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Location tracking using LoRa

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ABSTRACT

Local area network (LAN) as Bluetooth, WiFi and ZigBee are well established technology. The biggest problem with many LAN is the battery consumption and short ranges link budgets. LoRa is a new, private, unlicensed and spread spectrum modulation technique which allows sending low rates at extremely long ranges with minimal power consumption. More importantly, there is no access fee associated with this type of wireless technology. The main idea behind this work is to conduct performance and capability analysis of a currently available LoRa transceiver. We develop a location monitoring system using LoRa and global positioning system (GPS) module and we analyze the detectable range of its data, its battery consumption as well as received signal strength indicator (RSSI). Our deployment experiment demonstrates that the system is able to detect the transmitted data within 290 meters of distances. Using 6 volts of battery AA, the transmission of data still occurred after 24 hours. This project is emphasized a location monitoring system that provide low power usage but long range.

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1. INTRODUCTION

LoRa is a new, private, unlicensed and spread spectrum modulation technique which allows sending low rates data at extremely long ranges with minimum power consumption. More importantly, there is no access fee associated with this type of wireless technology. Local area network (LAN) as Bluetooth, WiFi and ZigBee are well established technology. The biggest problem with many LAN is the battery consumption and short ranges link budgets. Other than that, fundamentally mobile networks like LTE was developed for better data throughput but has disadvantage in term of power consumption. Both LAN and cellular network are quite expensive to deploy in a wide area for instance to cover a whole city. All these statements mentioned, a more efficient method is suggested to overcome these issues by using low power wide area network (LPWAN), LoRa. LoRa and the internet of things (IoT) have become the most important parts of

modern telecommunications which need best in class battery life. LoRa needs very minimal cost for deployment at the same time it did not need to be licensed.

LoRa has been used in many health applications where many aimed for the long range communication for real time monitoring. Marco in [1] used LoRa to monitor and control the humidity of different rooms in order to reduce the costs of air conditioning operation. In [2] LoRa has been used to monitor the temperature of blood fridges inside a blood transfusion service. Reference [3] aimed to monitor air quality using different types of gas sensors. Meanwhile the author in [4] have developed a location tracking system without using global positioning system (GPS) but using multilateration algorithm on the gateways timestamps from received packages. From the applications mentioned, LoRa has great potential for universal applications especially for long range monitoring purposes. Dragino LoRa is used in many experimental research as mentioned in [5-10] but so far there is no analysis related to distances capability of LoRa transceiver while few researchers [11-17] focusses on improving the LoRa protocol. The authors in [18-20] proposed a mobile application and prototype smart home system based on LoRa.

By comparing to the previous works, this paper presents the development and analysis of location tracking system using LoRa module and GPS shield. The rest of this paper is organized as follows. Section 2 explain the research method used in this work. In section 3 the author discusses the result and discussions found in this work, and finally the work is concluded in section 4.

2. RESEARCH METHOD

The block diagram of the proposed diagram is shown in Figure 1. The system consists of two parts which are LoRa transmitter and receiver. LoRa/GPS shield was stacked onto Arduino at transmitter part before location data being transmitted on the LoRa network. At receiver part, LoRa shield was stacked onto Yun shield for data collection and then onto Arduino.

2.1. Hardware and software component

LoRa or global positioning system (GPS) shield with the part number of SX1276/SX1278 was used in the project. In this project, Arduino Mega was chosen as the microcontroller as it has more pins that can be used as an input or output compared to other version of Arduino. Yun shield was stacked between LoRa and Arduino, where the purpose of Yun shield is to solve the storage issue for Arduino board as this project require more storage to store GPS data. The transmitter and receiver parts were shown as Figures 2 and 3. Arduino IDE was used to develop the project.

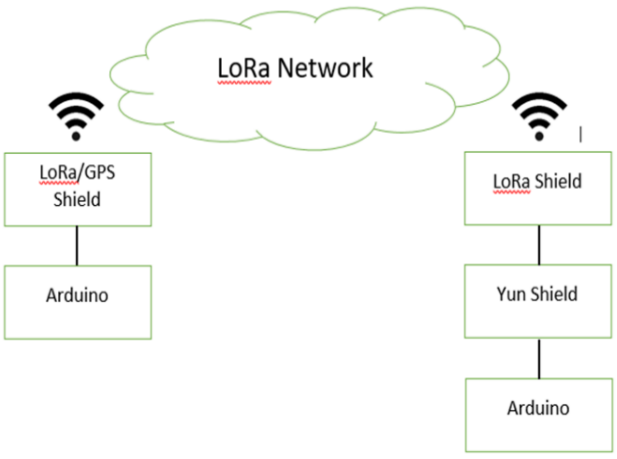

Figure 1. Block diagram of the proposed diagram

Figure 2. Transmitter

2.2. Experiment setup

Figure 4 shows how the experiment has been setup graphically before data was gathered and analyzed. Laptop was connected at each transmitter and receiver respectively while the serial monitor of each laptop will display the longitude and latitude data.

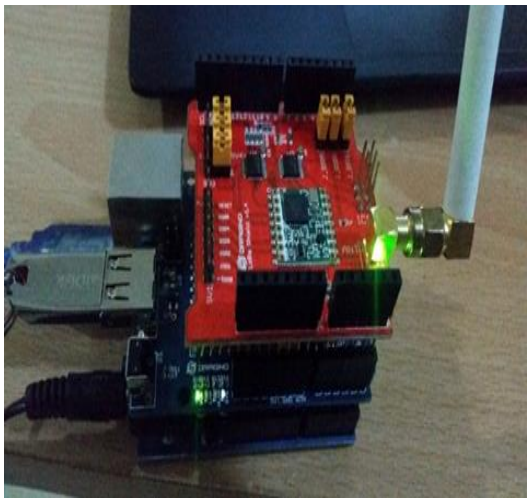

Figure 3. Receiver

Figure 4. Location of field test

3. RESULTS AND ANALYSIS

Serial data in Arduino will generate the reading from LoRa GPS. Figure 5 shows the display in the serial data. The reading shows the LAT, LON, SAT, and PREC which stands for latitude, longitude, satellite, and precision. The precision data shows the relative accuracy of the horizontal position while the satellite indicate the number of available positioning satellite. The reading is displayed in Figure 5. Figure 6 shows the received signal observed from serial data. The reading of receiver consists of latitude and longitude data. Apart from that, received signal strength indicator (RSSI) showing the measurement of the power presented in the received signal was also displayed.

The measurement for the time taken to receive signal and RSSI were observed for every 50 meters as shown in Figure 7. LoRa signal is able to be received within 290 meters of distances. According to LoRa datasheet, LoRa radio transceiver is able to perform transmission for up to 1500 meters of distances. The transmission could be interrupted by obstacles such as cars and buildings. However, LoRa still proven to be the best performance for long range transmission compared to other wireless technology such as Zigbee, radio frequency (RF) and wireless sensor network (WSN) where the transmission is limited within 100 meters of distances [21-25]. The RSSI reading is decreases as distances between transmitter and receiver increases. The performance of RSSI degraded as the distance increases.

Figure 8 shows the analysis of LoRa transceiver battery lifetime. Each LoRa hardware was supplied with alkaline battery AA which is equivalent to 6 volts power supply. It is observed that after 24 hours, the signal transmission still occurred from transmitter to receiver. LoRa proven to be the preferred technology for long hours of operating time.

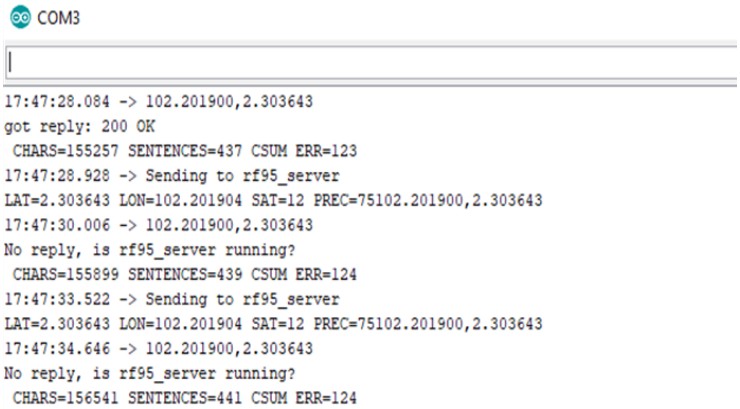

Figure 5. Serial data display the GPS reading at transmitter

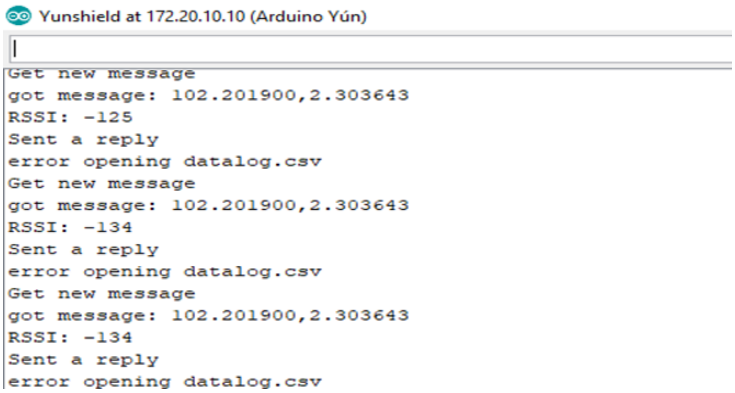

Figure 6. Serial data display the GPS reading at receiver

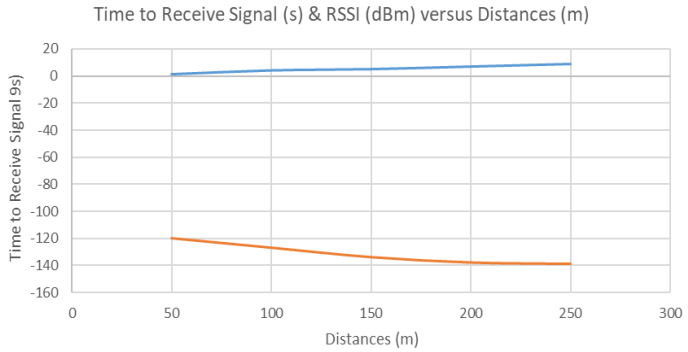

Figure 7. Signal received and RSSI versus distances

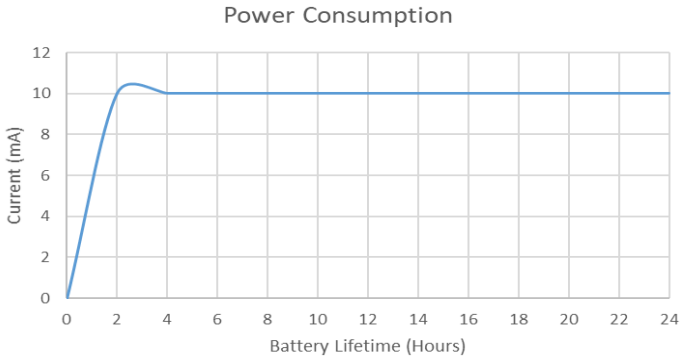

Figure 8. Power consumption

4. CONCLUSION

The results prove Dragino LoRa can give network coverage for 290 meters in suburban area with dense residential dwellings. This project could be extended by developing the gateway where the system can be improved by allowing the devices to communicate with an application over the network server. A pole is suggested to be used as a platform to place LoRa as Line of Sight is needed for better reception.

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