The Innovation Of IoT Water Monitoring Irrigation Solar System

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ABSTRACT

This research investigates the significant economic challenges posed by agricultural irrigation, driven by high electricity, water, and labor consumption. The IoT Water Irrigation Solar System is developed to promote sustainable agricultural sector growth while minimizing environmental impact. Extensive land exploration for agriculture has resulted in substantial environmental pollution globally. The National Water Services Commission aimed for a per capita water consumption target of 180 liters daily by 2020. The labor force reduction in Malaysia in 2022 incurred a RM22 billion economic loss. Emphasizing renewable energy adoption, such as solar power, is crucial for conserving non-renewable resources. Soil moisture studies play a critical role in optimizing water usage for agriculture. The IoT Water Irrigation Solar System integrates moisture detectors, temperature and humidity sensors, and solar panels. Furthermore, the Blynk Application enhances remote monitoring and data recording capabilities for efficient plant management from distant locations.

KEYWORDS

blynk application;iot; soil moisture

1. INTRODUCTION

In our modernization era, where human advancement is closely related to engineering and technology. The agriculture sector also made the same approach to it, whereas the development of technologies that are providing better style of working in that field. The invention of a machine that can do the job of man in higher efficiency for a longer period. Since then, the improvement for machinery keeps evolving to a higher height. In that, there are also agriculture, irrigation systems. Whereas it is a function to ensure that water supplying the plants is flowing efficiently.

IOT Water Monitoring Irrigation Solar System, is a combination of a few other functions that made it an innovation. As the terminology stated, this project is using IOT (Internet of Things) for its movement and monitoring system. In other words, the irrigation mechanism is flowing automatically without human's help. Besides, this system also makes use of renewable energy as a power supplier, that is solar panels.

In addition, the IOT Water Monitoring Irrigation Solar System Innovation has been done in this project to help deal with the problems that occur in the agricultural sector. They are known to be very effective for agriculture, and this research has been found in any country, and even though IOT has developed widely in recent times, innovation in the research is still done to cover the shortcomings and add benefits in order to further facilitate the limitations of humans to do a work that is beyond capacity.

Malaysia is a country that is focused on the expansion of agriculture. Thus, it is natural to think that more investment will get into water bills. Because plants need water for it to flourish and be fertile. As a result of that, the water consumption will increase and thus increase the cost for water.

Besides that, electricity consumption. To power up the necessary components, generally, electricity power is being used for it, Electricity is one of many things that is polluting the environment. If it is increasing, the pollution that is produced is also increasing.

Lastly, The problem of insufficient labor in agriculture is a big problem and can increase the cost of food in the country. According to the Minister of Plantation Industry and Commodities, Datuk Zuraida Kamaruddin, Berita Harian 19 July 2022, "Continued dependence on foreign workers can indeed affect the agricultural sector". This also causes the country's food production to be small and will be a big risk in the event of a reduction in the country's daily raw material production. The latest study shows that the Malaysian currency has declined by 7.5 percent per year against the US dollar since the beginning of 2022 and has a negative impact on agriculture.

The objective of this study are : to design a machine that can reduce the water and electricity cost to supply the agriculture plants; to produce IOT system that can measure the humidity and temperature for agriculture plants; to find out the effectiveness of using the Internet Of Thing can increase the limitations of humans in doing something beyond their ability; and to achieve green technology and sustainable practices.

2. METHODOLOGY

There are 5 steps that are necessary in order to complete the assemblement without trouble as shown in figure 1. These steps are taken according to the rough sketch of the project as what is needed to construct the project. After identifying the material needed for them, the ideas for the methodology starts. It all comes down to 5 main components before the assemblement. The methods provides great insight of what the project will turn out to be, the data that it will harness and security that the project will not fail.

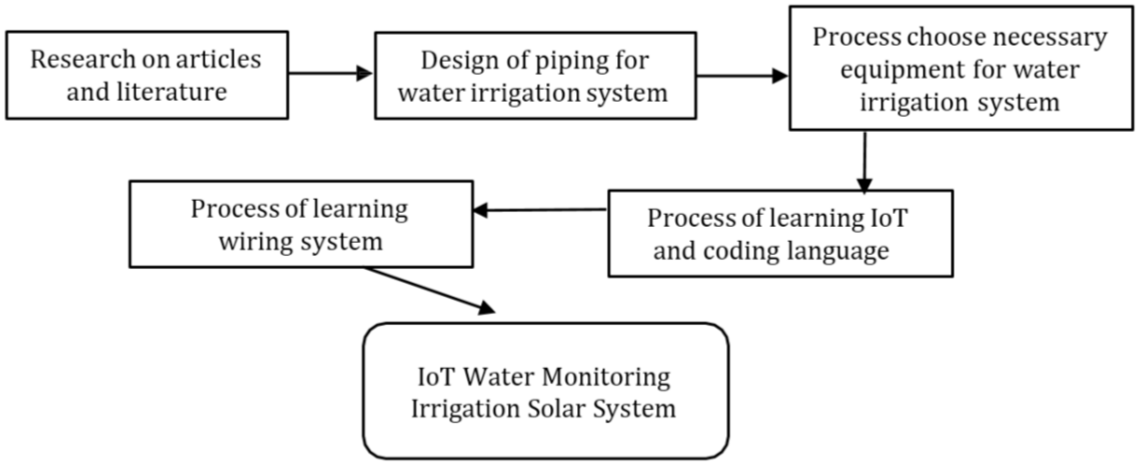

Figure 1. Proces of Produce IoT Water Monitoring System

The quality of a project is significantly enhanced by utilizing a broad range of accurate and relevant reference sources. From the outset, extensive literature searches and article reviews were conducted to ensure originality and to understand existing innovations in the field. The process of learning IoT and coding was integral to our innovation. During the coding phase, there are encountered and resolved over 200 errors through self-directed online learning.

Additionally, understanding wiring systems proved essential, as they are closely related to IoT systems. This included familiarizing ourselves with various components and the flow of electricity through them. We experimented with different types of connections, guided by social media resources such as Facebook, TikTok, and YouTube channels like Viral Science, Sritu_hobby, and Cytron Technologies Malaysia.

After mastering electronics installation, we focused on mapping the piping system. The selected innovation needed to be practical, easy to install, and cost-effective. The installation of the IoT system involved using various materials and techniques based on the skills acquired during the course, including wood product installation and various pipe connections.

3. RESULTS AND DISCUSSION

Figure 2 illustrates the operational process of this innovation. It begins with the water tank, which supplies water based on the readings from the soil moisture sensor. To ensure adequate pressure throughout the irrigation system, the height of the flowing water must exceed that of the irrigation system. This setup uses the pressure formula $P = \rho g h$ to ensure that the water tank generates sufficient pressure to sustain the system's functionality.

Other than that, Figure 3 provides a detailed view of the IoT project box shown in Figure 2. All components in this project are utilized to their full potential to guarantee smooth water flow to the plants. The materials selected for constructing the irrigation system have been carefully analyzed for durability and long-term functionality. This design is tailored for modern farmers, integrating IoT technology to enhance agricultural practices.

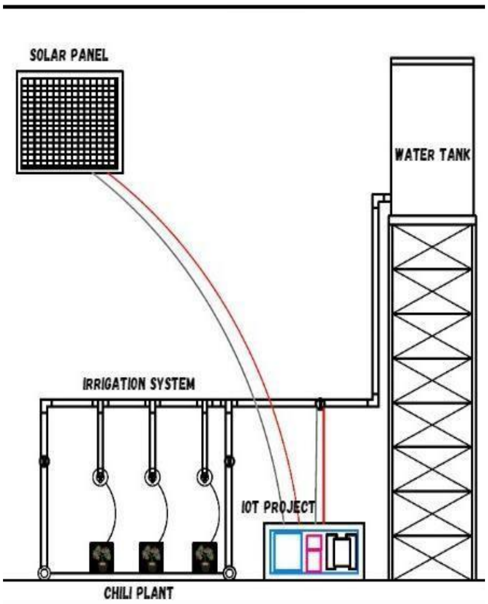

Figure 2. Raw Sketch of IoT Water Monitoring Irrigation Solar System

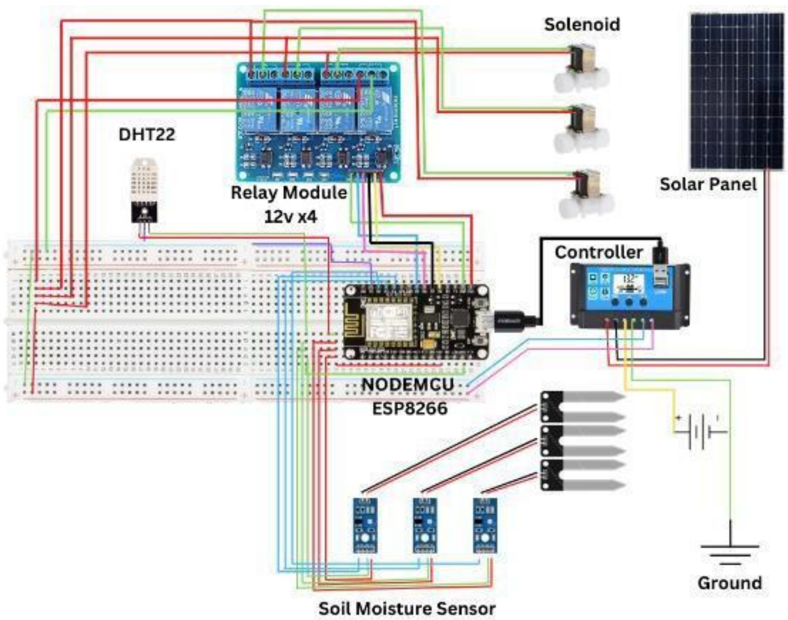

Figure 3. Raw Sketch of IoT Water Monitoring Irrigation Solar System

This innovation measures three main parameters: temperature, humidity, and soil moisture. The system automatically irrigates the soil when it becomes dry, ensuring it stays adequately moist. This automation can be controlled either manually or through the Blynk app. Data can be accessed at any time via the Blynk app. The entire system operates on solar power, making it sustainable and energy-efficient.

The focus of our project revolves around five key components: the soil moisture sensor, temperature sensor, humidity sensor, solar panel, and the Blynk app. Together, these elements work to monitor environmental conditions and manage irrigation effectively.

3.1. Soil Moisture

The soil moisture sensor is a key component of this innovation, used to measure the moisture level in the soil. It is integral to our system, as it provides data that is transmitted to the Blynk app. According to Nasrullah (2019), chili plants thrive when soil moisture is between 50% and 70%. This range translates to a moisture reading between 500 and 750. Readings below 500 indicate that the soil is too wet, while readings above 750 suggest the soil is dry. The system is programmed using Arduino to automatically activate the solenoid valve when the moisture reading exceeds 750, indicating that the soil is dry. This process is managed through Blynk and NodeMCU8266, which connect to Wi-Fi. Water is then delivered through the irrigation system until the moisture level falls to 750 or lower, maintaining optimal soil conditions.

Figure 4 shows a moisture reading of 291, which is below 500, indicating that the soil is currently wet. In this case, the solenoid valve will automatically shut off to prevent overwatering, thereby conserving water and ensuring that the soil remains within the ideal moisture range for the plants.

3.2. Humidity and Temperature

The humidity component used in this innovation is the DHT22 sensor. This advanced component is capable of measuring both humidity and temperature in the environment. The DHT22 can record temperatures ranging from -40°C to 125°C and humidity levels from 0% to 100% relative humidity (RH). It is highly sensitive and accurate, making it an essential tool in agriculture.

Humidity and temperature are critical factors for plant health, as different plants have specific requirements for these conditions. For instance, strawberries require an optimal temperature of around 0°C and a relative humidity of 90-95% to thrive. In contrast, the sample plant used in this project is chili. According to research from Chili-plant, a community dedicated to chili plant studies, the ideal conditions for chili plants are a consistently warm environment with a temperature of about 26°C and high humidity around 70%.

This aligns well with Malaysia's climate, where the average temperature ranges between 26°C and 31°C and humidity levels are between 70% and 90% RH (A.Z.A. Saifullah, 2012). The DHT22 sensor is employed in this innovation to monitor these environmental conditions, ensuring they are suitable for chili plants and enabling optimal growth. By accurately tracking temperature and humidity, the system helps to determine whether the conditions are favorable for plant flourishing.

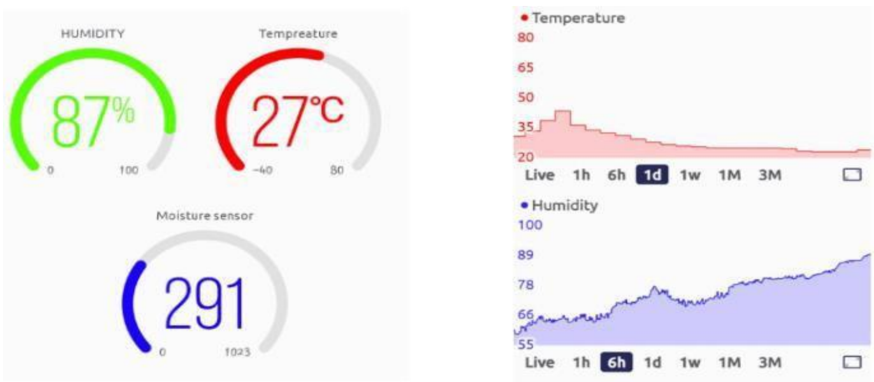

Figure 4. Moisture, temperature and humidity reading on Blynk apps

4. CONCLUSION

Based on the data extracted from the sensors, the system's performance aligns well with the actual weather conditions and soil status. For instance, if it is raining, the sensors accurately detect the increase in humidity and adjust the irrigation accordingly. The system halts the water supply during rainfall, preventing unnecessary water waste. The plants were fertile and produced chilies, confirming the effectiveness of the technology. The measured humidity and temperature data were verified against weather app forecasts. The DHT22 sensor provides more localized readings specific to the immediate area, offering greater precision compared to broader weather forecasts from apps. This technology highlights the importance of environmental products that can minimize electricity consumption and reduce pollution. By integrating such systems, we can enhance agricultural efficiency while contributing to environmental sustainability.

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