Multi-node Wireless Sensor Networking System on LED Lamp Fitting Application

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Abstract

Electricity is the most essential energy in the world. In general, all devices and tools that are used for productive purposes require electricity as a power source. Lighting is one of the factors contributing to the increased demand for electricity; thus, this research proposed a technology that can save electricity while remaining efficient and can be monitored from anywhere. Using Internet of Things (IoT) concept, monitoring can be done easily from an application. Latency, jitter and throughput are used for testing each node as testing parameters. Result shown that the smallest latency value is 28,2312ms, smallest jitter testing is 4,7952ms and the smallest throughput is 9,781ms.

I. Introduction

Electrical energy is energy that is inextricably linked to human needs. This is due to the fact that all productivity devices used in human life require electrical power as a source of power. Based on the electricity demand on 2020 after the lockdown in some country [1], many countries have experienced an increase in electricity use following the lockdown. Furthermore, excessive energy use can harm animals and ecosystems in addition to influencing climate patterns and depleting natural resource reserves. Mining, logging, and material extraction associated with the production of fossil fuels devastate habitats on land and sea. Beside that, if electrical energy is not being used efficiently, it can have a negative impact on industry and business, costing huge sums of money. As a result, it is critical to develop technology to save electrical energy, particularly for lighting control.

The proposed system involves the development of a micro-controller communication system that is linked to the server and database. When the intensity of the light is not in accordance with the provisions, an integrated tool with an adaptive lighting sensor system can control the intensity. The power consumption data used by each micro-controller will be stored. To facilitate the monitoring, the stored data is also displayed on a website so that anyone that connected on the local connection can manage the lighting. Many studies have promised significant energy savings when efficient lighting is used to address excessive energy consumption in public lighting, which is the highest energy consumer for outdoor lighting.

In this work, a communication system to communicate between the lamp and the server is proposed. The process of sending lighting nodes to the website and vice versa will be explained and tested. The network quality in the process of storing and sending orders will also be counted. Based on Telecommunications and Internet Protocol Harmonization Over Networks (TIPHON) standart, the value of the latency, throughput and jitter will be classified as Bad, Poor, Fair, Good and Excellent.

II. Proposed Method

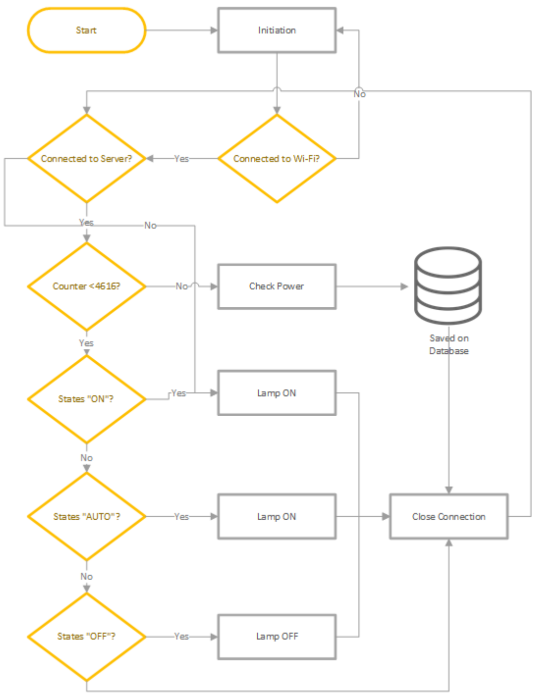

Figure 1 Proposed system flow chart

The system proposed a lighting system that can generate light in accordance with IoT-based intensity standards. Each node is connected to an access point and it is connected to the internet. Detailed work flow can be seen on Figure 1. Initiation is the first step, the use of initiation is to prepare all variables used, including the SSID, WiFi password, and server used The system first connect to the WiFi access point, then connect to the server. If the connection is established, the system enters a counter that serves as a timer for 10 minutes. When the counter falls below 4616, the system examines the command string to which HTTP responded.

The string received is either "ON," "OFF," or "AUTO." If the received string is "ON," the node turns on the light with maximum pwm before closing the connection and reconnecting to the server. When the string received is "AUTO," the node turns on the lamp in accordance with the light intensity standard. When the received string is "OFF", the node turns off the light. However, if it fails to connect to the server, the system automatically executes the ON command on the node. When the counter exceeds 4616, the system sends out a power reading. This power value will be saved in the database at a later stage. However, if the connection to the server fails, the data is not saved in the database.

III. Experiment and Result

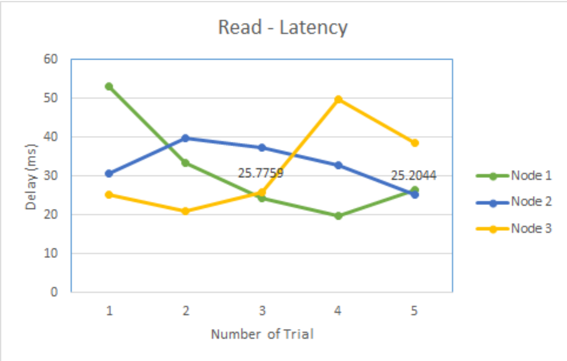

Figure 3 Read Latency (From server)

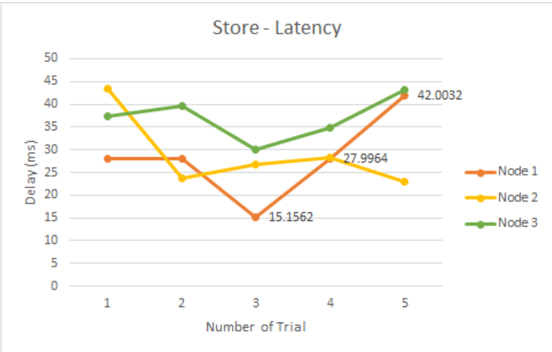

Figure 4 Store Latency (From server)

To tested the first parameter is by taking the value of the latency as well as the average latency. Latency is the amount of time it takes for a packet to travel from one point to another, which is its destination. To retrieve data on this parameter, this work try to run for 5 tests, giving orders and storing data for 4 minutes each. This latency test is run in parallel with three nodes. Each node is placed in a room that is one, two, or three meters away from the access point. Latency is counted using WireShark [2].

Based on Figure 3 and 4 the average latency(ms) after 5 trials are counted. With this result, measurement of the average latency are counted using equation which $\overline{\mu}_{rs}$ is the average latency, I are the index of the trial and T is the total of trial.

$$\overline{\mu}_{rs}=\frac{l}{T} \qquad (1)$$

Table 1.1 Average latency and Jitter result

Node	Node 1	Node 2	Node 3
Read Latency (ms)	31,4724	33,1818	32,1460
Store Latency (ms)	28,2312	29,0235	36,9882
Read Jitter (ms)	9,5626	4,7952	10,7939
Store Jitter (ms)	12,5601	6,5756	5,7197

Throughput is the Throughput is the average rate at which data is received by a node within a given observation interval. Result shown that The maximum throughput is shown on the 5th trials which is 19,542 bits/s, the minimum throughput is the 2nd trials which is 9,781 bits/s. Result of the throughput can be seen on Table 1.2. The jitter is tested based on the latency result. Jitter is a variation of the queue length in data processing time, also known as a latency variation. The latency value in the latency test is used to perform this test. This parameter is tested by calculating the difference between the delay after and before a packet. Result of the Jitter can be seen on Table 1.1.

Table 1.2 Throughput result

Details	I^{th} Trial	Throughput (bits/s)
Min	2nd	9,781
Max	5th	19,542

IV. Conclusion

Conclusion, in this paper we tried to give an idea about making a multiple streaming system from Unmanned Aerial Vehicle (UAV to HoloLens. This system can help multiple HoloLens user to see multiple view that drone could display based on each drone perspective.

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[2] WireShark, “Wireshark.” [Online]. Available: https://www.wireshark.org/