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Implementation of the Lora Wireless Network on the Sap Tapping Bowl Cover Tool in Seri Tanjung Village

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ABSTRACT
Smart Sistem Penutup Mangkok sadap getah karet is a technologically advanced device designed to automatically close rubber tapping cups when it rains, preventing rainwater from mixing with the latex inside the cups. This device is implemented in Seri Tanjung Village. However, there is still a limitation that the use of this device is not optimal for rubber farmers to monitor rainfall and ensure its performance because rubber plantations are located in remote areas far from the farmers' homes. To address this issue, researchers have devised a solution by designing a Long Range (LoRa) technology network to be integrated into the device. In this research, the researchers utilized the action research method, which describes, explains, interprets, and solves a problem by taking concrete actions in the form of a development process focused on practical application. The results obtained indicate successful data transmission from the device connected to the Transmitter to the device linked to the Receiver. Testing the wireless LoRa network connection at a distance of 4 km yielded successful reception of notifications by the receiver
Keywords : *LoRa, Wireless Network, Modul SX1278*

1. Introduction

Smart Rubber Tapping Bowl Cover System is a tool with Smart System technology which is useful for automatically closing the rubber tapping bowl when it rains so that rainwater does not mix with the rubber sap in the tapping bowl. This tool was applied to Seri Tanjung Village. Seri Tanjung Village is a village in Tanjung Batu District, Ogan Ilir Regency, South Sumatra, Indonesia. This village is also known as Sritanjung and is 60 km from the capital of South Sumatra province, namely Palembang. The way this tool works is that when it rains and is hit by a water sensor installed at one point, the water sensor will send a signal to the servo motor to close the bowl of sap tapping so that rainwater does not enter the bowl. The Smart Rubber Tapping Cover System is one of the innovation products from REO which is under the auspices of the Directorate of Innovation and Business Incubator (DIIB). However, there is still an assessment that the use of this tool is not optimal for rubber farmers in monitoring rainfall and ensuring whether its performance is going well or not. Because the rubber plantation is in a remote place and far from the rubber farmer's house.

So, from the problems above, researchers are trying to find a solution by designing a LoRa (Long Range) technology network that utilizes the SX1278 module which will be applied to the Smart Rubber Tapping Bowl Cover System tool. LoRa (Long Range) technology is a wireless audio frequency technology that operates in the license-free radio frequency spectrum. [1]–[3] This technology makes it possible for farmers to monitor the rainfall that falls on the rubber plantation and ensure that the tapping bowl cover works well even though the rubber plantation is remote and far from the rubber farmer's house.

In this research, the researcher aims to apply LoRa technology to enable farmers or rubber plantation managers to monitor the condition of the tapping bowl cover tool from home, even though the rubber plantation is in a remote place and far from the farmer's house. The application of LoRa technology allows users to obtain information about the status of the tapping bowl cover, whether it is in the open or closed position. This optimizes control and protection of sap from rainwater.

Previous research is one of the things to consider so that it can provide references in writing or reviewing the research carried out. Research Vol.5 No.2 December 2021 conducted by Michael Paul Smart Simbolon, Heru Wijanarko, Fitriyanti Nakul, and Rahmi Mahdaliza entitled "Application of LoRa Wireless Communication in Portable Attendance Recording Systems" [4]. In this research, researchers implemented LoRa wireless communication by using a portable attendance recording system as the research object. The designed LoRa Wireless Communication is intended for a portable attendance recording system at the Batam State Polytechnic (Polibatam). Researchers also created a portable attendance recording system that applies LoRa wireless communication. The method used in this research includes a framework consisting of hardware design and mechanical design, software design, testing. As a result of this research, researchers succeeded in wireless communication using LoRa which can be applied to a portable attendance recording system.

2. Literature Review

a. LoRa

LoRa is a wireless technology used to create long distance communication links. When there are many technologies older wireless systems use frequency shift modulation (FSK) as the physical layer because it is the modulation layer very effective to achieve low consumption,LoRa uses spread spectrum chirp modulation, which retains the same low power characteristics as FSK modulation, but improves significantly contact range[5].

b. Buzzer

Buzzer is an electronic device that converts electrical vibrations into sound vibrations Basically, the operation of a horn is almost the same as that of a speaker. The vibrator consists of a coil attached to a diaphragm. Buzzers are often used as a signal that a process is complete or that an error has occurred with a tool[6].

c. LCD

LCD (Liquid Crystal Display) is a type of display medium Use liquid crystal as the main agent. LCD (liquid crystal Display) can display an image/character because it is present Many light spots (pixels) are made up of liquid crystals like a point of light. Although it is called a bright spot, it is a liquid crystal Does not emit light alone. The 16x2 LCD screen can display a lot 32 characters include 2 lines, each line displays 16 characters character[7].

3. Research Methods

A research method is a step that is owned and carried out by a researcher in order to collect various information or data and carry out investigations on the data that has been obtained [8].
In this research, researchers used action research or action research methods. The action method or action research is a method that describes, explains, interprets and solves a problem by taking real action in the form of a development process that focuses on practice rather than knowledge [9]. This method starts from the Diagnosing, Action Planning, Action Taking, Evaluation stages. The stages can be seen in Figure 2 below.

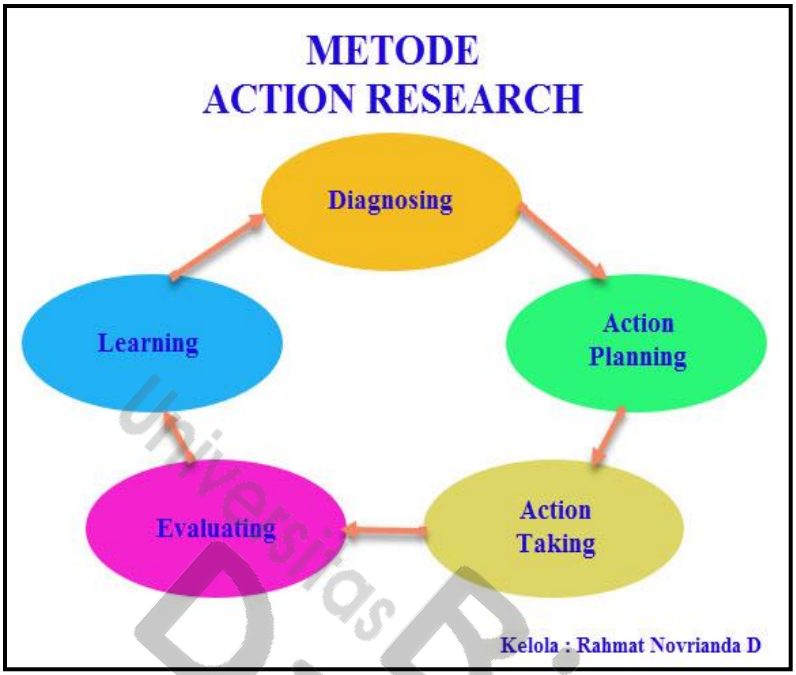

Fig. 1 Action Method or Action Research [10]

The steps in the Action Research Method are as follows;

1. Diagnosis

At this stage, researchers diagnosed problems with the smart rubber cover system. Where in this case the researcher conducted a Literature Study to find out and increase insight into this problem from various sources such as Research Journals, Proceedings and so on. At this stage the researcher also discovered various factors and what solutions needed to be taken to overcome the problem.

2. Action Planning

From this diagnosis, researchers try to find appropriate solutions to overcome existing problems. Where researchers plan to implement LoRa (Long Range) Wireless Networks.

3. Action Taking

After the planning was made, the researcher began to execute what had been previously planned, which in this section consists of various stages, namely;

a) Network Topology Design Identification Stage.
b) LoRa Configuration Stage.

4. Evaluation

At this stage, the researcher evaluates the results of the research. Where the researcher will test the connection between the Transmitter and Receiver and the researcher will also test the maximum distance of the LoRa network that is applied.

5. Learning

This step is the final step of the Research Method, where in this step the researcher carries out trials again regarding the research results and re-understands the use of the research results.

4. Results and Discussions

Researchers identified problems in the Directorate of Innovation and Business Incubators (DIIB). Where the researcher identified a problem with one of the innovations in the directorate. The problem identified is an innovative product from REO which is under the auspices of the Directorate of Innovation and Business Incubator (DIIB), namely the Smart System tool for

covering rubber tapping bowls. This tool is still considered less efficient for rubber farmers who have rubber plantations located in remote places. Because the location of the rubber plantation is far from residential areas and far from the rubber farmer's house [11]. Therefore, this can make rubber farmers face difficulties when they want to monitor whether it is raining in their rubber plantations and whether the equipment is closed or not. This tool from the smart rubber bowl cover system was applied to a village, namely Seri Tanjung Village. Seri Tanjung Village is a village in Tanjung Batu District, Ogan Ilir Regency, South Sumatra, Indonesia. This village is also known as Sritanjung and is 60 km from the capital of the province of South Sumatra, Indonesia, namely Palembang.
After successfully identifying the problem, the next step taken by the researcher is to find the right solution or action to overcome the problem. The researchers plan to apply LoRa Wireless Technology to the Smart Rubber Tapping Bowl Cover System. In this step, researchers also made preparations regarding the requirements needed in designing LoRa Wireless Technology as a connecting medium before implementation. This preparation involves an in-depth analysis of system requirements which will become the basis for design. What researchers use is the LoRa Ra-02 SX1278 module. This module functions to create a LoRa network. LCD and buzzer to display notifications connected to the receiver.

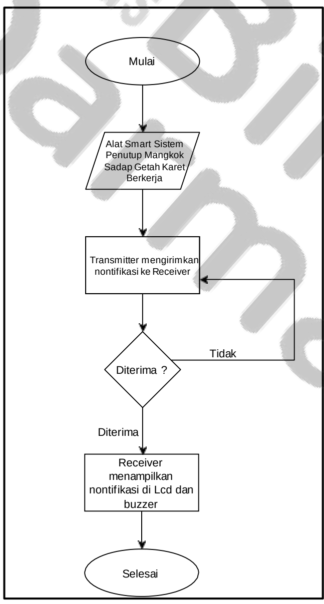

Fig. 2 Flowchart

Figure 2 above shows the steps that a system must go through. After the planning was made, the researcher began to execute what had been previously planned. LoRa network technology is structured using several circuits involving several devices at once. The devices used in this network structure are LoRa Ra-02 SX1278, and the tapping bowl cover tool. Below is a visual representation of the network scheme that has been prepared by the author.

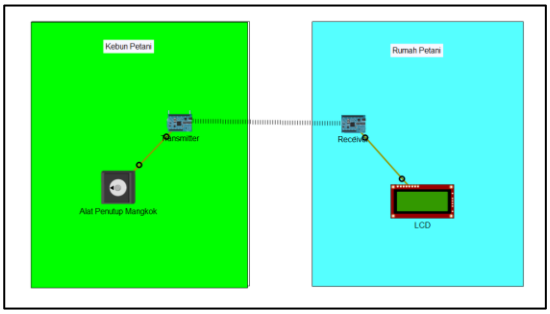

Figure 3 LoRa Wireless network topology

The topology currently being used for research is a point to point network, namely an ad hoc network. In the context of computer networks, the term "ad hoc" refers to a type of network connection that is created for a specific purpose and does not require a router to connect the devices. Next, the tester connects the tool to the transmitter, which can be seen in Figure 4 below.

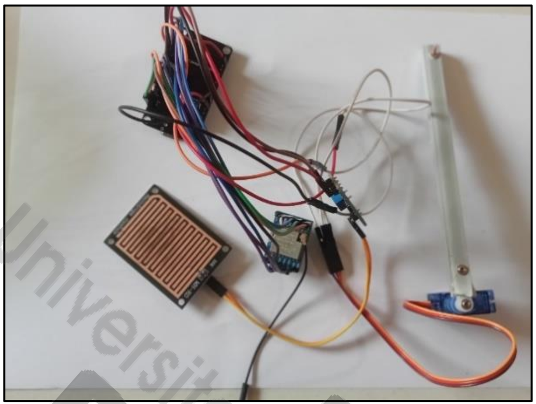

Figure 4 Transmitter and equipment

The transmitter is connected to the instrument so that when the instrument detects rain, the transmitter combined with the instrument sends a notification to a receiver located in the farmer's house.

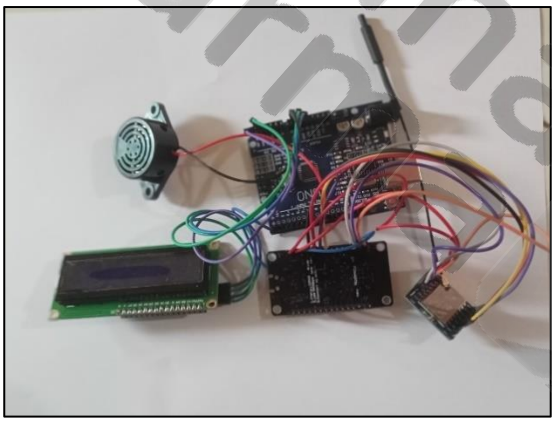

Figure 5 Receiver

Figure 5 is a picture of the receiver where the device functions to receive signals from the transmitter and display them on the LCD and buzzer. After the tool design is complete, the researcher will carry out an evaluation. There are two evaluations that the researcher will carry out, namely the researcher will test the connection of the transmitter and receiver. After the connection is successful, the researcher will continue by testing the distance that can be reached by the LoRa network.
The connections can be seen in pictures 6 and 7 below.

Figure 5 Results displayed on the Receiver serial monitor

The image above comes from the display on the Receiver serial monitor, which functions as a data receiving device from the Transmitter device connected to the tool. In the picture, it is clear that the Smart rubber tapping bowl cover system (Transmitter) acts as a data sender and sends the message "Hello LoRa 1" to the Receiver device which is connected to the LCD and buzzer as the data receiver.

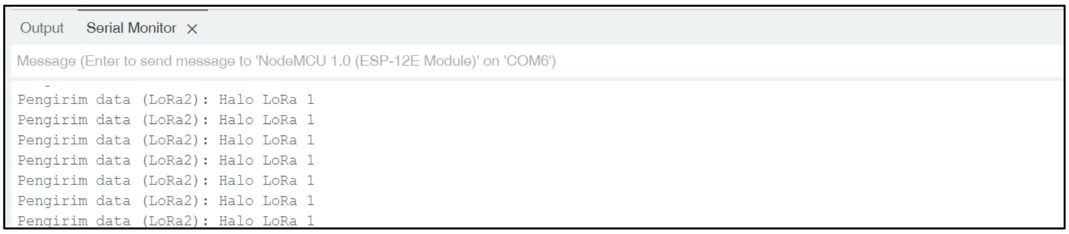

Figure 6 Results from the Transmitter serial monitor

The image above is taken from the display on the Transmitter serial monitor, which acts as a data sender to the Receiver. In the illustration, it is clearly seen that the LoRa Transmitter device functions as a data sender and sends the message "Hello LoRa 1" to the LoRa Receiver device as the data recipient. From pictures 5 and 6 you can see that the researcher succeeded in making a connection between the transmitter and receiver. Next, researchers will test the distance that can be accessed by the LoRa wireless network.
In order to test the LoRa distance connection, an experiment was carried out sending data from the Transmitter device to the Receiver device 5 times with different distances between the Transmitter and receiver. The first test involves placing the Receiver 1 km from the Transmitter and seeing whether the device can still receive messages from the Transmitter or not.

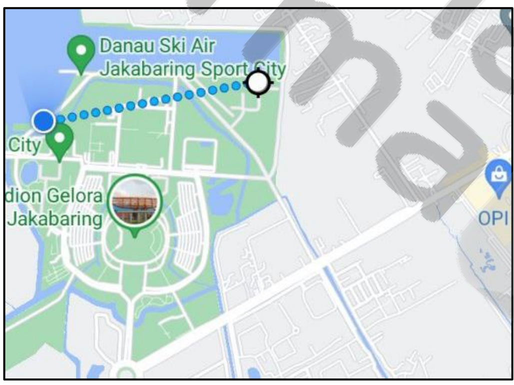

Figure 7 displays on Google Maps the distance between the Transmitter and Receiver

Figure 8 LCD display of the receiver

You can see in the picture above that at a distance of 1 km the LCD on the Receiver can still display messages from the Transmitter. The results obtained if the LoRa technology network can still be connected at a distance of 1 km.

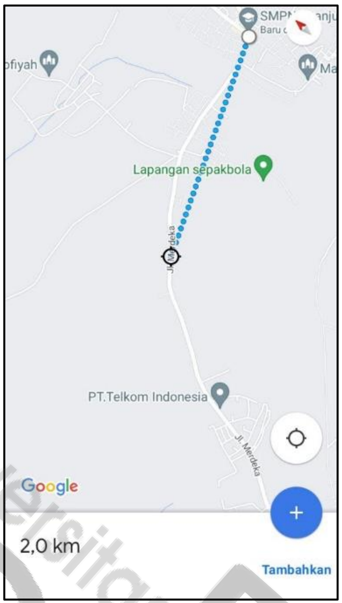

Figure 9 displays on Google Maps the distance between the Transmitter and Receiver

Figure 10 LCD display of the receiver

You can see in the picture above that at a distance of 2 km the LCD on the Receiver can still display messages from the Transmitter. The results obtained if the LoRa technology network can still be connected over a distance of 2 km.

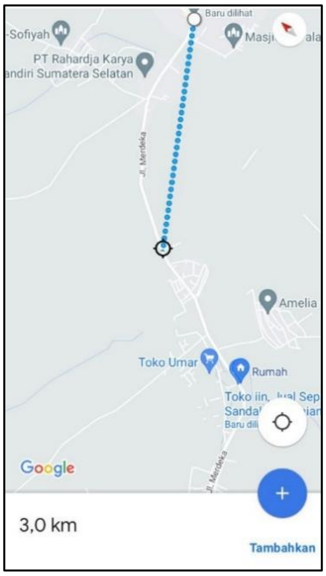

Figure 11 displays on Google Maps the distance between the Transmitter and Receiver

Figure 12 LCD display of the receiver

You can see in the picture above that at a distance of 3 km the LCD on the Receiver can still display messages from the Transmitter. The results obtained if the LoRa technology network can still be connected over a distance of 3 km.

Figure 13 displays on Google Maps the distance between the Transmitter and Receiver

Figure 14 LCD display of the receiver

You can see in the picture above that at a distance of 4 km the LCD on the Receiver can still display messages from the Transmitter. The results obtained if the LoRa technology network can still be connected over a distance of 4 km.

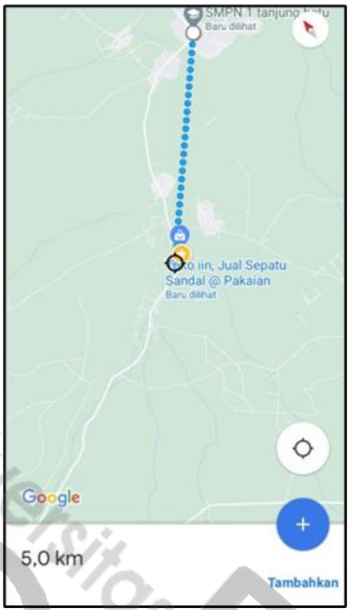

Figure 15 displays on Google Maps the distance between the Transmitter and Receiver

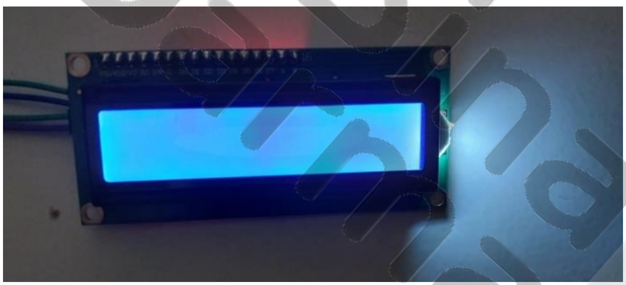
Figure 16 LCD display of the receiver

Bisa di lihat pada gambar di atas dengan jarak 5 km *lcd* pada *Receiver* tidak menampilkan pesan dari *Transmitter*. Hasil yang di dapat jika jaringan teknologi *LoRa* tidak bisa terhubung dengan jarak 5 km. Dan setelah itu peneliti melakukan langkah selanjutnya yaitu Learning dan dari hasil pengujian penerapan jaringan Nirkabel LoRa pada alat smart sistem penutup mangkok sadap getah secara keseluruhan dapat dilihat pada tabel 1.

Table 1 Overall Test Results

Testing distance	Results
1 KM	Successful
2 KM	Successful
3 KM	Successful
4 KM	Successful
5 KM	Unsuccessful

5. Conclusion

LoRa wireless network technology requires the use of modules and antennas to be effective in sending and receiving data. The module used in implementing this LoRa network is the LoRa RA-02 SX1278, which is managed via the Arduino IDE software to achieve the desired configuration. This implementation is limited to the LoRa connection testing stage to verify its performance and test the maximum distance of the implemented LoRa wireless network. The results indicate that the design that has been carried out has succeeded in transmitting data effectively and the maximum distance that can be connected is 4 km. To verify the results of data transmission, information can be accessed via the LCD display and sound from the buzzer connected to the receiver at the rubber farmer's house. For suggestions, the application of this technology to rubber covering devices that will be placed in remote locations, especially in rubber plantations, faces its own obstacles due to the lack of internet signal in these areas. Therefore, the possibility of adding devices such as the ESP32CAM or similar seems unlikely. As a proposed solution, the author recommends the establishment of a wider and more integrated internet network infrastructure. This will enable the application of Internet of Things (IoT) technology with wider and more flexible reach and control, opening up opportunities for more effective monitoring and control. To establish connections between LoRa devices, antennas are an important component in the LoRa network to unify MAC addresses. The author recommends the option to strengthen communication performance by adding an external antenna. Through this step, connections between LoRa devices can be established more quickly, and the communication coverage of the RA-02 SX1278 LoRa module can be expanded significantly. Apart from that, another recommended alternative is to consider purchasing a LoRa module with a wider range. By using any of these options, improvements in communication efficiency and range can be expected, according to the needs and objectives of implementing LoRa technology.

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