DEVELOPMENT OF A NETWORK CONNECTION FOR REMOTE AND LOCAL DEVICE FOR TRAFFIC MONITORING SYSTEM

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***Abstract* – Traffic congestion is one of the most significant problems in our country that all of us have been facing. However, with the continuous expansion of technologies in our society, there are many ways that it enables the people to utilize its applications and make innovative ways to take action in some of our societal problems. The Internet of Things (IoT) is one of the most fast evolving technology currently used to create inventive ways to make a solution to certain problems. The Internet of Things (IoT) enables the users to send and receive data even without a direct physical contact to the device. In this study, the researchers made use of the Internet of Things (IoT) to create a solution about traffic congestion. The remote device deployed in an intersection of street was able to gather data about the road condition. This includes images, temperature, humidity, flood level, and other parameters. With the use of various network connection, the remote device is connected directly to a computer that will upload the said data to a website that the users will be able to see to get a real time update. In this connection, there are two setups, the first is the LoRaWAN and the other is the Ad hoc connection. First, the LoRaWAN connection is able to send telemetric data for almost a kilometer. In this setup, the researchers used packetduino as the LoRaWAN device to send small amounts of data to the computer. Next, the Ad hoc connection which is able to connect the remote device to the computer. In this connection, the researchers used Raspberry Pi to connect directly to the computer. With this, the two devices were placed together in the remote device and they were able to send necessary data that will be used to create a real time update that is shown on the website.**

Keywords: Internet of Things (IoT), LoRaWAN, Ad hoc connection.

I. INTRODUCTION

Traffic congestion is one of the main problems in the Philippines, you might spend the half of your day going to or from your workplace or school by traveling the worst traffic spots in the country. Traffic problems exist when the traffic demand of the city is too high for the traffic system to cope up. Car accidents, numerous vehicles on the road, and infrastructure developments are just some of the causes of traffic. Solutions have been suggested and implemented but some of them aren't satisfactory enough to the people, especially to the commuters. [1] A study was conducted and stated that due to the traffic situation, Metro Manila loses P 3.5 billion per day. This will increase to P 5.4 billion per day if this is not solved by 2035 (Japan International Cooperation Agency, 2018). [2] Boston Consulting Group stated that the traffic in Manila is third in longest traffic wait time in the Southeast Asia, next to Bangkok and Jakarta.

[3] According to the Philippine Statistics Authority, our population has increased for over 71.9 million of 15 years of age and above in October 2018 and approximately 43.5 million persons are in the labor force that is either employed or unemployed (PSA, 2018). Due to the continuous expansion of today's technology, hours from being stuck in the middle of the traffic might be lessen.

The electronic world has been expanding since the relay, the first ever electronic device, was invented. As a result, many things in the worlds becomes affordable to the masses, one of them is mobile car, therefore, more cars are traveling the road.

One of the growing technologies in electronics today is the wireless sensor network (WSN), a technology for sensing and carrying out the tasks given. This scientific knowledge is a great advancement in different kinds of field, which includes biological, medical care, military, household, and economical functions. Wireless Sensor Networks (WSN), a huge development in the field of communication, is made of numerous of sensor nodes that able to sense, actuate and relay the collected data or information. One of its applications is the intelligent traffic system which is a part of a Smart City.

[4] Smart City has no accurate definition but instead described as Urban Intelligence. It gives the people comfort and security in all aspects [5] A characteristic of an intelligent city is a set of infrastructures that is built to help the development of the economy. The study is focused on how this revolutionary knowledge can, becomes a solution to the traffic problems in a third world country like the Philippines and become an advanced and high-tech Smart City, where everything is possible.

II. METHODOLOGY

2.1. LoRaWAN

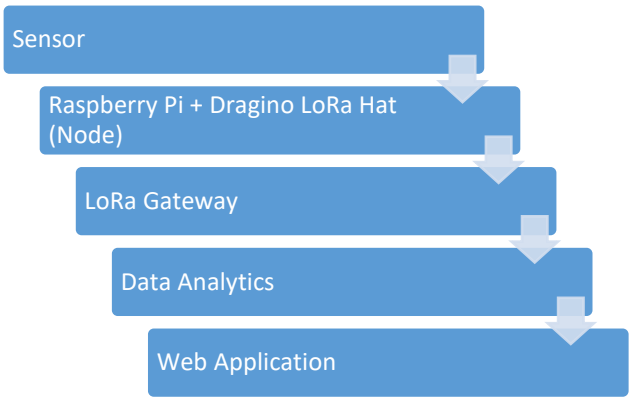


Figure 1. Block Diagram of the LoRa Network

The LoRa (Long Range) connections consist of end nodes or sensors, a gateway and a server. In order to achieve a functioning LoRa connection, the gateway must be programed first and register it in the server.

Figure 2. Rak2245

The Rak2245 is used to be programmed as a gateway. First Rak2245 is connected to Raspberry pi (Debian Lite) then the instructions will show up to program the gateway.

Figure 3. Working Gateway

After the gateway is programed it is required to register it to a server, where the data will be gathered and compiled. Connect the working gateway in the thethingsnetwork.com by creating an account. Click Console, Gateways then Register Gateway (OTAA). After that, the gateway will be connected to the TTN and will be ready to receive messages.

Figure 4. The things network as a server

Next is to program the end nodes, create an End Node in the TTN by clicking Applications and Register Device. After that, program the end node device i.e. Packetduino to connect it to the TTN. When the connection is successful, test it to send sample data into the gateway.

2.2. Ad Hoc Network

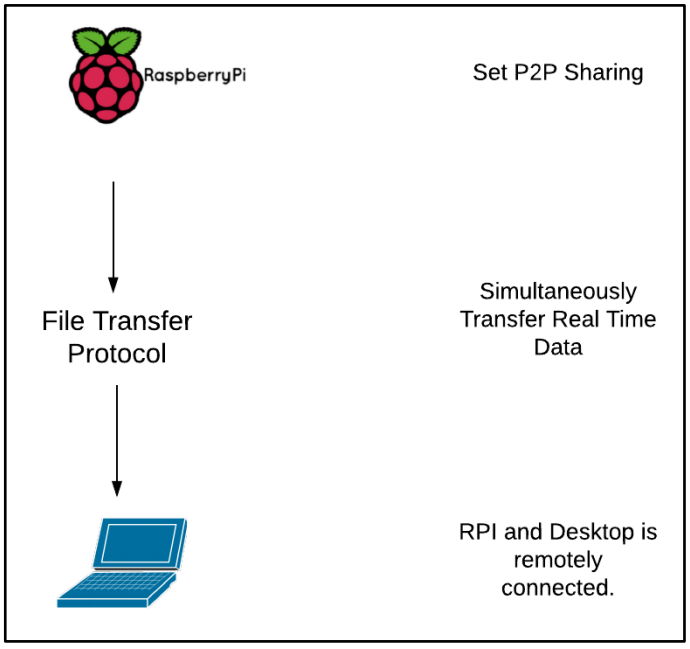


Figure 5. Block Diagram of the Ad Hoc Network

In order to establish a secure connection between the Raspberry and the Computer, different software must be installed in the computer to achieve the interconnection between the two devices. First, the Xming. The Xming will allow you to gain access in opening other interfaces aside from your computer. Next, the VNC. The VNC will serve as the remote control of Raspberry Pi. This will be able to transmit keyboard and mouse functions and share screen view.

Before the other software to be installed, format the memory card to be used on the Raspberry Pi and put SSH file to 'boot' folder. In here, be careful in using the memory card because the SSH file because sometimes it might just get lost in the process. Put the memory to the Raspberry Pi to its corresponding port. Connect the Raspberry Pi to a computer via Ethernet Cable to share a common network. Here, get the IP address because this will be used in future processes.

Third, the PuTTY. The PuTTY is a software which will allow you to gain a remote access to the console of the Raspberry Pi from a computer prior to where it was installed. In here, we can execute raspbian commands whenever configurations are needed to be done.

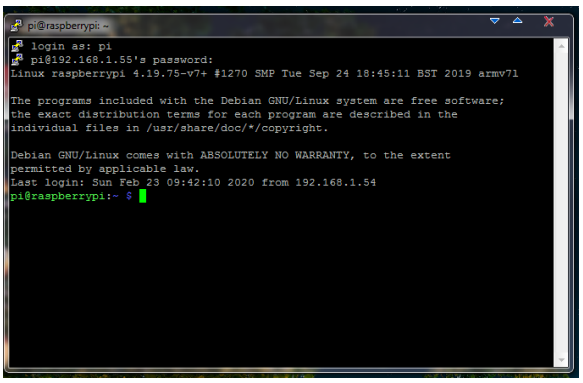


Figure 6. Raspberry Pi console via PuTTY

Then view the Raspberry Pi interface via VNC, then type 'sudo raspi -config' , change to password and enable the SSH and VNC viewer. Get the MAC address of the Raspberry Pi. Then remove the connection of the Raspberry Pi and the computer by ejecting the Ethernet Cable however the Raspberry Pi must be on. Then place

the MAC address of the Raspberry Pi to PuTTY and VNC.

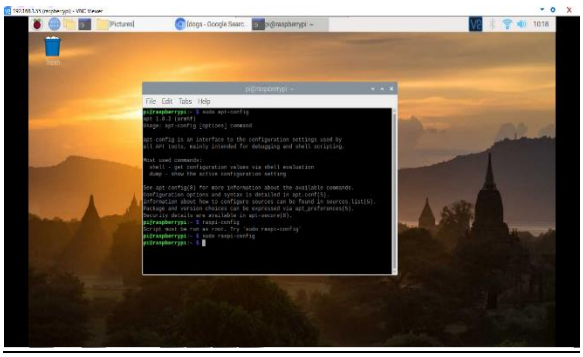


Figure 7. Raspberry Pi view from VNC Viewer

Next, the WinSCP. The WinSCP is the main tool to be used here since this will be the software that will allow the file transfer protocol between the Raspberry Pi and the computer. In here, place the MAC address to the logging section of WinSCP. After logging in, there will be two directories which is the local directory (left side) that is the computer and the remote directory (right side) that is the Raspberry Pi. Configure the folder destinations that will be used by accessing both directories. After that, create a script file using notepad that will show the process of file transfer. Take note of the username and the password of the Raspberry Pi that you configured a while ago. Also, mind the MAC address and IP address used in earlier process. Lastly, the file directories used in the process.

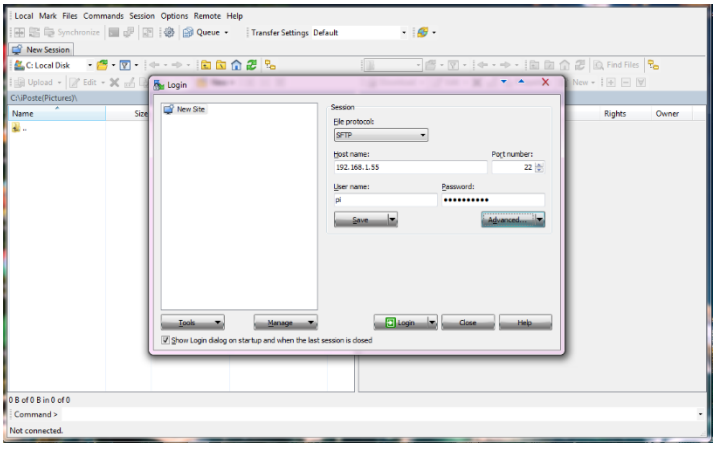


Figure 8. Logging into WinSCP

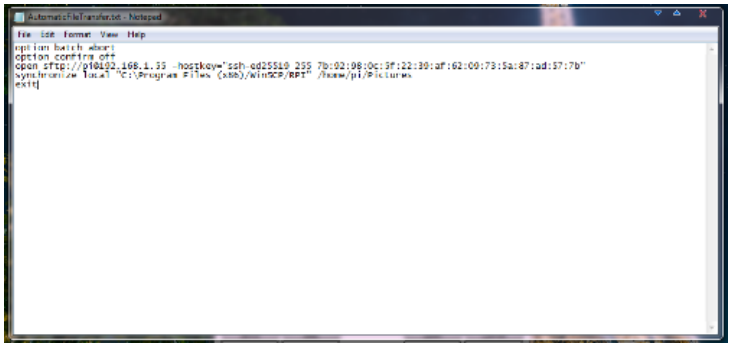


Figure 9. Windows Script File (AutomaticFileTransfer.txt)

Generate a windows batch file that will automate your file transfer by using notepad and changing the file extension to .bat , this will allow the run of your script file earlier. In here, you will need to place the name of the script file in the batch file. After that, just click this windows batch file and press enter and the files will transfer automatically and will end up in the directory you configured. The process will go as long as the windows batch file is not terminated.

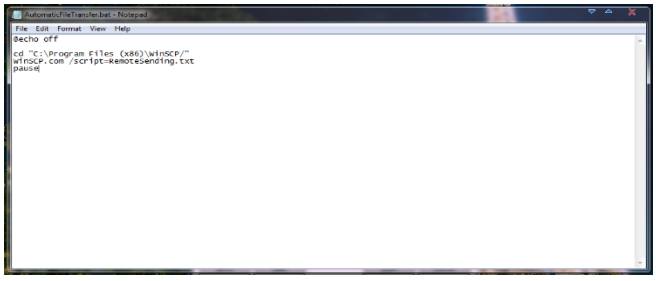


Figure 10. Windows Batch File (AutomaticFileTransfer.bat)

However, this might not work in some other cases so we provided other methods that is a different one but the files will just end up in the same directory as the first process. First, open the WinSCP just like the earlier process. Click ‘Commands' on the upper window pane, then find ‘Static Custom Commands’ and click ‘Keep Local Directory up to Date’.

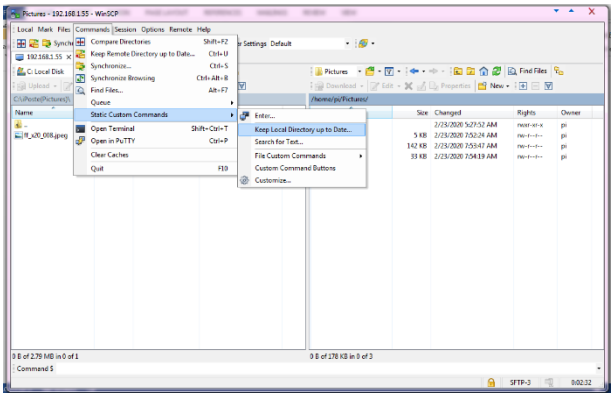


Figure 11. Keep Local Directory up to Date

The options will show up after doing the earlier process. In here, configure the directories and the options included. The options includes deletion of files, beeping for change of files, continuity of program even errors are present, and the timing. The timing here will be the essence in providing real time capture as this will be able to transfer files at a designated interval.

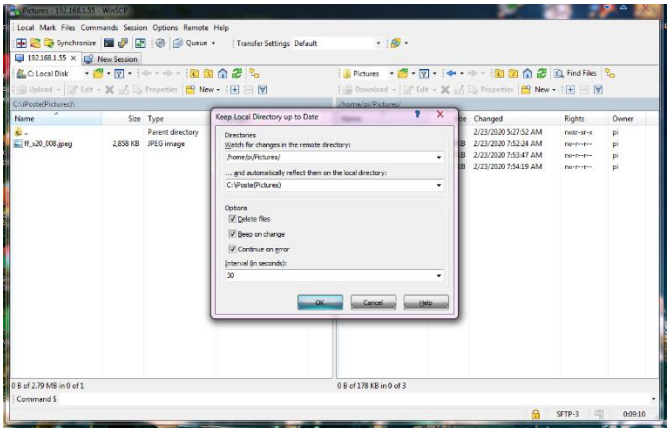


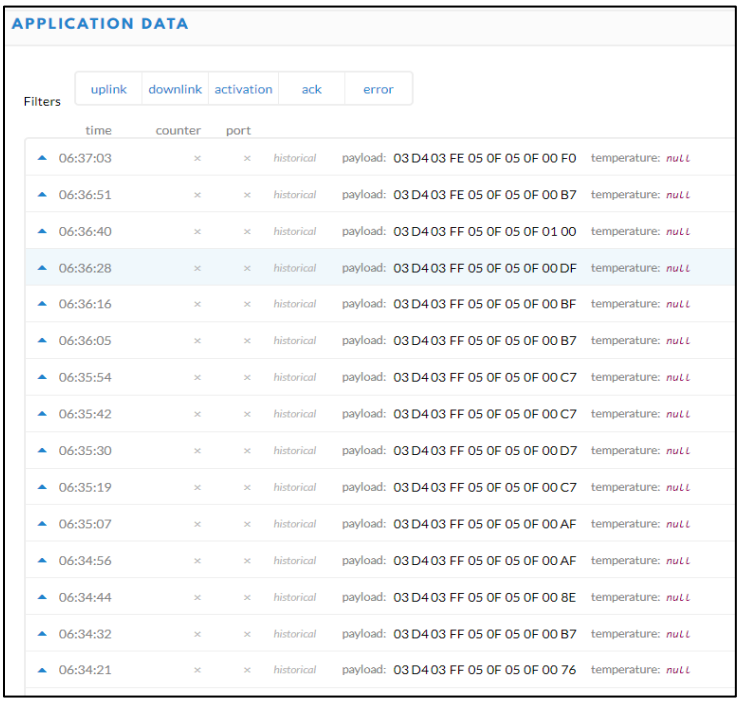
Figure 12. Options for Keep Local Directory up to Date

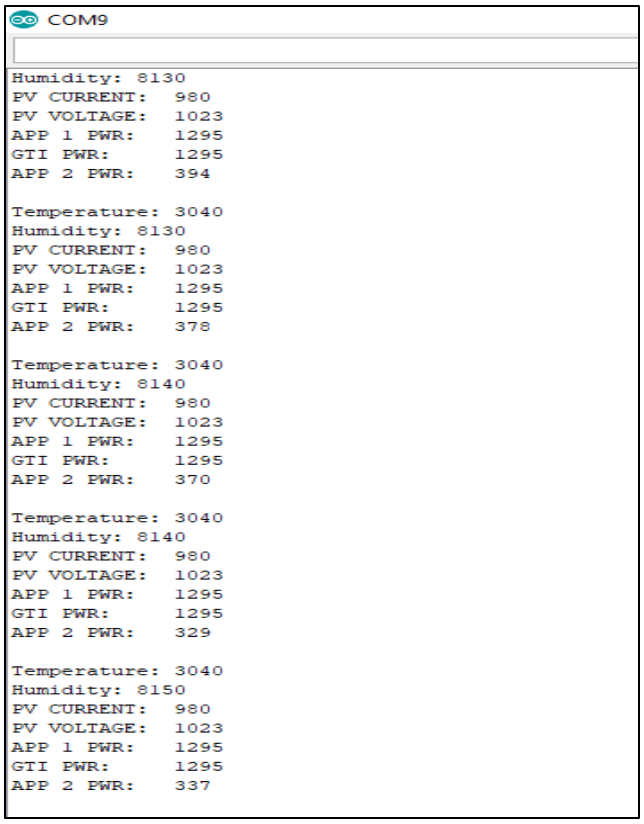
In this part, there are two ways involved in establishing a secure connection. You can run either of the process and the results will still be the same. The process will just be up to the user depending on the conditions needed to be satisfied. However, we recommend the second method as it only needed to run once on WinSCP and the update will be made based on the interval specified in the options.

III. RESULTS AND DISCUSSION

3.1. LoRaWAN

Figure 13. LoRaWAN Setup





Figures 14 Receiving Data using LoRa

3.2 Ad Hoc Network

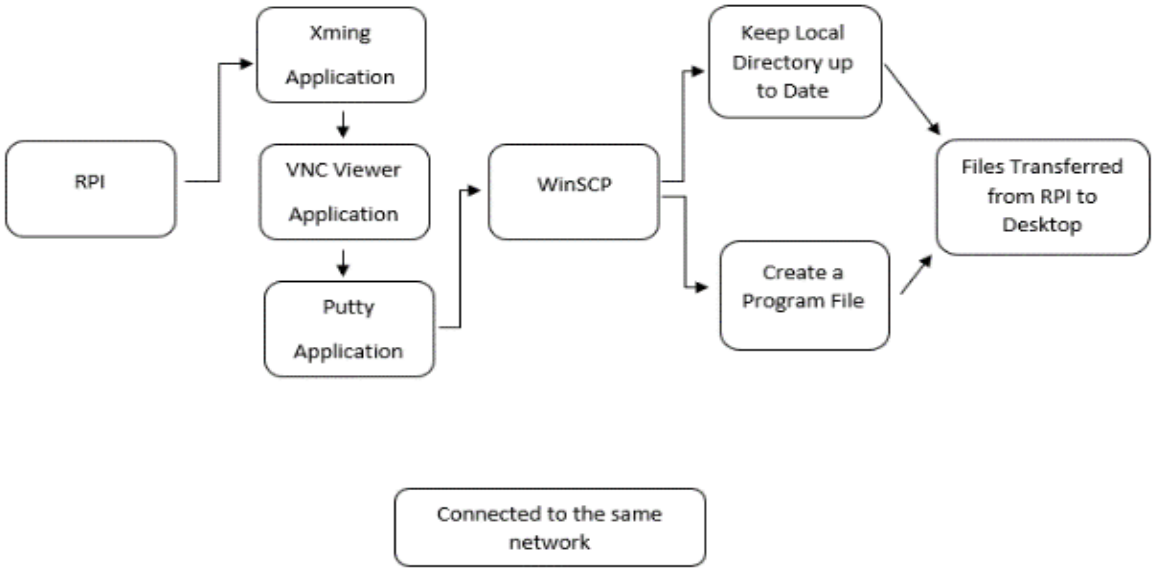


Figure 15. Ad Hoc Network Setup

The microprocessor and desktop should be connected within the same network in order to establish the Ad-Hoc connection. To check the condition of RPI, remotely connect it to the desktop using these applications; Xming, VNC Viewer and Putty. These applications are free of charge and can establish a secured connection within devices. Using the WinSCP application and the Secure File Transfer Protocol (SFTP) these will be used to synchronize the sending and receiving of files. There are two ways in order to synchronize files. First is to go to the command then to the "Make the Directory up to Date", make sure to set the desired configuration. Then the other way is to create a program that synchronize the files from the RPI to the desktop.

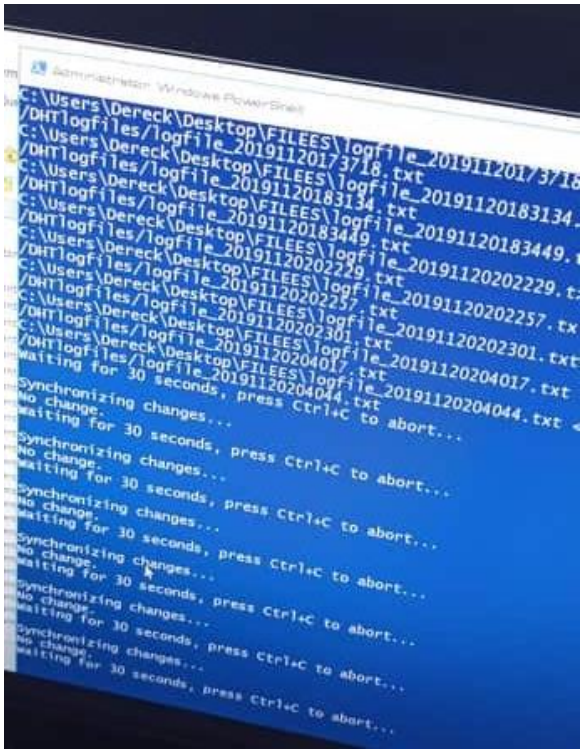


Figure 16. Synchronized directory of Raspberry pi and the computer via WinSCP

This result shows the periodic update of the computer on the contents of the Raspberry pi that is remotely connected to it. It shows that the checking interval is between 30 seconds. This process remains uninterrupted to ensure the continuity of the real time update.

IV. CONCLUSION

The following conclusions were made regarding the overall function of the system through the testing/operation of the project:

The distance of the two types of connection of the remote device (Raspberry pi) to the base station (desktop computer) is different. Based on the results from the previous, the researchers conclude that Ad Hoc connection can only connect two devices for less than 10 meters. Meanwhile, the LoRaWAN connection can connect for up to one kilometer. The results were gathered from initial testing of the connection of the devices and to the actual experiment. This results also states that the LoRaWAN provides remote connection at even long distances.

Based from the results shown in the previous chapter of the research, the transmission size of the connections is very different. Ad Hoc connection can send up to MegaBytes (MB) of data, with this size of data transmission, it can include wireless transmission of larger size of files such as images that is very evident on the results. On the other hand, the LoRaWAN can only send data for up to bytes of data, which means this only includes telemetric data such as temperatures, humidity, and other numerical values measured.

Security is another concern for a reliable connection, in this research the two types of connection shares a similar conclusion based on its operations and testing procedures. The two types of connection are reliable and provides good security with its respective connection. Ad Hoc and LoRaWAN both have its interface that can be accessed remotely, however this needs a password when someone try to login on the device, and that security code is only exclusive to the researchers.

V. REFERENCES

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