

Phase 2 Innovation -Smart Water Management Based on IOT.

INTRODUCTION:

Water represents an essential resource for survival. Today, the quality and quantity of water have decreased considerably. These are the effects of global industry development and the overexploitation of land and sea resources. Moreover, climate change has a strong impact on water resources, and drought is becoming more prevalent. All these factors can cause major damage to water resources, so intelligent water management systems are essential for maintaining efficient management in terms of the quality and quantity of drinking water.

One of the most important aspects of water sustainability is the continuous monitoring of water consumption in order to make the right decisions regarding the good management of this vital resource. Water scarcity, together with diseases caused by contaminated water, are major dangers that threaten humanity. Therefore, additional attention should be paid to this area, and the necessary resources should be allocated to monitoring water consumption. The collected data provide decision support for streamlining water resources.

Another important factor to note is population growth. The demand for water increases, and the need to develop an intelligent system becomes indispensable. An alternative that has become increasingly popular, with multiple benefits in many areas, is based on the concept of the Internet of Things (IOT). IOT has made significant contributions in various fields, including being integrated into intelligent water management systems. In households, the IOT concept can be implemented by installing sensors and collecting data in real time to provide continuous data monitoring. Solutions that include IOT in water management have multiple advantages including low costs and real-time remote data access. Furthermore, the integration of smart sensors in an existing system does not require many changes; IOT offers flexibility and only requires a few configurations to extend functionality

The Internet of Things:

IOT, through some software, has access to the Cloud as a platform and generated data by a sensor network is transferred to the Cloud. The Cloud as a computing platform increases the computing efficiency and data storage, which is done with a high level of performance, almost a hundred percent reliability, and extensive scalability. There are several Cloud services. In our study, Sharpsburg Municipality has applied Microsoft Azure. Different types of the Cloud services. The sensor network is built by sensor devices to collect a massive volume of information from different resources. The connections between devices and IOT applications are carried out through Hub hosted in the Cloud, creating a bi-directional connection between devices and the Cloud. IOT Hub as a managed service is a center for sending messages and supports sending information from IOT devices to the Cloud and vice versa. The process and storage of data start as soon as the data arrives at the Cloud, which has the ability in real-time response, so the Cloud can decide to begin automatic adjustments or send alerts, and this process does not require any user.

Sensor Network:

The main reason for increasing sensors' use in various aspects is easy deployment



and low cost. Various IOT sensors are applied based on our requirements for different goals in IOT, such as moisture IOT sensors, noise and acoustic IOT sensors, temperature IOT sensors, water level IOT sensors, light IOT sensors, image IOT sensors, chemical IOT sensors, and gyroscope IOT sensors. The type of integrated sensors in our study for water consumption investigation was Lo Ra (Long Range) for Sharpsburg's IOT network and Lo Ra WAN protocol. The Lo Ra has structured as a physical layer based on Lo Ra WAN protocol and can transfer a huge volume of data or information over a high range of a geographic area. Indeed, low power can send data over long distances using radio frequencies, making it a remarkable and efficient technology. Lo Ra Technology includes outstanding characteristics such as low cost, long-range, low power, and open standard. It means it has the capability to decrease the cost of operating and infrastructure investments, it penetrates deeply in the dense urban structure and can cover sensors in long distances which are more than 30 miles far away in the rural areas, increase the lifetime of a battery up to 20 years through the use of Lo Ra WAN protocol which is perfect for low power, and with the help of Lo Ra WAN protocol provides some form of Prediction of Water Consumption Using Machine Learning 4 collaboration among telecom operators, applications, and IOT solution providers to expedite the adoption and deployment process.

Innovative solutions to water scarcity offered by the IOT:

Reducing waste of water-intensive industries:

Agriculture, manufacturing or power production use very high volumes of water. Farming alone accounts for 70% of all water consumption. The same sector is liable for wasting approximately 60% of that water according to the UN's Food and Agriculture Organization.

Producers have to contend with increasingly erratic weather patterns which result in hotter and drier growing seasons.

Real-time water metering and other applications such as smart irrigation systems or crop water management systems can help farmers reduce waste while maintaining soil health, improving water conservation, and increasing crop yield:

- Water flows, humidity, and temperature data collected by IOT devices, can be used to train machines to trace treatment processes.
- It can be used to evaluate the impact of an individual treatment process.
- The data collected using soil and light sensors can be analyzed to recommend the quantity of water and fertilizers required in a field.

Labellum –a client – is one of the leading companies in IOT solutions for the agriculture. Their devices cover a wide range of applications, from water distribution network management, water consumption/metering, irrigation water management, flood/disaster management, water losses and leak detection, water storage (tanks, reservoirs, etc.), Aquarium Management and more.

These installations are designed to measure the essential aspects of a plantation, **reducing the environmental impact thanks to responsible use of energy and natural resources, and by improving soil fertility and maintaining water quality.**

In this case study, Labellum explains how their connected sensors and actuators allow an organic farming plant to lower costs and increase the quality of production:

Precision agriculture and automatic irrigation in organic crops with Labellum's IOT technology.



Labellum have calculated that overall, their solutions could help reduce the water consumption per capita by 10%, reduce leakage by 20%, reduce billings accordingly, predict potential failures and diminish the maintenance costs, while helping better manage water pressure and consumption. All of which allowed their clients to augment their revenue.

Monitoring water quality to fight pollution and diseases:

Manufacturing and other human activities can be responsible for polluting rivers and the groundwater table. Sensors and IOT technology for real-time monitoring and control can help monitor and prevent pollution and even improve the water quality.

To do so, IOT systems connected with AI-based software are deployed to capture standard parameters for monitoring the water quality: pH, Total dissolved solids (TDS)—including Oxygen, the Oxidation reduction potential (ORP) or the Temperature of different types of water. Using machine learning algorithms, the devices can be trained to predict the quality of water, monitor the effectiveness of a sanitizing agent or adjust the water treatment plan accordingly.

