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IOT based mobile application developed for water and power monitoring in residential building

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Abstract

The earth is known as "Blue Planet" as 71 % of the Earth's surface is covered with water. However, earth has an abundance of water, but unfortunately; only, a small percentage (0.3%) of water is eligible for use by humans. The other 99.7 % is in the oceans, soils, icecaps, and floating in the atmosphere. Most of the water used by humans comes from rivers. Water is the most valuable natural resource essential for living. Its basic human need in all economic operations like generation of power, agriculture, industries, and mining are all critical economic areas. Water supplies are under severe strain. With the population increase, the requirement for water from competing economic sectors is increased.Similarly, even electricity is very essential commodity of our lives and its generated using the water, which has gained equal importance as water as we need electricity to run various technologies in our day-to-day life, so the conservation of water plays a vital role in the development of the society and therefore every citizen is responsible for the conservation of these resources.

Therefore, information technology methods and internet communication technologies (ICT) play in water resources managing to limit the excessive waste of fresh water and to control and monitor water pollution. In this paper, a mobile app is built using the internet of things (IoT) as a communication technology that controls the preservation of the available amount of water and not wastes it by homeowners.

Keywords: water management, water conservation, IoT, microcontroller, sensors.

I.INTRODUCTION

Water management along with the power management the most important thing in human lives like use of water, food production, treatment of wastewater, cleaning, irrigation, energy balance. Water supply management has always been a source of many challenges. There are 32 billion cubic meters of treated water being lost each year from urban supplies systems in the developing world [10]. Intelligent monitoring is defined using different computational methods that provide the customers with relevant

tools and information in monitoring, control, manage, and optimize the network. The integration of modern informationtechnology with the cyber-physical world produces new applications, such as ubiquitous computing, which renders interactive computers usable though essentially invisible to people. It seeks to break away from desktop computing to always include consumers anywhere and with computer resources [7]. The goal is to break away from desktop computers to provide consumers with computing resources anywhere and anytime. The Internet of Things (IoT) has taken the globe by storm. The theory of wireless technology linking everything. IoT is the connection of devices, software, sensors, actuators, and physical objects are embedded in the network, cars, home appliances, and other products that help these things to communicate and share data. IoT is quickly developing with the latest developments in wireless technology and embedded devices, with low power, Microcontrollers being developed that are ideal for remotely distributed IoT systems to link and run for years without any maintenance. Making IoT not only luxurious but also required data aggregation for defense systems. Wireless sensor networks (WSNs) arebecoming more critical because they can monitor and manage sensitive information in theirenvironments. WSNs have made an impact in many industries such as the military, industry, and environmental monitoring. In-home gardens and agricultural areas, the WSNs are progressively being used to regulate water use and track services. There are various systems of water quality monitoring systems based on wireless sensor networks.The number of sensors used for measuringwater quality is often limited to between 2 and 4. For environmental protection, the WSN-based water monitoring and control system using ZigBee, GSM, Xbee, and mote Wi-Fi and TCC/IP was designed to transmit sensed data. No consensus as to parameters that should be used to measure different properties of water. The parameters are compared to demonstrate thepositive or negative effects of each technique.

Though water is naturally available source, it should be preserved for future generation, without water nothing can be done including the electric energy. So, people should involve in water management system and the power management, government should create more awareness on conservation of water. More awareness programs and camp should be created. A special subject about water management system should be implemented for school students in their syllabus as we read more about the rivers and water sources. This is not easy task water management in today's scenario. Increase in population is major problem in water conservation everything is commercialized and modern. In every construction field more amount of water is consumed every day. Without water construction works cannot be done.

The Internet of Things (IoT) refers to the evolutionary stage of the internet, which makes a global communicating infrastructure between humans and machines [4, 5]. IoT is constructing the global infrastructure, which will change the fundamental aspects of our lives, from health services to manufacturing, from agriculture to mining. IoT will offer the necessary facilities of the latest rising artificial intelligence (AI) development. This chapter discusses the overview, characteristics, advantages, disadvantages, common uses, security, trust, privacy, and functional view of IoT. Furthermore, this chapter proposes application areas of IoT in detail. IoT appeared as a powerful technique with appliances in numerous domains. IoT has origins in multiple former methods: sensor networks, embedded systems, and pervasive informatics. Many IoT devices are linked mutually to develop specific purpose schemes; in the global network, they are rarely utilized as public access devices.

II. Literature Survey

A smart water management system used in cities. Martin D et al [1] has described about condition is about the local area protected or Wi-Fi protects which is connected to the microcontroller for the command to ON/OFF the motor consequently. Using internet, the water distribution schedule is sent to the people's mobile phone in cities. It creates an application to send the details to the water and the operator can send any complaints if occurred. The prime component is Atmega 128A microcontroller. This system is mainly implemented to distribute ideal water circulation and in addition decrease manpower engaged within this. Initially, the status of the tank is displayed on the LCD. If it indicates low, then the pump is at ON mode and if at high, the pump is OFF automatically. It is mainly used in Residential colonies, and in chemical industries. Dispersal and control system, which is mainly used in flats and apartments. Water when contributed from the overhead tanks to individual flats, the tanks will be examined for its level using level sensors and a threshold will be set for individual users as stated to number of flats, because of this, the user will be apprised with the limit of water to be used. The amount of water flow in the pipeline will be controlled according to the user's request. The process of water distribution is like if power available, system will check for the water level in the tank. If the power is not available, the same is intimated to the user using SMS, so that he can make essential arrangement for the water. Once the water level position to MAX level of the water tank then the motor will trigger to OFF as a result. Author describes using this system the Indication of Water levels in the Tank, Indication of Motor Running shall all be noticed. According to this water use, information would be sent to cloud utilizing the IOT space. MahmoodMR et al[2] has discussed about the cloud information would be sent to the concerned inhabitant's individual's mobile application. The cluster of data is by using IOT and the return of getting information from cloud to mobile application which can be utilized by the client or the head of corporation for review and controlling the inventory of water. The siphoning of water is through stream, which acts as a switch to pump naturally. It gets on and begins filling the tank when the water level is vacant or level ONE and quit filling the tank when water level arrives at most extreme level NINE. The proposed framework abolishes manual checking and controlling for home, rural or modern clients. The proposed system uses assured sensors to sense various stages of the storage. LCD modules are very consistently used in most embedded projects; the cause is cheap price, availability, and programmer friendly. Arduino UNO microcontroller utilized for building computerized gadgets and interactive items that can detect and control objects in the physical and advanced world. Where at each stages the position of the water level will be displayed in the LCD mentioned as 20%, 40%, 60%, 80% and at the top or 100% of the tank level. This paper is used to perceive water leakages due to burst pipe. The data is sent remotely to the director where a graphical UI speaks to the information got and alerts the overseer of any abnormalities identified. All remote sensor hubs speak with one another remotely and send data to a portal associated with a PC, which has the GUI. All handling and calculation are done on the GUI. The author presents the hypothesis on continuous observing of water quality and amount utilizing IoT. A Wi-Fi module is associated with the Arduino gadget, which help to evacuate the information to the cloud over web. The water flow sensor measures the amount of water move through the funnel in each time, this information will be sent to cloud for capacity and analysis purposes. The move of water through the residential pipeline can be watched, estimated, and visualized from anywhere on the planet-utilizing web through PC or Smartphone and with the assistance of transistor and relay we can

turn on turn off it at whatever point required. The programmed water supply framework depends on the Real time controlling framework. Through the sub-control room, the information is sent at what time which zone water supply is going on. The system is mainly constituted with controlling device and communication device. The controlling gadget is introduced on valve side and when the valve will be open or close the data is update in Sub-Control room through specialized gadget.

The water can be monitored and controlled in an efficient manner and reduce the manpower.The water is mainly wasted in houses by water tank overflow, tap leakage and by pipe leakage. One main reason for these issues is the irresponsibility of the owner, and due to their busy life. This system is not only applicable in-home automation rather, but it can also be implemented in Agriculture Fields, Industries, Factories, Poultry Farms, Public places, or government sector for efficient use of water.

Some of the application domains:

IoT application areas identified by the IoT European Research Cluster (IERC) based on the inputs of specialists, reports, and studies. Top examples of IoT applications are smart city, smart industry, smart transport, smart buildings, smart energy, smart manufacturing, smart environment monitoring, smart living, smart health, smart food, and water monitoring. Industrial automation and production stressed from the short-lived manufacturing life cycle and the need for short-term marketing in numerous domains. The next generation of production schemes will be constructed on elasticity and redesigned as an important goal. The new list of IoT appliances presented beneath includes examples of IoT applications in different areas, indicating why IoT is one of the planned technique fashions over the subsequent five years.

Here in this paper, we are considering only two smart services of IoT: smart living and smart food and water monitoring Water and energy consumption.

Water monitoring and energy consumption: Monitoring energy and water use to get advice on how to save costs and resources. Smart shopping system: Get advice on where to sell based on consumer preferences, buying behavior, the existence of allergies, or expiration dates. Remote control devices: Remotely turn on, off devices to prevent accidents, and for energy saving. Blockchain in the Industrial Internet of Things 1-12. In [12] SalihA et al described Smart home products: Transparent LCD display refrigerator that shows what is inside, expired food details, ingredients for a well-stocked kitchen and all the data obtainable through the app on the smartphone. Washing machines permit one to control the laundry from far away and work routinely when electricity prices are very low. Smart cooking apps monitor the automatic cleaning function of the oven and permitting adjustable temperature control from a distance. Meteorological station: Shows conditions of the outside weather, for example, humidity, heat, atmospheric pressure, air velocity and rainfall using meters capable of transmitting information over long distances. Regular checking of safety procedures and standards: Baby alarm, an optical tool used to record images and house alarm schemes that are making human beings feeling safer in their everyday lives at home. Gas detector: Real-time data concerning gas consumption and the state of gas piping can present by linking local gas meters to the internet protocol (IP) network. Concerning monitoring and assessing water quality, the result could be a diminution in labor and repair prices, enhanced precision, and meter readings price reduction, and perhaps gas usage diminution. Quality of

water: Analysis of the appropriateness of water in natural flowing watercourses and oceans for all the animal life present in a particular region or time and the appropriateness for potable usage. Flooding: Monitoring the variability of flow rates of rivers, reservoirs, and dams. Control the supply chain: Monitoring storage conditions during supply chain activities and manufacture tracing for tracking reasons. ToscanoA.et al [3] in there paper has explained the Water management: Real-time data concerning water condition and water usage can gather by linking a water meter to the IP network. Enhancement of wine excellence: Monitoring water stored in the soil and trunk width in vineyards to regulate sugar levels in grapes and health of grapevine. Grounds where the game of golf is played (golf course): Selected irrigation in arid areas to decrease the essential green-water assets. Greenhouses: Regulate microclimatic level to increase vegetable and fruit manufacture and excellence. In-field water quality monitoring: Decreasing food spoilage with excellent tracking, statistical management, continuous data acquisition, and crop field management, with excellent management of fertilization, irrigation, and electricity.

Automatic water control system senses the water movement and afterward demonstrates the water level inside the container and passes information to the owner through pop up message MouftahHT et al [6] has given, which is shown in below figure1.The device will have water level sensor merged in the container, and by using IR sensor it helps to control the flowing of water from the tap. AWMS helps to detect the leakage in pipe with the 120dB water leak alarm and make the continuous water flow from the tap in the case of less, medium, and high level of water present in the water tank. Water leak alarm will send the signal to smart phone through the pop-up message saying that water leakage in the pipe. So, users can take the control decisions.

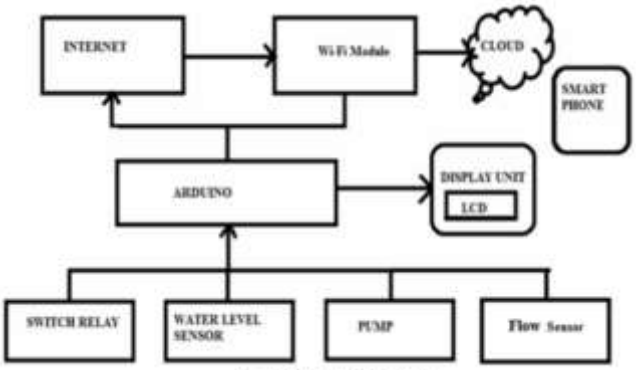

Fig 1: System Architecture

The existing system does not contain any timing devices. The existing system does not contain any mobile application control. The water consumed by the customer is measured by using flow rate sensors and customers should pay the amount as per their usage of water measured by flow sensors.

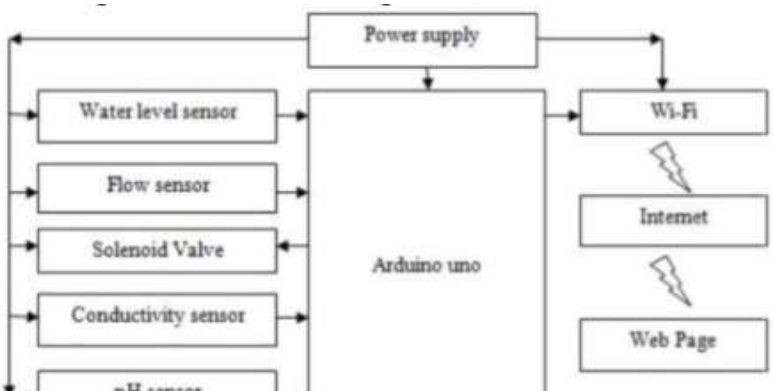

Fig. 2: Existing system block diagram

In addition, the water level of the storage tank is measured by using water level sensor. The existing system consists of website monitoring. When the customer used the amount of water allotted for them then the controller will give the signal to solenoid valves, the solenoid valve will automatically cut the water supply to that user. Here Arduino Uno is used as a controller to control the overall process. Separate power supply is provided each component of the entire system.

III. Methodology

Nowadays IoT is used for various smart services and the mobile applications. In our proposed system, a mobile application is built which will notify the members of the house about the usage of water and the power on the daily basis. Our idea here is to conserve and regulate the usage of the resources like water and electricity by monitoring the activities of the members of the house.

When the water consumption exceeds the range then the message is sent to mobile. The Wi-Fi module is used to share or store the data from controller to cloud. The cloud relates to mobile application and notification control. The mobile application is issued for users, by using that mobile app users can access their usage and level of water. Here this proposed system can control the overall process. All the process is interlinked, and all the data will be stored in cloud and the collected raw data is stored in the database which is then send to the cloud for the calculating the usage of the water and power they by triggering the notification for the users about the consumption of resources.

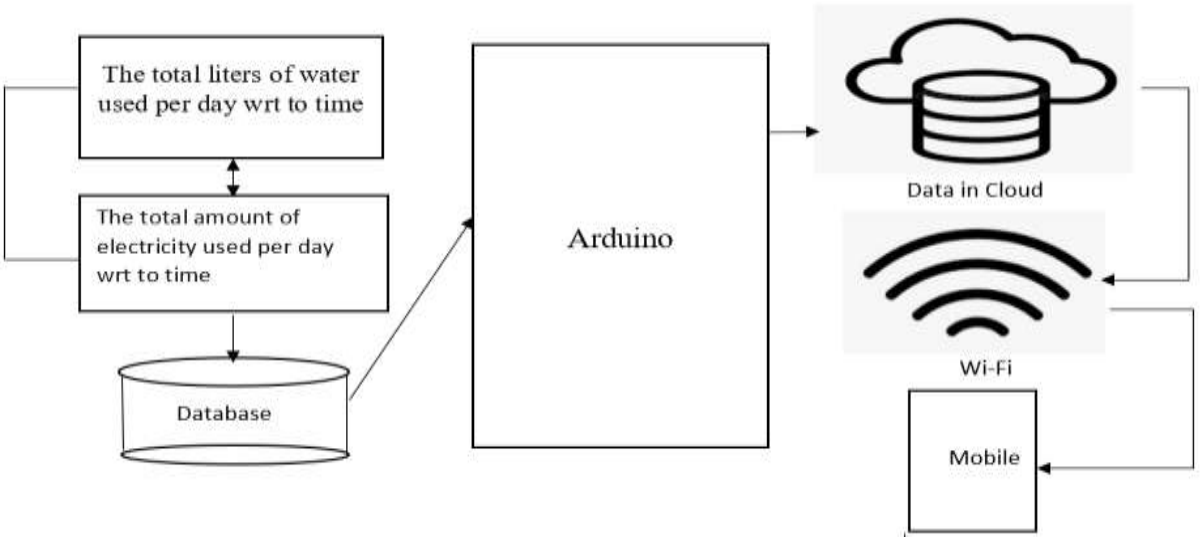

Fig.3: Proposed System

Initially, the total amount of water and the electricity used per day is set as the default value in the mobile app for the user who has installed this application. Now if the total amount of water or electricity consumed per day exceeds the default value, then immediately the raw data is stored in database then sent this value to the Arduino board to further calculation then using the cloud database along with the internet the notification is sent to the mobile phone of the user who has installed the app so that the notification will help them to controlled the use of the resources and also brings the awareness so where to consume less plan the usage for the future.

Advantages of the proposed system:

- Energy consumption can be controlled when the notification is sent to mobile
- Water usage can be controlled accordingly after the usage or notification message
- Low cost for maintenance
- More reliable and can be reused at any time
- Ease when relocating the residency

Disadvantages of the proposed system:

- The mobile phone should always be ON.
- The Wi-Fi or the internet supply to the residential building should be constant.

IV.Conclusion.

The water and electricity demand are the most challenges in the world nowadays. Therefore, there should be Conservation of water and power as to manage the resource available in world is the most importance. In this proposed work, an IoT design for water, power monitoring, and control approach, which supports internet-based data collection on real time bases. This proposed system shall implement in highly populated residential buildings like hotels, lodge, hostels, dormitory, apartments, shopping malls etc. This system can measure the quantity of water distributed to every household by using flow rate sensors.

The proposed work has been planned to use Arduino controller, Wi-Fi module using the internet where there is less chances of delay in data and this application is also helpful to the parents when kids or the elder people at the home to monitor the water and power energy.

Thus, this system can be very helpful in all the residential building in controlling and conserving the water and the electricity as it would help our future generation to use the sources.

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