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Analysis of Data Communication on gunshot wound for Fast Fighting Engineering Exercises LoRa 1278 based

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Abstract

To assist soldiers in training agility and accuracy, a technology is needed for movement and targets, many factors need to be considered, such as field conditions, target movement and personnel movement towards the technology used, understanding of shooting theory and the physical and psychological conditions of the personnel themselves. To realize this application, the writer uses communication to move the gunshot wound to be tested using a long-range radio nRF24l01 which functions to send and receive data between the sensor and the gunshot wound, and Lora 1278 is used to transmit data obtained from the detection of microwave radar sensors processed by Arduino which is then sent to the receiver on a gunshot wound. Parameters consisting of throughput, delay, packet loss, RSSI, and SNR greatly affect the quality of data transmission, and from testing the best data quality can be obtained at a distance of 50 meters. Based on the test data for the distance of 80 m, 70 m, and 50 m, the greatest delay value was obtained at a distance of 80 m at 0.143 s, with packet loss of 0.75%.

Keywords: Arduino, Sensor Radar Microwave, Lora 1278, Lcd.

1. Introduction

Soldiers in carrying out exercises to train agility and accuracy in shooting require a concentration of a target. To assist soldiers in training agility and accuracy, a technology is needed for movement and targets, many factors need to be considered, such as field conditions, target movement and personnel movement towards the technology used, understanding of shooting theory and the physical and psychological conditions of the personnel themselves. To realize this application the writer uses communication to move the gunshot wound. It will be tested using a long-range radio nRF24l01 which functions to send and receive data between the sensor and the gunshot wound. by analyzing data communication that has a set point and using TDM (Time Division Multiplexing) in the PDM (Pulse Duration Modulation) method, the results will be obtained from tool testing [m.niswar, et.al, 2013].

The making of this final project is expected to provide benefits for students and universities, it is hoped that in the future it can be developed so that it can be more useful for military institutions, some of the benefits obtained are that this research institution or college can be used as a medium in the teaching and learning process of Control Systems and Electronics. Then add a reference about the science of Control Systems and Electronics for Electrical engineering students, University of Merdeka Malang. For students, this research can be used as a source of information and reference in the context of developing science and technology which is currently developing rapidly. Media that can help students apply the theories that have been obtained and develop skills in the field of electronics. Proceedings of the seminar will be made by directly reproducing the paper that has been submitted by the author without the retyping process, also without changing the format or font size. To ensure clarity in the reproduction process and tidiness of the proceedings, the authors are expected to review them carefully and follow the guidelines.

2. Literature Review

a.1 Data Communication Parameters

The design and research was carried out with reference to the data communication parameters related to Data Communication Analysis on Fire Wounds for the LORA 1278-based Fast Combat Technique Exercise, which are as follows:

a. Delay
Delay is the time delay of a packet caused by the transmission process from one point to another which becomes its destination. (Mey Fenny Wati Simanjuntak, 2016), (Rika Wulandari, 2016)

b. Packet Loss
Packet Loss, is a parameter that describes a condition that shows the total number of packages lost. (puput dani prasetyo adi,akio kitagawa, 2019)

$$Packet\ Loss\ (\%) = \frac{Received\ Data\ (bit) - Data\ Send\ (bit)}{Received\ Data\ (bit)}\ x\ 100\% \qquad [1]$$

c. Throughput
Throughput is a quantity that shows the actual data information bit rate of the bit rate on a telecommunications network. The formula for calculating throughput is as follows:

$$Throughput\ (bps) = \frac{the\ amount\ of\ data\ sent(byte)}{times\ of\ sending\ data\ (s)} \qquad [2]$$

d. RSSI (Receive Signal Strength Indicator)
RSSI Is a parameter that shows the receiving power of all signals. the measured frequency band of the pilot channel.

e. SNR (Signal to Noise Ratio)
SNR is the ratio (ratio) between signal strength (signal strength) and noise strength (noise level).

a.2 LoRa 1287

Incorporates a LoRa™ (Sezana Fahmida,2020) spread spectrum modem capable of longer distances than existing systems based on FSK or OOK modulation. SX1278 offers a choice of bandwidth and spread factors, however, includes lower UHF bands, you can see the LORA 1278 specifications can be seen in the table 1.(Marco Zennaro, 2020)

Table 1. LoRa 1278 Spesification

No	LoRa 1278 Parameter	Spesification
1	Chipset	S X1278
2	Interface	SPI
3	Range	10 Km (LoS)
4	Frequency	433 MHz
5	Signal Power	20 dbm / 100 mW
6	Voltage	1.7 - 3.8V

Microwave Radar Sensor is a sensor module that has been designed as an alternative to PIR motion sensors. Like the PIR sensor, this sensor also detects movement only within the detection range, Microwave Radar Module Specifications can be show in table 2. Lucas (Martins Figueiredo, 2020).

Table 2. Microwave Radar Module Specifications

No	Microwave Radar Parameters	Spesification
1	Supply Voltage	4–28 VDC
2	Frequency	3,2 GHz
3	Transmit power	20 mW / 30 mW
4	Sensing Distance	5–7 meter

The measurements used in this study include testing the functionality and distance of the sensor readings in the gunshot wound as follows:

a. Whole circuit functionality

The functional testing of the automatic system for this firing lesion drive was carried out using the Black Box Testing method. The Black Box Testing method is a testing tool that prioritizes testing the functional requirements of a tool. The purpose of the Black Box Testing method is to find malfunctions in the device.

b. The optimal reading distance measurement in each module
Tests with various variations in the distance of the sensor placement and firing lesions to determine the optimal reading distance for each module, which will later be used as a reference for providing information when the tool is ready for use to achieve practicality in its use.as explained in the introductory chapter, this final project will analyze data communication on gunshot wounds for fast combat training exercises based on LORA 1278 using microwave radar sensors, Arduino Uno, Lora 1278 communications, and DC motors. This circuit is a schematic in the Arduino design with a microwave radar sensor and the Lora 1278 communication module can be seen in Figure 1 and Figure 2.

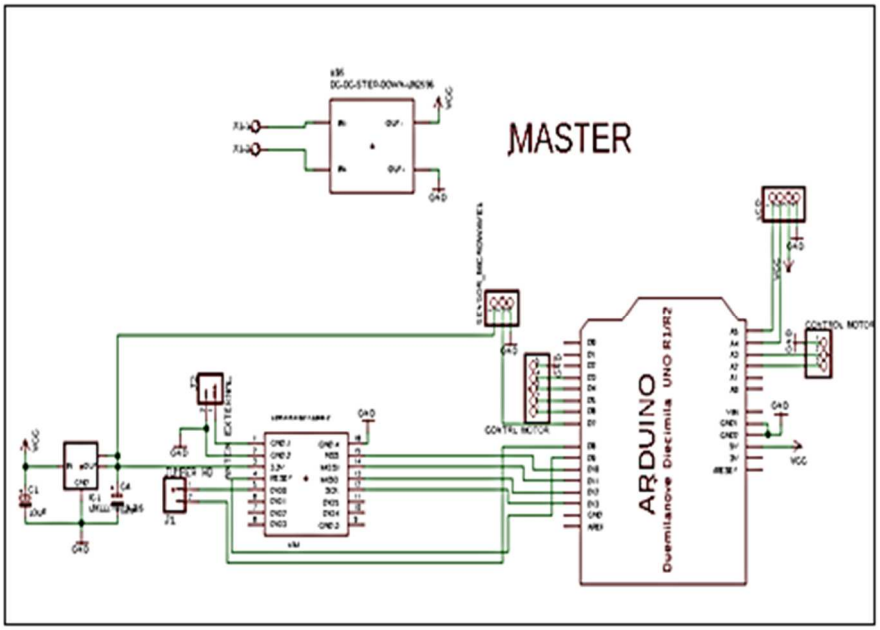

Figure 1. Gunshot wounds Schematics

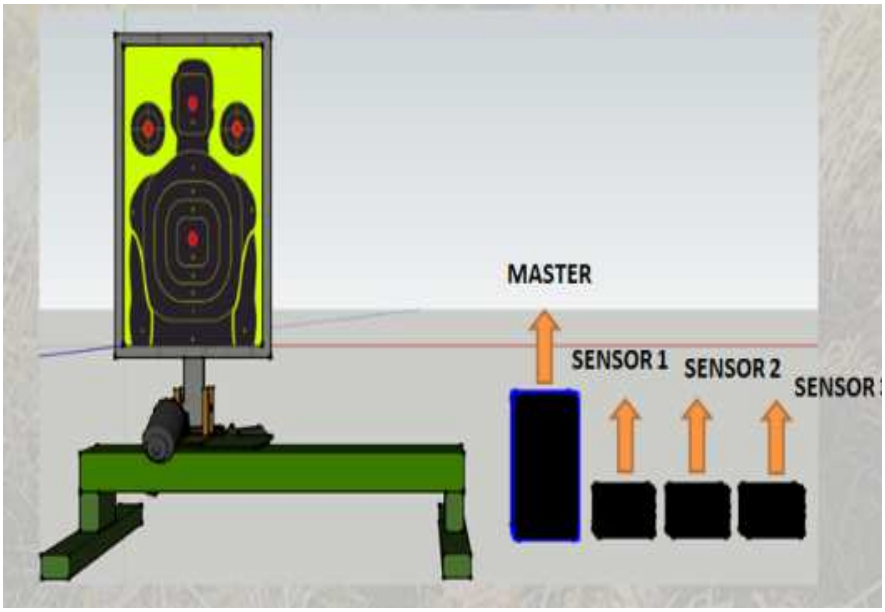

Figure 2. Design Prototype

3. Method, Data, and Analysis

Based on this background, several problems can be formulated as follows:

1. How to test using long-range radio nRF24l01 on sensors and communication LORA 1278 on gunshot wounds with a distance of 80, 70, and 50 meters.
2. How to communicate to the sensor with the firing lesion so that it can detect movement and move the gunshot wound automatically.
3. How to analyze data communication using several parameters, namely delay throughput, packet loss, RSSI, and SNR.

The objectives to be achieved in the making of this final project are to get the maximum results from the data communication analysis process using parameters, i.e., delay, throughput, packet loss, RSSI, and SNR. Furthermore, this discussion can be carried out in a directed manner and as expected, it is necessary to apply the boundaries of the problems to be discussed. The limitations of the problems in this final project include:

1. Analyze parameters based on a distance of 80.70 and 50 meters.
2. The parameters used are delay, throughput, packet loss, RSSI, and SNR.

The writing method used during the preparation and realization of this final project is as follows:

1. The literature study method is carried out by taking related materials from books, the internet, and other sources as references.
2. Research and experiments, by carrying out the research process, design, and mechanical testing made.

The design of this final project research includes a discussion of the Block Diagram and Flowchart tools that have been made. The most important thing that must be considered in making a design is a block diagram that covers the workings of the designed tool, then the characteristics of the components used, the whole block diagram of the sensor part, and the part of the shot using the Arduino Uno microcontroller which has a block diagram shown in Figure 3.

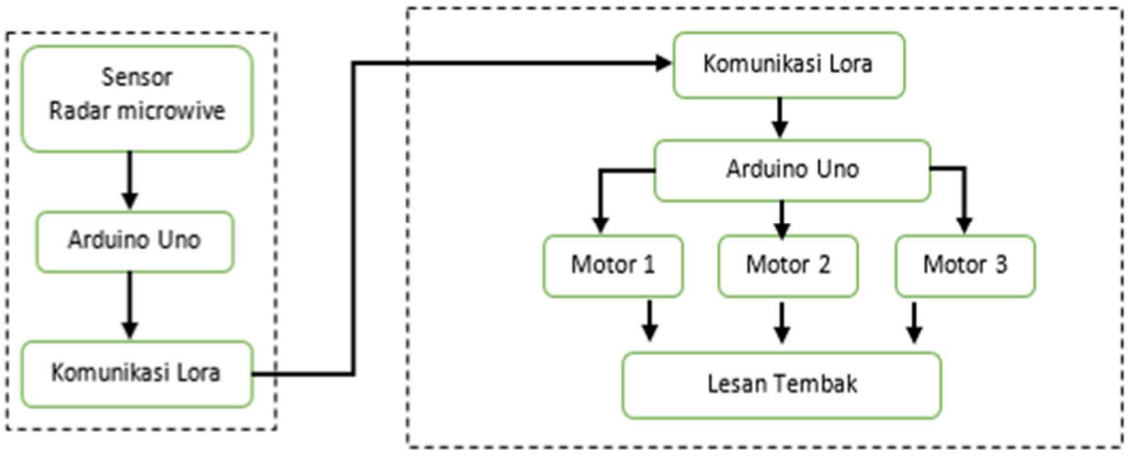

Figure 3. Block Diagram

Figure 3 is a block diagram that describes the work system of the tools used in research and development in this final project is the microwave radar sensor and LoRa communication, the output is a DC motor to drive the gunshot wound. The display of the flowchart [figure 4] can be seen in Figure 5, which explains the initial conditioning of the system and the input that must be done so that the gunshot wound can stand quickly, move right and left with a distance of 1.5 meters, and rotate.

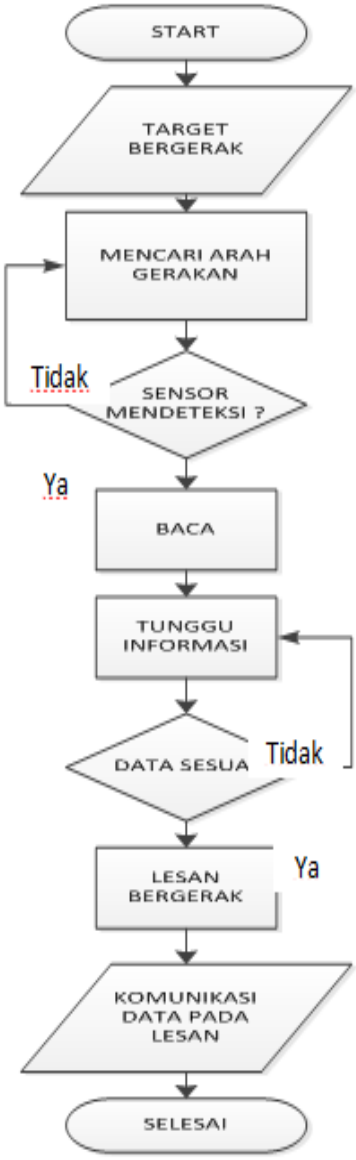

Figure 4. Flowchart of Automatic Drive System on the gunshot wound

If you have received a command from the sensor through Lora's communication, there are 3 sensors used. Where the sensor is placed at a distance of 80 meters, it will give commands to the DC motor to move the gunshot wound to stand upright quickly for 10 seconds. Then the sensor which is placed at a distance of 70 meters will give the order for the gunshot to stand upright and move to the right as far as 1.5 meters after that it returns again to the left and for the sensor, at a distance of 50 meters it will give orders for the gunshot wound to

stand upright, move and rotate. [Arifin Wahid Ibrahim, Triyogatama Wahyu Widodo and Tri Wahyu Supardi, 2016].

Time Division Multiplexing (TDM) is a method of placing multiple data streams in a single signal by splitting the signal into many segments, each of which has a very short duration. The analysis of this tool using the PDM (Pulse Duration Modulation) method to achieve maximum results from the analysis carried out. Block diagrams in the PDM method can be seen in Figure 5. (Ruri Hartika Zain, 2016)

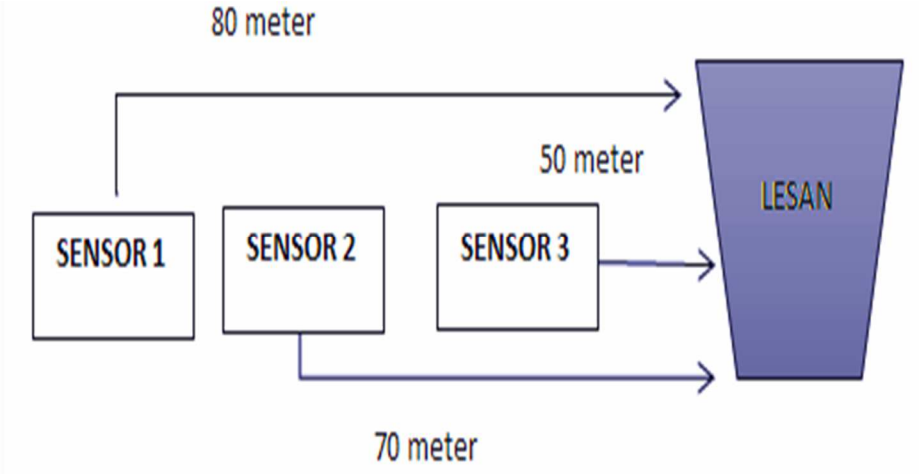

Figure 5.TDM on this research

4. Results

This Microwave Radar Sensor is placed in the area where personnel will pass, equipped with arduino and LoRa 1278 which are used as motion detectors of personnel. This sensor is 35.9 mm long, 17.3 mm wide.

Figure 6. Microwave Radar Sensor

Also made a microwave radar sensor on the firing lesion with. To move the gunshot wound automatically and with different movements at a predetermined distance, i.e., 80, 70, and 50 meters, a microwave radar sensor is used as a motion detector, LoRa 1278 as a data transmitter and receiver, and an ATmega 328 or ATmega 8 microcontroller as a device. input and output control.

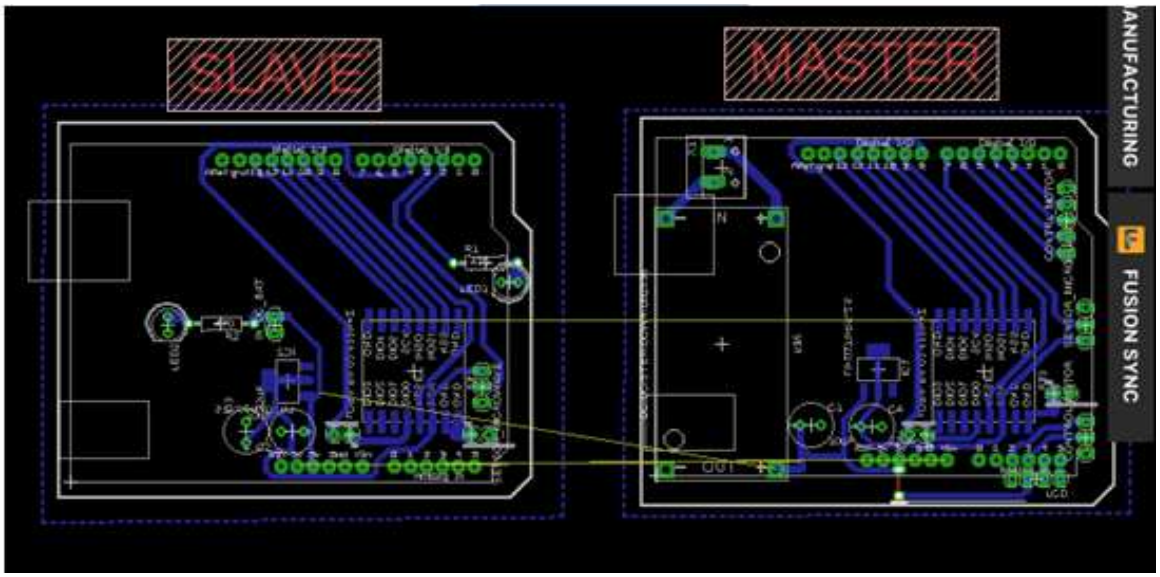

Figure 7. Layout of Master Slave and sensors positioning

Sensor Electrical Characteristics

Power (P) Master On the gunshot wound

Voltage (V) Arduino = 3.3 volts, Voltage (V) LCD = 5 volts, Motor Driver Voltage = 3 volts, LoRa Voltage 1278 = 5 volts, Current (I) Arduino = 4.7 mA, Current (I) LCD = 1.3 mA, Current (I) Motor driver = 5 mA, Current (I) Lora 1278 = 47.2 mA.

Power (P) Sensors at a distance of 80, 70, and 50 meters.

Voltage (V) Arduino = 3.3 volts, Voltage (V) Microwave Radar Sensor = 5 volts, Lora Voltage 1278 = 5 volts, Current (I) Arduino = 5 mA, Current (I) Microwave Radar Sensor = 47.2 mA and Current (I)) Lora 1278 = 5 mA

Table 3. Delay Data result

No	Delay	Total Delay Total	Data Sent
1	80 meter	0.58 s	4
2	70 meter	0.47 s	4
3	50 meter	0.35 s	4

Table 4. Packet Loss Data result

No	Paket Loss	Data send	Data received
1	80 meter	4	1
2	70 meter	4	2
3	50 meter	4	3

Table 5. Throughput Data result

No	Throughput	Data send	Data received
1	80 meter	4	11
2	70 meter	4	10
3	50 meter	4	8

From the Data Table, the following tests are obtained the Testing the sensor at a distance of 80 meters, This test aims to analyze the value of Delay, Packet Loss, Throughput and RSSI (Receive Signal Strength Indicator) and SNR (Signal to Noise Ratio) measurements displayed on the LCD. Data Can be seen in Table 6. Testing data for 80 meters distance with TDM.

Table 6. Testing data for 80 meters distance with TDM

No	Parameter	Value or Unit
1	Delay	0.145 s
2	Packet Loss	0.75%
3	Throughput	0.363mBit/sec
4	RSSI (Receive Signal Strength Indicator)	-31 dBm
5	SNR (Signal to Noise Ratio)	8.00 dB

Testing Sensors at a Distance of 70 meters, This test aims to analyze the value of Delay, Packet Loss, Throughput, and RSSI (Receive Signal Strength Indicator) and SNR (Signal to Noise Ratio) measurements displayed on the LCD. Data can be seen in Table 7. Testing data for 70 meters distance with TDM.

Table 7. Testing data for 70 meters distance with TDM.

No	Parameter	Value or Unit
1	Delay	0.117 s
2	Packet Loss	0.5 %
3	Throughput	0.400mBit/sec
4	RSSI (Receive Signal Strength Indicator)	-35 dBm
5	SNR (Signal to Noise Ratio)	8.10 dB

Testing Sensors at a distance of 50 meters, This test aims to analyze the value of Delay, Packet Loss, Throughput, and RSSI (Receive Signal Strength Indicator) and SNR (Signal to Noise Ratio) measurements displayed on the LCD.Data can be seen in Table 8. Test data for 50 meters distance with TDM.

Table 8. Test data for 50 meters distance with TDM

No	Parameter	Value or Unit
1	Delay	0.08 s
2	Packet Loss	0.25 %
3	Throughput	0.500mBit/sec
4	RSSI (Receive Signal Strength Indicator)	-44 dBm
5	SNR (Signal to Noise Ratio)	8.25 dB

5. Conclusion

Based on the results of planning, designing, manufacturing, working methods, and testing tools, conclusions are drawn. From the results of the automatic firing test results, the response time speed is obtained as follows: 1. Parameters consisting of throughput, delay, packet loss, RSSI, and SNR greatly affect the quality of data transmission, and from testing the best data quality can be obtained at a distance of 50 meters. 2. Based on the 80-meter distance test data with TDM, the delay is 0.143 s, packet loss is 0.75% and throughput is 0.364mBit / sec. 3. Based on the 70-meter distance test data with TDM, the delay is 0.114 s, packet loss is 0.5% and throughput is 0.364mBit / sec. 4. Based on the test data of 50

meters distance with TDM, the delay is 0.143 s, packet loss is 0.25% and throughput is 0.400mBit / sec.

6. Suggestions

1. For the automatic leach to work better and more efficiently in the future, it is necessary to add a specification or type of high-speed torque so that the resulting movement is more accurate.
2. Data communication needs to be improved so that the performance of the device is as expected.
3. In placing the position of the firing lesion, it is necessary to pay attention to possible disturbance factors such as the weight of the lesion, the load force of the lesion after moving, so it is necessary to add a system that can balance the position of the lesion after firing.

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