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Automated System Using Wireless System Integrated with Sensors and AI Technology

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***Abstract*: The market for electronic sensors is rapidly growing due to the increasing demand for automation in various sectors. This research paper aims to introduce the development design of an electronic sensors with a user dashboard and monitoring data. Our focus is on the low cost wireless network and server sensors and Artificial Intelligence (AI) and our ultimate goal is to achieve a fully autonomous monitoring system for any needs sort of water leakage, water level and water tanks. Our automated system is designed to provide accurate and real-time data that can help individuals and organizations to conserve water, manage water wastage, and prevent water damage and others.**

***Keywords*: WSN, AI, ML, Network, Sensors, Automation.**

1. Introduction

Nowadays, one of the major challenges is to digitalize and develop an automated control system for different area, sort of agriculture, leakage water and others, which can be achieved by deploying wireless network that relies on advanced sensors, servers, and high secured databases. In fact, and as an example, water resources management has become a significant challenge for many communities and organizations, with water scarcity and water pollution being the most significant issues [1]. According to the United Nations, 2.2 billion people worldwide lack access to safe drinking water, and by 2050, the demand for water is expected to increase by 55% [2]. Therefore, in this paper we will introduce a perfect solution to address these challenges and cater to the increasing demand for efficient water management technologies by developing a smart technology based on wireless sensor nodes (WSN) to achieve an integrated monitoring and control system that is compatible with any other systems used in analyzing various environmental data, controlling smart types of irrigation, and monitoring soil, humidity, rain and others, by implementing wireless nodes topology depending on the types of sensors and the targeted area [3]-[5].

Furthermore, we have developed Artificial Intelligent (AI) algorithms [6]-[8]. To analyze real time data, predict and maintain sustainability of our smart system, many field tests were conducted to ensure reliability and efficiency of the solution. Water leakage is a critical global issue that leads to significant water losses and financial burdens. Sort of our study in this paper focuses on developing smart nodes equipped with pressure sensors to detect water leakages efficiently. By strategically implanting these sensors on pipes and leveraging the Bernoulli principle, we can promptly identify and relay information about leakages to operators, regardless of the distance [9].

2. Methodology

To address the global challenge of water leakage, we employed the following methodology:

1. Problem Identification: We identified water leakage as a critical issue leading to significant water losses and financial burdens.
2. LoRaWAN Technology Overview: We explored the capabilities of LoRaWAN technology, which offers long-range communication and low power consumption, making it ideal for large-scale networks.
3. LoRaWAN Node Architecture [10]: The architecture of our LoRaWAN nodes featured the integration of LoRa transceivers for data transmission and sensors for data collection. This allowed for reliable and efficient communication between nodes and gateways.
4. Implications and Benefits: Our paper study has significant implications for water conservation, resource optimization, and the advancement of IoT technologies. The scalability and low power requirements of LoRaWAN make it an ideal solution for long-term deployment and sustainable monitoring of water infrastructure.

In this research paper investigates the potential of utilizing LoRaWAN technology and wireless nodes to address this challenge. LoRaWAN, a long-range wireless communication protocol, offers low power consumption and scalability for large-scale networks. This paper showcases the architecture of LoRaWAN nodes, which integrate LoRa transceivers for data transmission and different sensors for data collection as shown in Figure 1. Our research focuses on developing smart nodes equipped with pressure sensors to detect water leakages. By implementing these sensors strategically on pipes, we can promptly identify and relay information about leakages to the

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designated operator, even over long distances. The study paper highlights the architecture of LoRaWAN nodes, comprising LoRa transceivers for data transmission and sensors for data collection. These nodes utilize single-hop wireless communication to connect to gateways, enabling efficient network connectivity. Also, various use cases for LoRaWAN nodes can be presented, including applications in smart cities, smart agriculture, and industrial Internet of things (IoT). These use cases demonstrate the versatility and potential impact of the technology in different area sort of, waste disposal, intelligent lighting, traffic control, animal tracking, irrigation management, and equipment monitoring. By using as autonomous operation, the reduction of water leakages and support sustainable water management practices can be contributed. The findings of this study research paper have implications for water conservation, via detecting and mitigating water leakage issues, resource optimization, and the advancement of IoT technologies.

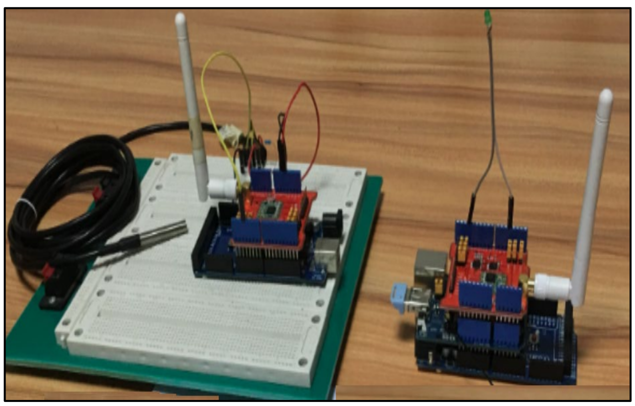

Fig. 1. Integrate LoRa transceivers for data transmission

3. Sort of Hardware Used

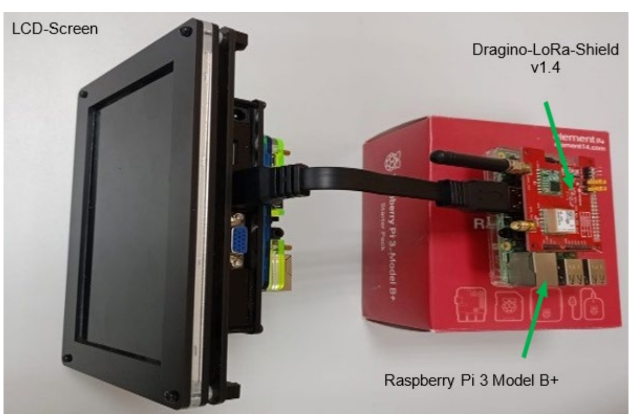

Fig. 2. The tested IoT gateway

Figure 2 is shown, sort of tested hardware is used. The Raspberry Pi is a credit card sized computer. The Raspberry Pi 3 Model B+ is an improved version of the Raspberry Pi 3 Model B. It is based on the BCM2837B0 system-on-chip (SoC). The Raspberry Pi was designed by the Raspberry Pi Foundation to provide an affordable platform for experimentation and education in computer programming. The Raspberry Pi can be used for many of the things that a normal desktop PC does, including word-processing, spreadsheets, high-definition video, games, and programming [11].

The Dragino LoRa Shield v1.4 is a long-range transceiver on an Arduino shield form factor and based on open-source library. It allows the user to send data and reach extremely long ranges at low data-rates. Also, can provides ultra-long range spread spectrum communication and high interference immunity whilst minimising current consumption [12].

4. About the Solution

For example, obtaining water leakage information and data, in any public place makes it difficult to predict the locations of that leakage and thus work to solve and avoid this problem accordingly. A logical solution to this problem would be devices with continuous sensors for measurements related to water leaks, and these downstream devices would then have to transmit that data to the people who are able to respond to the problem. This process seems very energy consuming, expensive and inefficient. But what if there was a solution that not only erased all these problems, but also made them automatic? The solution in this scientific paper solves such problems in an innovative and automated process.

The sensors detect their respective leakage water points, turn that into data, and are connected to end devices that will forward the raw data to a gateway capable of translating and transmitting the data regardless of the protocols. The gateway will then forward that data to a server that translates it to words humans can interpret, and promptly displays it on a GUI (Graphical User Interface) [13]. The nodes utilize single-hop wireless communication to connect to gateways, ensuring efficient network connectivity.

Figure 3, is shown, the general complete architecture system as advanced future technology, is a cutting-edge solution that is equipped with low cost wireless network and server sensors and AI network, and user dashboard, which displays the wanted status information as users can use the information to take an action in real time. Embedded Gateways [14], [15], are hubs that connect IoT devices and sensors to access cloud-based computing and data processing. They have multiple uses, including but not limited to,

1. Enabling the communication between two networks of various protocols (i.e., Bluetooth, LoRaWAN, Zigbee).
2. Transforming data streams to match device capabilities.

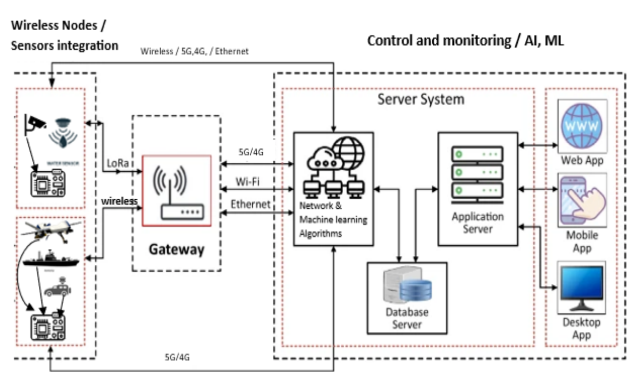

Fig. 3. Complete general architecture system

5. Results

Embedded gateway is designed and coded it successfully to interface with a customized server and receive sensor data. It can receive data over the distance of one thousand meters. This range is much better than the known Bluetooth protocol, with a range of ten meters and varying efficiency. The designed gateway can receive data from devices with a LoRaWAN protocol. It has a high range, low power, and highly efficient system, all while maintaining cost efficiency. The type of data that can transfer through my gateway right now is limited to leakage water zoon, but it can be optimized to receive complex data as shown in Figure 4.

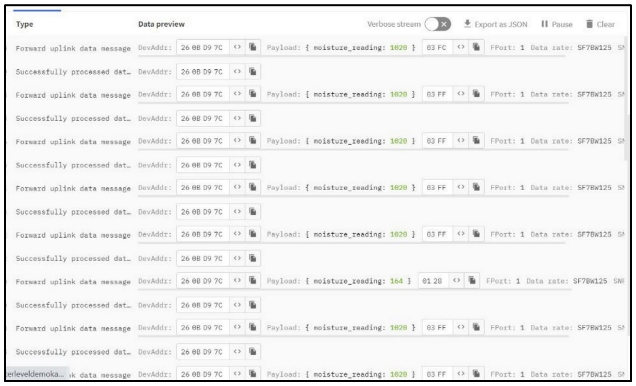

Fig. 4. Translated sensor data on the application GUI

Fig. 5. Dashboard information of the system

The results of our research demonstrate the effectiveness of LoRaWAN nodes in detecting water leakages. Sort of data and information about the system coverage can be presented in the dashboard as shown in Figure 5. By strategically placing pressure sensors on pipes, we can accurately identify and monitor leakages in real-time. The integration of LoRa transceivers ensures reliable and efficient data transmission from the nodes to the designated operators, enabling prompt action to minimize water wastage and prevent further damage, and make it an ideal solution for long-term deployment and sustainable monitoring of water infrastructure. These findings have significant implications for water conservation, resource optimization, and the advancement of IoT technologies.

6. Conclusion and Future Work

In conclusion, this research paper highlights the potential of wireless LoRaWAN nodes in detecting and mitigating water leakages. By leveraging the long-range and low-power capabilities of LoRaWAN technology, we can efficiently monitor water infrastructure and facilitate immediate action in case of leakages. The integration of clean energy and artificial intelligence further enhances the capabilities of LoRaWAN networks, contributing to sustainable water management practices. Our findings have broad applications in smart cities, smart agriculture, and industrial IoT, fostering resource efficiency and supporting the United Nations' sustainable development goals. It has become necessary, as these technologies can be used in many fields, including the agricultures and others. It can be used in developing and analyzing information, predicting weather, environmental and detect the leakages of waters and change conditions that may affect any operations, and defining strategic and mission plans more effectively. It clear the important of developing machine learning systems and intelligent systems to control and improve actions. As well as the improving and developing smart agricultures technologies, by different advanced tech. Also, from this study we can see we have to direct the development, research and manufacturing bodies to benefit from this experience and to prepare the infrastructure for that. Building huge data centers for each sector and field to contain correct, accurate and local information. Linking it together as an integrated information network for reference when needed, called national platform. That will greatly support the sustainable development in many different sectors. Looking ahead, our future work aims to integrate clean energy and artificial intelligence into LoRaWAN networks to enhance their capabilities.

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