android Application was designed based on App Inventor for Android (AIA) which MIT platform. As the result, sensor ID based on NFC tag and flow rate of water using Android application on Smartphone was showed by the system. According to the experimental test, the flow monitoring ran well and displayed real-time of flow water in the closed channel pipeline system. The accuracy of wireless water flow measurement is 99.98%.

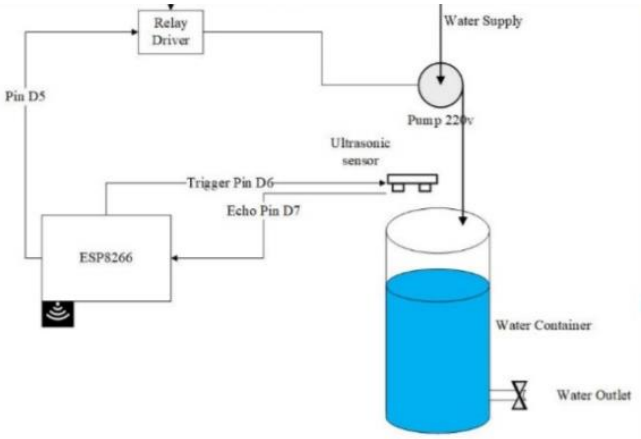
Amanpreet Kaur et al (2018) [13] discuss regarding the rising demand of the computation power,due to which the datacenter has become the hub for significant increase in the power consumption, heat

dissipation and rise in temperature of the servers. Cloud datacenter's energy consumption has increased tremendously due to increase in the computation requirements of the user workload. Researchers proposed different techniques to optimize the energy consumption. The paper also focuses on different aspects of cloud computing for holistic management of cloud resources in an energy-efficient, reliable and sustainable manner. Anisha et al (2017) [14] discuss regarding critical challenges faced by the world which is water shortage and also aims to conserve water, by introducing a regulatory system that reduces the rate at which water is obtained at the outlets in a house after a specific volume. The proposed design must be installed at the inlet of every house. Once 80 percent of a specific maximum volume of water is reached, the rate of water flow at all the outlets of house will automatically decrease. The volume of water used is detected by a water flow sensor. A micro-controller receives the input data and electronically reduces the outlet rate of water flow by using a solenoid electro-valve. If this system is implemented in every household successfully, the global scarcity of water can be effectively reduced to the greater extent. Tanaya Tavade et al (2017) [15] discuss regarding the Electronic Control Module (ECM) which is the heart of the electronic engine. It looks after the supervisory and the controlling parameters of the engine. Its main function is to monitor all the parameter of the engine and act accordingly to increase the efficiency of the system. For mechanical engine, there is no supervisory control over the working i.e. any faults in the engine cannot be realized immediately. There are certain parameters that have been identified like temperature and pressure of the intake air, oil, coolant. A proper working condition state should be logged and analysed for anticipation of engine efficiency and the less emission. This paper discusses the implementation of a data logger system which will act like a fault diagnostic system for mechanical engine and log the data on the web server for remote access. This is implemented using the Controlled Area Network (CAN) protocol for communication and Raspberry Pi which is a card size computer which acts like an Internet of things (IOT) device.

III.METHODOLOGY

3.1 Proposed Solution

Internet of Things (IoT) is a well-established paradigm that allows the physical objects or things to connect, interact and communicate with one another. We propose a low-cost open platform based on ESP8266 to supervise and monitor the state of components of the water monitoring systems. The system provides centralized monitoring and management for various technology systems. Working as a central component of a facility control centre, it can acquire, process, and visualize data from sensors. The aim is to increase the efficiency and reliability of water supply cycle.



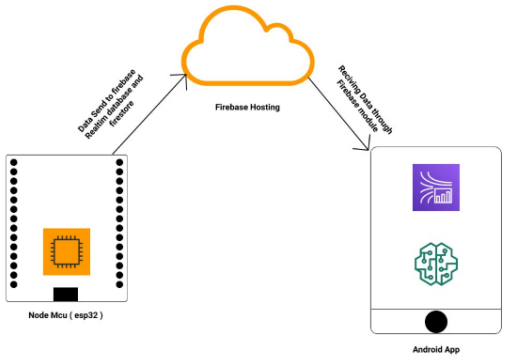
3.2 Proposed Model

The ground water storage tank is been filled by main water supply. In case both ground water storage and elevated water storage tank is full we are closing the inlet value. The motor initiation occurred when the ground tank level is within the permissible limit. Inlet motor was turned off upon the completion of filling the reservoir. Readings for the volume of water

on each node is noted, the level of water in the reservoir is also noted. In case there is water cut and no supply for two days we are changing the volume of water supply to each flat based on the reservoir water storage and intimate the flat owners regarding water supply amount through notification. The ultrasonic sensor is used to find the volume of water in the tank and all sensor value is updated on the cloud.

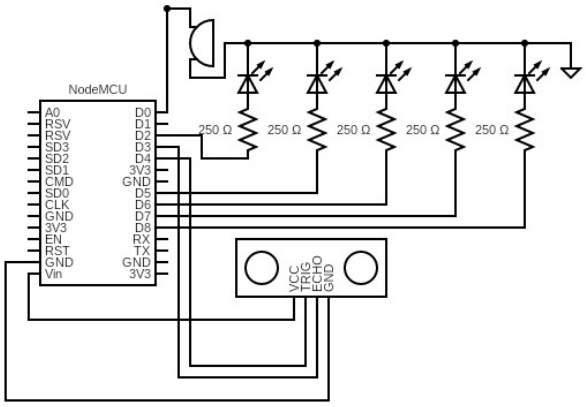
The controllers can provide the supervisor with different parameters, such as water level, time and volume. The real time values are stored in Json format. Firebase database is a free platform where all types of apps (android, ios, webapp) can be created, Firebase console platform provides many features, as they are such as 2- real time database. Real time database is used for storing the real time value . The Firebase Realtime Database is a cloud-hosted database. Data is stored as JSON and synchronized in real time to every connected client.

Node MCU (ESP8266): Node MCU is a WIFI micro controller unit; the main use of this module is to transfer any real time values to the websites or database via internet. It works only when internet hotspot is applied through this .



3.3 System Architecture

Taking about this proposed system, we have used NodeMCU, Ultrasonic sensor and Firebase to build a water monitoring system.



IV. EXPECTED RESULTS

In urban area societies are facing issues regarding daily adequate water supply. The system is been developed to provide information regarding availability of water levels, precautions to measure for utilization of water, decision making for further enhancement of water storage and statistical analysis report of required period through android mobile application based on the real time values received from sensors which will help to regulate the utilization of the available water resources and use effectively. Sensor based real time data processed by control program to take real time decision and real time values will be stored in firebase. The graph will help the user to compare the water consumption on day-to-day basis. The display of water tank using graphics in application will help the user to track the water consumption. The registered users will get the messages regarding water level updates.

V. CONCLUSION

Our intention of this work was to establish a flexible, economical, easy configurable and most significantly, a conveyable and handy system which may solve our water wastage problem along with saving the electrical energy. This enhances the efficiency of water distribution and reduces wastage. This system will help to understand the real time water level and

how to use it effectively and smartly until regular supply of water is resumed. The system also helps us to predict the water usage-based festival season and vacation and also sends messages to the users indicating the level of water and also we can refer the graph for analytical calculation and determine the the usage pattern.

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