SMART WATER SYSTEM

IOT-RESIDENTIAL BUILDINGS

INTRODUCTION:

One of the essential elements in the universe is water. Nowadays, consumers continuously seek methods to simplify their lives. Monitoring water quality is critical to ensuring the planet's health and long-term viability. Water is the source of many infectious illnesses, and garbage thrown by residents and environmental disasters from industrial enterprises pollute most of the nearby freshwater supplies in Saudi Arabia. Drinking water can be stored in an overhead tank. The principal causes of water quality deterioration in residential buildings are the development of microbes in overhead tanks and distribution networks, corrosion of pipe material, and the non-replacement of existing pipes. To avoid catastrophic health implications, it is necessary to continuously and remotely check the quality parameters of the water system in real-time.

IoT can promote sustainable economic development and improved water resources and energy management in SA, which invests in citizens' well-being by supporting IoT adoption. Additionally, water systems should be equipped with technology to create smart procedures. In many water systems with weak infrastructure, uncertain supply, and customer satisfaction, or significant discrepancies between proportional bills and actual consumption or use, smart water systems can help improve the situation. There are several benefits to adopting a smart water system, including minimizing financial losses, and creating new business models better to serve urban and rural populations. The benefits of IoT technology in our smart water system project are well-known to us at this point. As a result, we will be able to control our energy consumption better and manage our resources. This project's primary objective is to design a novel, trustworthy, and adaptable water quality monitoring system for real-time monitoring of a remote water level throughout an IoT zone. Wireless sensor networks offer a novel framework for gathering and relaying data from various sources. Extensive testing is performed on an Internet of Things system designed specifically for this network. The Internet of Things network's end goal is to allow for the monitoring and management of water supplies, distribution systems, and reservoirs. There has been extensive testing and analysis of this.

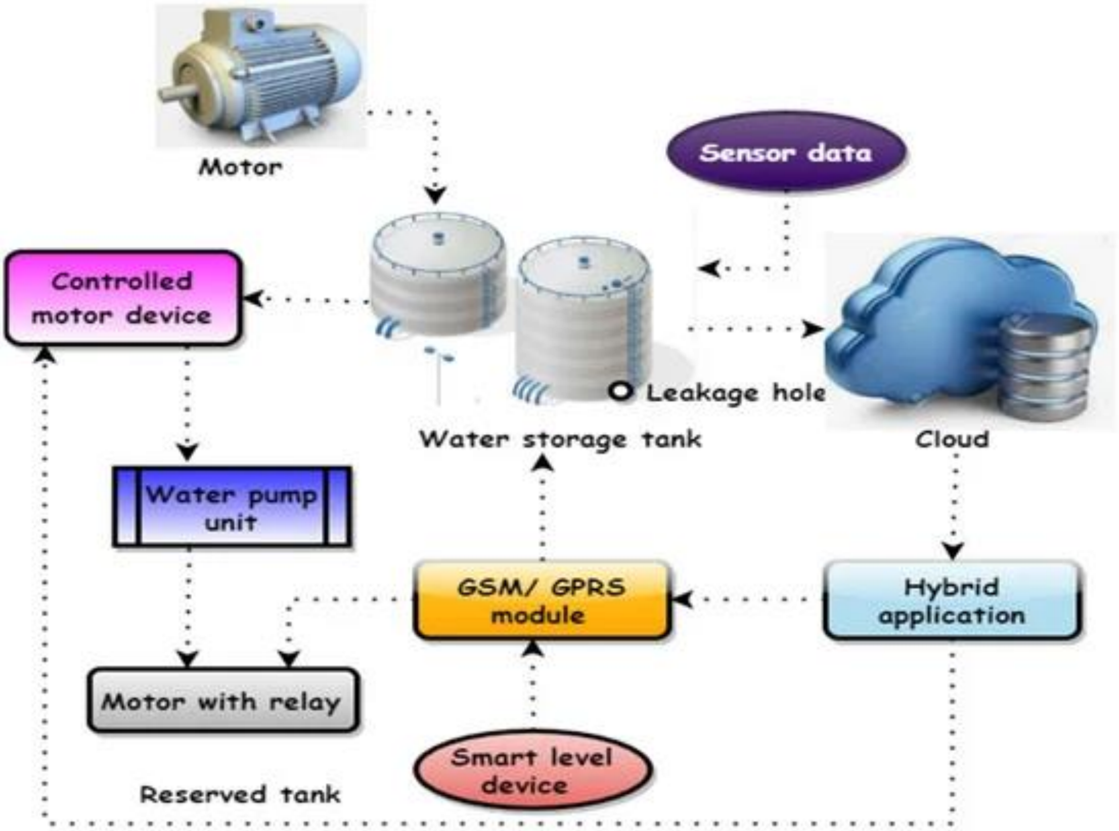
In this paper, hybrid applications and IoT devices are given prominence. Water is more commonly squandered at residences, and the major supply source is wasted. GPRS and GSM modules are the two IoT devices: a water tank level sensor that sends data to the cloud for analysis and a motor that turns on and off automatically. Using an IoT-SWM system, the water level can be monitored and controlled while leaks in the tank are detected and an estimated measurement is provided.

The main contributions of this paper are:

- Smart water management gives a greater understanding of the water system, including flaw detection, preservation, and water management.
- A comprehensive database of regions with water losses or unlawful connections can be built with the introduction of smart water system technology by public service corporations.
- Smart water grids can save costs by conserving water and energy while improving the quality of service to consumers. Wireless data transfer allows consumers to assess their water use to reduce water costs in other circumstances.

PROPOSED METHOD:

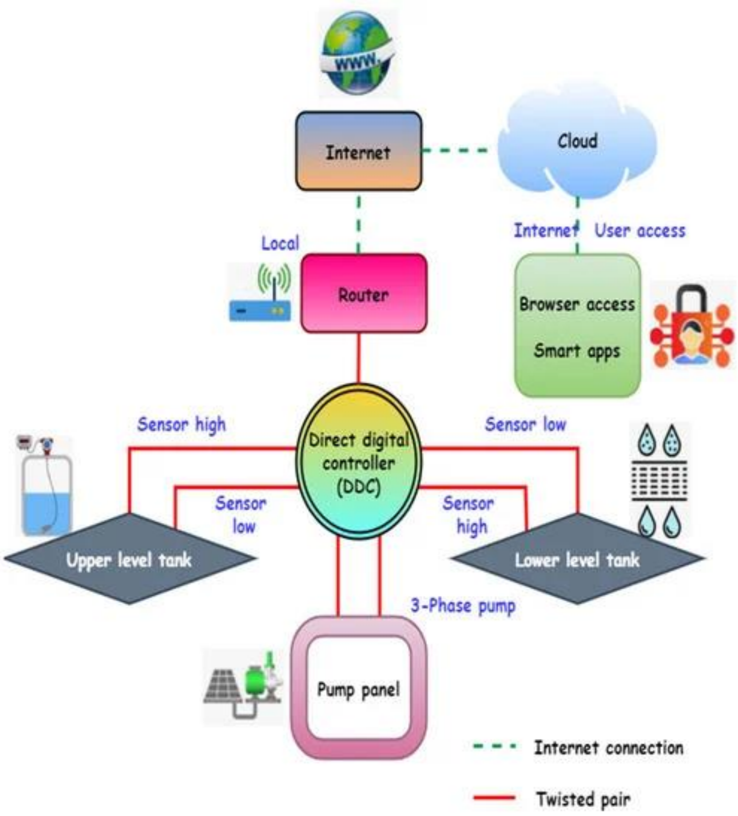
A hybrid application and two devices make up the microgrid system. The first device measures the water tank's height and sends the real-time information to the cloud using a smart-level device. The GSM module of the smart level sends a signal to another device, a motor-controlled device, which automatically activates and deactivates the motor based on the signal. They activate and deactivate motors when they receive an input signal. With this technology, a leakage measurement hybrid application has been constructed. The device's ultrasonic Smart Level sensor continuously monitors the tank's height and uploads that data to the internet once per minute. With a microprocessor and UR detector, the GSM/GPRS module may send data to the cloud, where it can be stored and accessed remotely. The effects are extraordinary. As the water level in the tank rises or falls, the intelligent level device sends a signal to the regulated motor device to turn the motor on or off, respectively. IoT devices upload information to the cloud, which can be evaluated later. Users can tell the system to alert them if a specific threshold is met. A system for intelligent water management should allow for constant monitoring of water levels. Overflows and leaks in water systems can be spotted quickly by real-time monitoring. They need a constant data connection and a lot of juice to monitor in real time. Decisions can be made in real-time with the use of cloud computing. An increasing number of IoT devices are used in the water management system. Now that inexpensive sensors can be linked to the Internet of Things devices, we can more accurately assess water quality.



Smart water tank using IOT.

Three-phase pumps, as previously indicated, are often used in water management systems for high-rise structures. This can lead to tanks being overfilled or pumps being overworked, which wastes water and energy and shortens the life of the pumps. For this reason, an intelligent water management system was created that can be used alone or as part of a larger building management system (BMS). Water level sensors in different tanks were linked to a direct digital controller (DDC), which controlled the whole system. The DDC controls the pumps through the pump panel to which it is connected. People can remotely operate the pump and check tank levels using a smart app with a DDC. It needs to be linked to a local Wi-Fi network or the internet to attain this purpose.

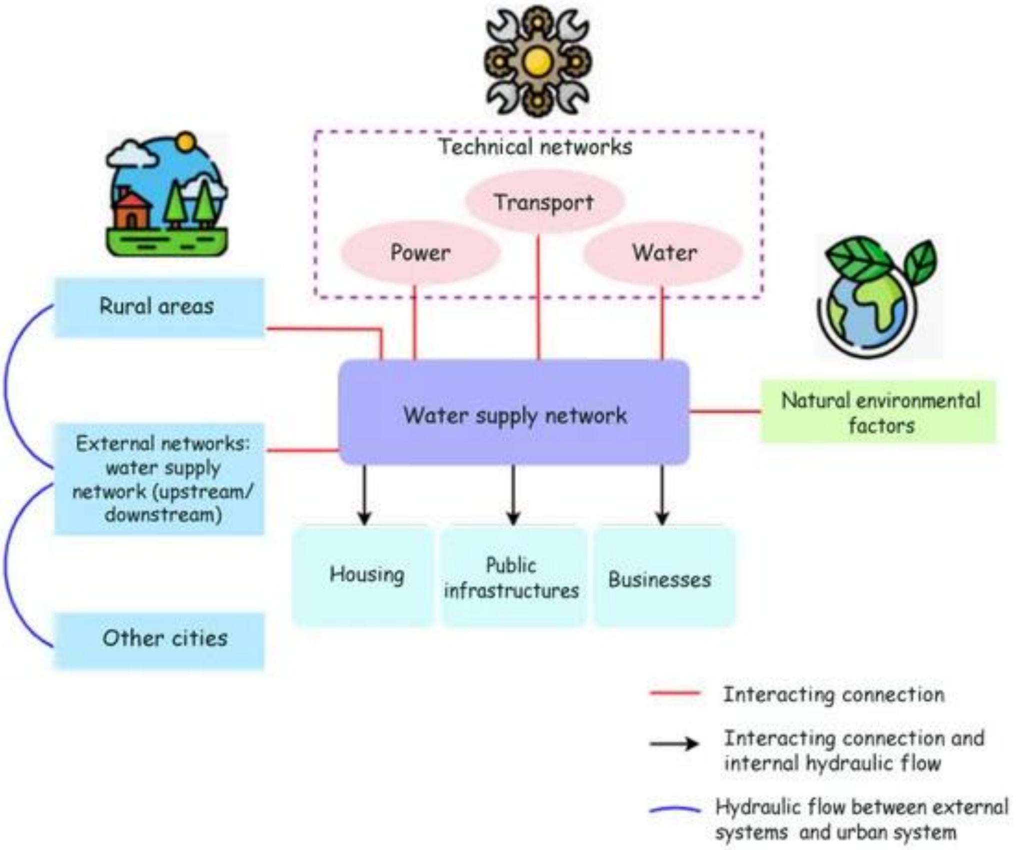
The DDC can be linked to a router and used as a local Wi-Fi network or connected to the internet. In the case of a local network, people can use a smart app or a web browser on a connected device to access it directly through that network. The DDC is linked to the cloud server using the internet connection option. People get additional functionality when using the cloud server option by storing data on a remote cloud server. People can use the smart app or browser to send DDC instructions or get status information by establishing a cloud server connection. It is possible to keep the cloud server's pump and water level history if needed. An efficient water management system is essential for overcoming the difficulties associated with water shortages. Management of water resources is made feasible via continuous monitoring of quantity and quality. Monitoring water levels in real time may drastically reduce water waste caused by overflowing storage tanks. By comparing the water levels at various times of day, the water management system may aid in detecting water leaks in a smart house.



IoT-based smart water management systems

During functional analysis, the activities of a system are represented by two types of functions: main and technical. The essential aim of a system's behaviour is communicated by its functions, and the system's response to stressors imposed by the external environment is model using technical functions. Using functional block diagrams (FBDs), the system and its surrounding environment are represented in functional analysis. An external functional analysis aims to identify the system under consideration, its boundaries, and the external contexts with which it interacts. The urban system is defined by its physical and administrative limits when applied to Saudi Arabia. Using this FBD, people can see how the urban system interacts with its surroundings, including other cities and rural areas, as well as external technical networks (such as those for power and water, telecommunications, and transportation), as well as environmental factors (such as weather and seismic conditions).

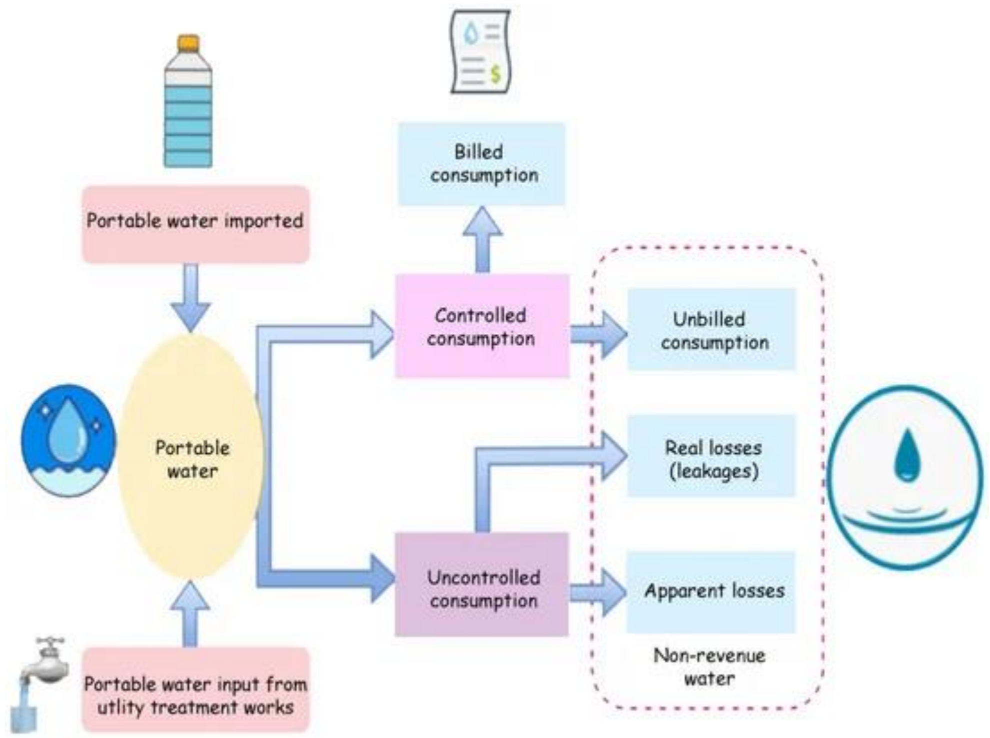
Various urban engineering professionals gathered for brainstorming meetings to develop these concepts. An urban system can be distilled down to its most basic elements with this FBD. A typical urban system is used to conduct the internal functional analysis. Technical networks, housing, companies, and public infrastructure are among the many subsystems that urban planning experts say should be distinguished. Each of these four major subsystem groups includes the Saudi Arabian people. The FBDs have taken over most of the more specialized responsibilities. This is a good illustration of an FBD for a drinking water supply (DWS) technical network.



The strategy of a water supply network.

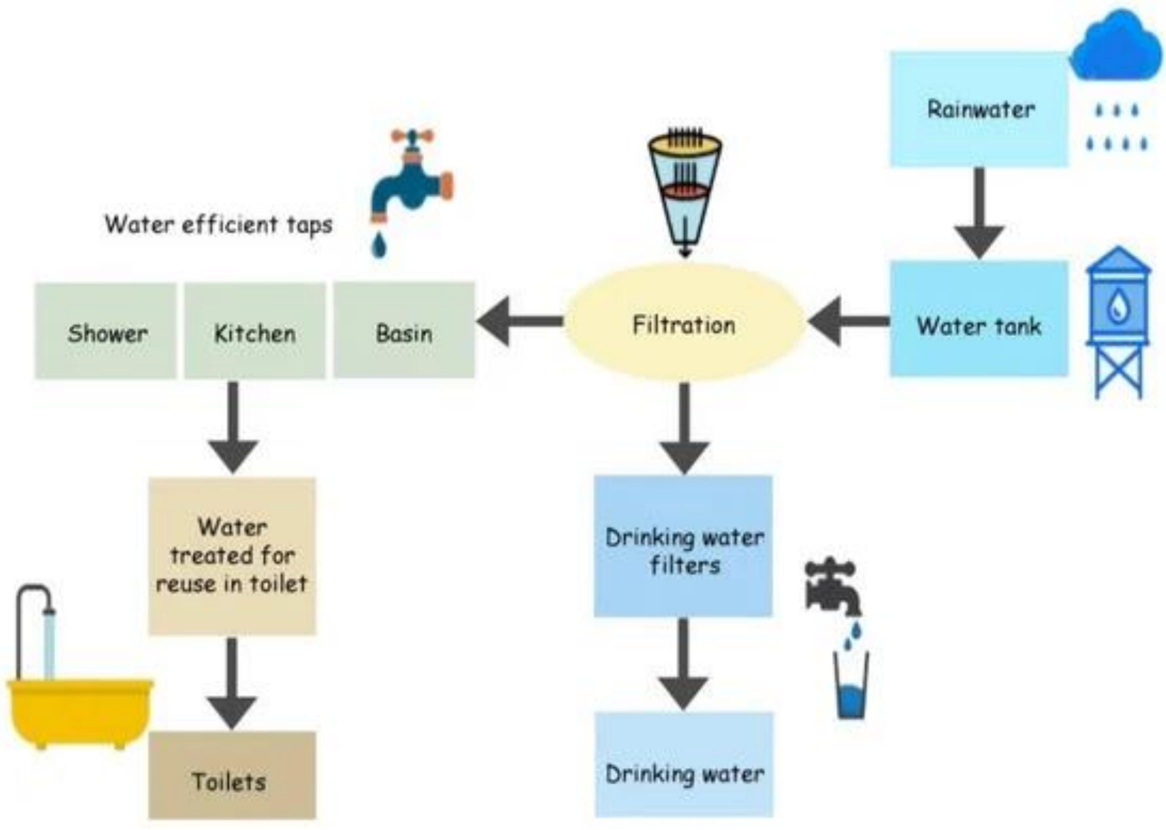
There are two types of water in the reference system (RS), billed water (BW) and non-revenue water (NRW), as well as controlled and uncontrolled consumption. People pay directly for the water they use, referred to as billed water. The NRW is the total amount of water lost and consumed by authorized agencies, including the NRW. Due to natural losses, Saudi Arabia's water companies are judged on their administration and operations quality. The visible or monetary losses are due to unlawful use for water loss. The actual losses are water loss, bursting or explosion of pipes and reservoirs, and reservoir evaporation. Since it is impossible to distinguish between the apparent and actual amount of water lost, it is necessary to enhance their values by utilizing recorded readings and improving network monitoring (i.e., water metering).

According to this suggested technique, Saudi Arabia can achieve the economic level of leakage (ELL) in water loss reduction. ELL represents the objective value of water companies, which involves looking for the highest amount of money that can be invested relative to the amount of water wasted. According to the analysed case studies (RS and CMC), lowering water losses in the water distribution system is the best way to increase NRW. RS must have been imperative to enhance its water loss monitoring and management.

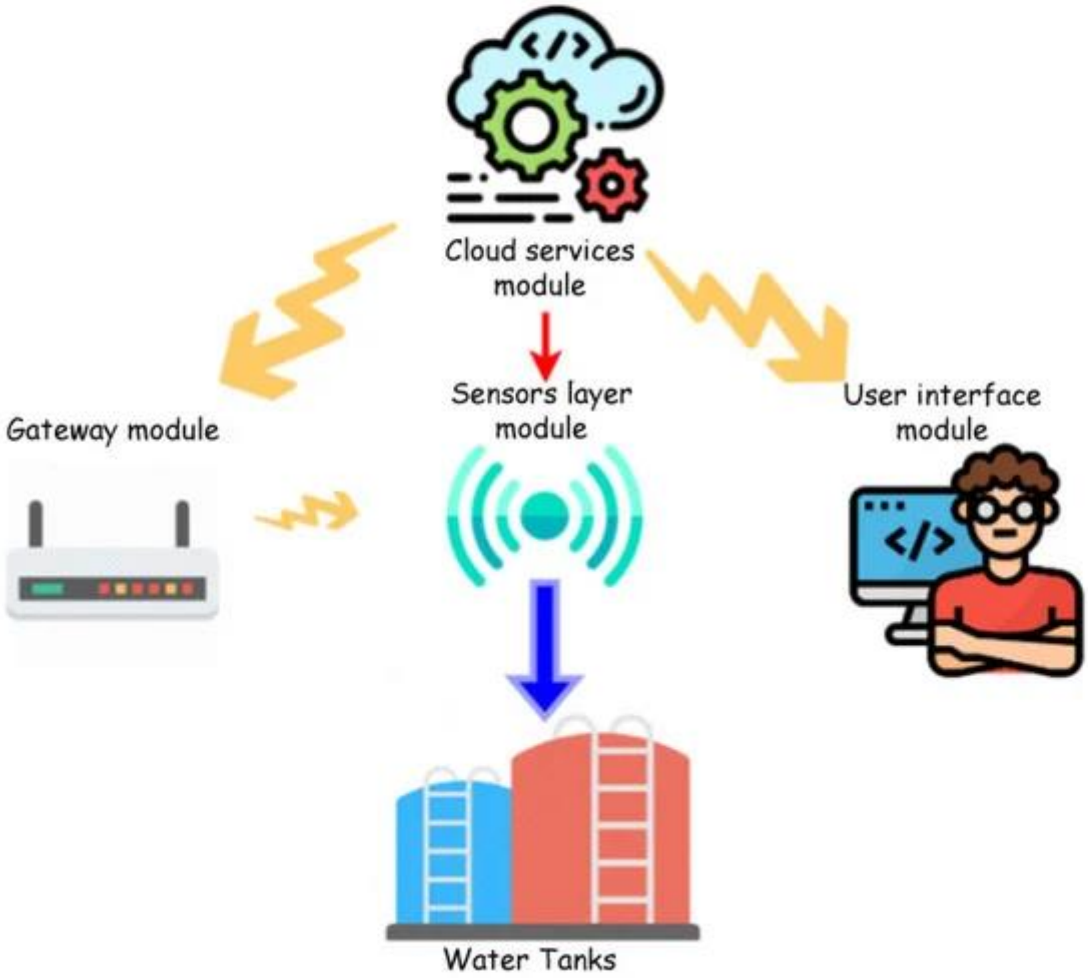


Drinking water distribution for residential buildings.

The concepts mentioned above guided the development of the water management system. Involvement of the Institute for Sustainable Futures with the 60 L building's water management principles included installing water-saving fixtures and equipment, such as waterless urinals, throughout the facility. Water is collected from roofs and gutters for usage in the home, such as drinking, bathing, and using in sinks. Only the weekly testing of the firefighting system required by law necessitates using the water supply. On the bottom level of the four-story building, two 10,000-L polypropylene storage tanks will hold rainwater collected from the roof. There is constant water quality monitoring, and chemical procedures will be used if necessary. As a result of rainwater treatment, there is a direct link to the scheme's water supply (after it has passed through the system). An automated mechanism activates the link whenever there is a power outage or low tank water. During system testing, the switch can be controlled manually. A future smart water management system should be built on an architecture based on the Internet of Things. Defined here are the fundamental characteristics of a sophisticated and efficient water management system.

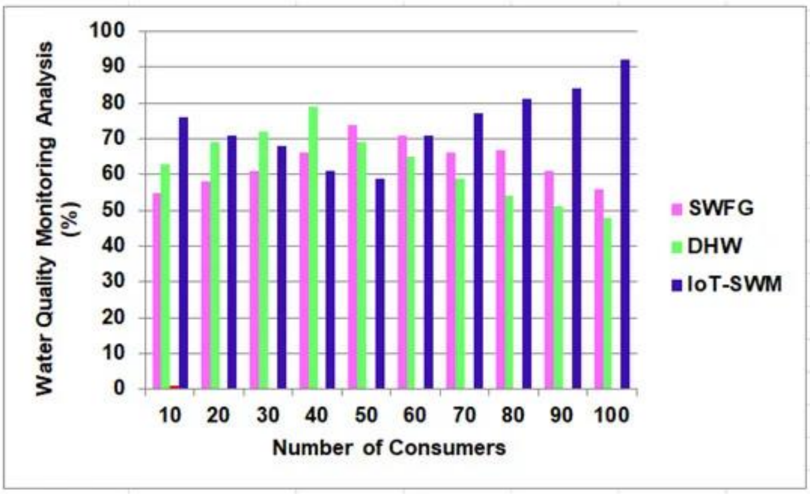


Greywater recycling system for the residence.



Automatic Quality Control for Water

RESULT:



Water quality monitoring analysis.

CONCLUSION:

The water sector has been grappling with creating an efficient and long-lasting water system. It is included in the IoT-SWM. People intend to broadcast more data to the cloud and analyse it further to construct some algorithm to determine the tank's lifespan and the proper aspects of leaking. Procedures and actions are determined depending on the threshold, capital cost, and the accessibility of equipment and materials. Even though statistically minimal water savings can be achieved using in-line flow restrictors, they can be much more cost-effective than water-efficient taps in certain situations. If they have been installed as part of normal maintenance visits, the expenses would be lower. They are a low-cost alternative to outdated toilets and are unlikely to save a lot of water. When it the time comes to renovate restrooms, installing water-saving toilets should be considered. To better understand the workings of a crisis-stricken metropolis, this urban crisis feedback analysis tool should be used. With this approach, municipal stakeholders affected by a natural disaster can better plan for a future occurrence of a comparable hazard. We have compiled a list of the most important features of advanced water management systems. There are still barriers to real-time measurement that need minimal energy use. With this in mind, we propose as future work an IoT-based design for a smart water management system that takes into account all of these crucial characteristics and makes use of IoT-based predictions to boost the smart management system's efficacy. As a bonus, future research can use the Internet of Things coverage factor while calculating measurement uncertainty. The authors offer recommendations for the next steps and research groups to join to improve IoT security, lessen the impact of organisms, implement AI/ML approaches, and reduce the entire system's cost. The numerical outcome of the proposed method increases the stormwater quality (98.7%), the efficiency ratio (95.1%), water demand ratio (93.6%), the leakage detection ratio (97.5%), and non-revenue water ratio (98.4%).