VOL 4. NO.1, SEPTEMBER 2022
E-ISSN 2686-3278

# PROCEEDING OF

# CONFERENCE ON MANAGEMENT AND ENGINEERING IN INDUSTRY (CMEI) 2022

## INDONESIA 4.0 ACCELERATION

TANGERANG, 21 - 22 SEPTEMBER 2022

MASTER OF MECHANICAL ENGINEERING
SWISS GERMAN UNIVERSITY

## Preface from the Chairman of the Conference on Management and Engineering in Industry (CMEI)

**Dena Hendriana, B.Sc., S.M., Sc.D.**

*Head Department of Master of Mechanical Engineering, Faculty of Engineering and Information Technology, Swiss German University*

Welcome to the fourth Conference on Management and Engineering in Industry (CMEI). This is conference is conducted by Master of Mechanical Engineering in the Swiss German University at Alam Sutera, Tangerang, Indonesia. The conference is open for all academic community to share the knowledge in the areas of management and engineering which are applicable in the industry. It is held on Wednesday, 21 September 2022 in the campus of Swiss German University at Prominence Tower, Alam Sutera. The theme of this conference is “Indonesia 4.0 Acceleration”. This theme is aligned with Master of Mechanical Engineering vision and mission to prepare our students for the era of Industry 4.0 in the global economic.

There are eight papers presented in this event with the topics related to the theme. We thank reviewers who have been working hard to improve the quality of the papers until this conference proceeding ready to be published on time. We thank all the members of the committee who prepare and run the event. We thank Rector, Vice Rectors, and Dean of Faculty of Engineering and Information Technology for their support on this event.

We thank God that we have run the event of the conference smoothly and published the conference proceeding on time. We hope that this event is beneficial for everybody and also the proceeding to be beneficial for the readers.

Best Wishes,

Dena Hendriana, B.Sc., S.M., Sc.D.

CMEI

Conference on Management and Engineering in Industry

**Steering Committee**:

1. Rector, Dr. rer. nat. Filiana Santoso
2. Vice Rector of Academic Affairs, Dr. Irvan S. Kartawiria, S.T., M.Sc.
3. Dean Faculty of Engineering & IT, Dr. Maulahikmah Galinium, S.Kom., M.Sc.

## Organizing Committee

**Chairman:** Dena Hendriana, B.Sc., S.M., Sc.D.

**Secretary**: Dr. Ir. Henry Nasution, M. T.

### Treasurer Procurement:

1. Lestari Nur Wijayanti, S.St
2. Natalia Dharma, S.E
3. Latifah Bahrum, S.E
4. St. Ayu Diana Lestari, S.Pd

### Communication, P.R & Promotion:

1. Irzan Fahmi, S.Kom
2. Somanudin, MM
3. Artauly Blessing Christseptiona, S.Kep., M.M

### IT Infrastructure:

1. Faisal Ifzaldi, S.Hum.
2. Dipl.-Ing. Iqbal, S.Kom

### Reviewer:

1. Dr. Ir. Henry Nasution, M. T. (Swiss German University)
2. Dena Hendriana, B. Sc., S. M., Sc. D. (Swiss German University)
3. Dr. Ir. Gembong Baskoro, M. Sc. (Swiss German University)
4. Dr. Ir. Hanny J Berchmmans, M. Sc. (Swiss German University)
5. Dr. Ir. Widi Setiawan (Swiss German University)
6. Edy Sofyan, B. Eng., M. Eng., Ph. D. (Swiss German University)
7. Dr. Ir. Ary Syahriar (Universitas Al Azhar Indonesia)
8. Dr. Ita Mariza (Politeknik Gajah Tunggal)
9. Dr. Ir. M. Amin Soetomo, M. Sc. (Swiss German University)
10. Dr. Tanika D. Sofianti, S. T., M. T. (Swiss German University)
11. Dr. Eng. Sumarsono, S. T., M. T. (Universitas Mercu Buana)

12. Dr. Eng. Aditya Tirta Pratama, M. T. (Swiss German University)
13. Dr. Eka Budiarto, S. T., M. Sc. (Swiss German University)
14. Dr. Eng Cuk Supriyadi Ali Nandar (Agency for the Assessment & Application of Technology - BPPT)

## Moderator:

1. Dena Hendriana, B.Sc., S.M., Sc.D.
2. Dr. Ir. Henry Nasution, M. T.

## Proceeding:

1. Dena Hendriana, B.Sc., S.M., Sc.D.
2. Dr. Ir. Henry Nasution, M. T.

## Registration & Certificate:

1. St. Ayu Diana Lestari, S.Pd
2. Irzan Fahmi, S.Kom

Conference on Management and Engineering in Industry

# CMEI 2022 PROGRAM

## 21- 22 September 2022

**Date: 21 September 2022**

| Time | Location | Activities |
|---|---|---|
| 08.00 – 08.30 | Google Form | Registration |
| 08.30 – 08.35 | Main Room | National Anthem: Indonesia Raya |
| 08.35 – 08.40 | | Opening by MC |
| 08.40 – 08.43 | | Praying |
| 08.43 – 08.47 | | Report by Chairperson |
| 08.47 – 08.51 | | Report by Conference Chair |
| 08.51 – 08.55 | | Welcoming Address by The Rector |
| **Keynote Session** | | |
| 08.55 – 09.27 | Main Room | Keynote Speaker 1<br>**Johnny G Plate, S.E.**<br>Minister of Communication and Informatics Republic of Indonesia |
| 09.27 – 09.59 | | Keynote Speaker 2<br>**Dr. R. Hendrian, M.Sc.**<br>Deputy for Utilization of Research and Innovation, BRIN |
| 09.59 – 10.13 | | Break |
| 10.13 – 10.33 | | Plenary Speaker 1<br>**Dr. Nuki Agya Utama**<br>Executive Director of the ASEAN Centre for Energy (ACE) |
| 10.33 – 10.53 | | Plenary Speaker 2<br>**Dr. Waseem Haider**<br>School of Engineering and Technology, Central Michigan<br>University, USA |
| 10.53 – 11.23 | | Q & A Plenary Session |
| 11.23 – 11.43 | | Seminar by Sponsor |
| 11.43 – 13.00 | | Break |
| 13.00 – 15.40 | **Parallel Session** | |
| 15.40 – 15.45 | **Announcement of the Best Paper<br>(Head of Master Mechanical Engineering** | |
| 15.45 – 15.55 | **Closing of the Seminar<br>(Head of Master Mechanical Engineering)** | |

# CMEI 2022 Parallel Session

**Date: 21 September 2022**
**Room: Breakout Room (Zoom)**

**Moderator: Dr. Henry Nasution**

| Time | Presenter | Title |
|---|---|---|
| 13.00 – 13.20 | **Firdaus Agung Syafutra**, Gembong Baskoro, Aditya Tirta Pratama | Relationship Between Productivity and Employee Involvement at PT. UTX Site TGR |
| 13.20 – 13.40 | **Rustanto**, Gembong Baskoro, Aditya Tirta Pratama | Improving Maintenance Strategy Scania R580 by Using FMEA in Full Maintenance Contract PT. SIS Adaro |
| 13.40 – 14.00 | **Willian Septianuggraha M.**, Tanika D Sofianti, Gembong Baskoro | DFMEA, PFMEA for Improving Maintenance Program of Hydraulic Spare Parts: A Case Study in Indonesia Heavy Equipment Distributor Company |
| 14.00 – 14.20 | **Himawan Kunto D.A.**, Henry Nasution, Dena Hendriana | Design and Development Vehicle Anti-Collision Warning System |
| 14.20 – 14.40 | **Nelson Purba**, Henry Nasution, Widi Setiawan | Application of Computer Vision for Counting Oil Particle Contaminants |
| 14.40 – 15.00 | **Syaifuddin Zuhri**, Dena Hendriana, Henry Nasution | Lapping Machine with Arduino for Overhaul Hydraulic Pump at Small Hydraulic Excavator Komatsu |
| 15.00 – 15.20 | **Hery Cahyadi**, Henry Nasution, Cuk Supriyadi Ali Nandar | Drowsiness Detection with Computer Vision for Heavy Equipment Hauler |
| 15.20 – 15.40 | **Yudhistira Nizar**, Dena Hendriana, Hanny J. Berchmans | Automatic Warning System to Prevent Collisions and Provide a Safe Distance Between Heavy Duty-Trucks |

# Content

is very dense. Accident rates also tend to increase and it is necessary to anticipate early. whether caused by unsafe conditions or unsafe acts. Any portion from 2019 to 2021 recorded KTA 52%, TTA 48% is shown in Fig. 1.

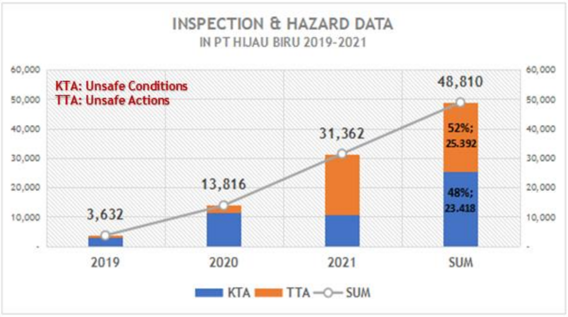


Fig. 1. Inspection and hazard data 2019 - 2021

Property damage due to by collision between heavy duty-trucks in haul road accours almost every year is shown in Table 1. The factors that cause accidents can be categorized into four aspects, namely operator habits, skills, not yet facilitated a good safety system, and problematic products, for example brake components [1-2]. The collision incident indicated that there was a potential for negligence on the part of the operator in maintaining a safe distance while driving and maintaining the engine speed. Either when the condition is moving or stationary or parking.

TABLE I
PROPERTY DAMAGE IN HEAVY DUTY-TRUCKS

| YEAR | PICTURE | DESCRIPTION | AMOUNT - IDR | LOST TIME |
|---|---|---|---|---|
| 2019 (TR-3285 vs TR-3287) |  | **Accident Property Damage, Human & Environment Safe.** Operator A decides to maneuver the dump truck instantly when he sees the potential for rain and slips as well as the position of the downhill road. Operator B in the back had communicated via radio so as not to maneuver until the road was level, but the operator of unit A had turned the steering wheel and a collision was unavoidable. | 17.865.141 | 10 Days |
| 2019 (TR-3283 vs TR-3014) |  | The operator did not realize that when maneuvering the dump truck, the position of his unit was at an unsafe distance from the unit on his right which was also in the same queue position for loading coal. The operator focused on his coffee bottle which he put down while he was maneuvering and a collision was unavoidable. | 4.810.925 | 5 Days |
| 2020 (TR-3299 vs TW-3006) |  | **Accident Property Damage, Human & Environment Safe.** Operator A dump truck waiting at the crossroads to exit the parking lot shortly after picking up the unit for operation. Unbeknownst to operator A, another unit from the direction of the main road moved (a smaller unit of measure) and finally a collision occurred. | 321.817.246 | 28 Days |
| 2020 (TR-3275 vs TR-3215) |  | **Accident Property Damage, Human & Environment Safe.** Operator did not realize that there was a parking unit behind the machine he was driving. When starting work activities, the operator moves the machine that is currently parked to exit the parking area by moving backwards first. | 96.000.000 | 20 Days |
| 2021 (TC-3089 vs TC-3125) |  | **Accident Property Damage, Human & Environment Safe.** Operator was late in anticipating a collision with the braking process within the safe distance allowed on the machine. Even though the brake system on the machine has been activated suddenly, it still cannot make the machine stop at the desired position. | 2.500.000 | 3 Days |
| | | | **442.993.312** | **66 Days** |

* Corresponding Author | Dena Hendriana | Email: dena.hendriana@sgu.ac.id

PT Berau Coal as one of the mining bowheers in Berau regency has formulated a safe driving method by setting a minimum distance between heavy duty-trucks.


Fig. 2. Safe driving distance

Operator of vehicles/units on coal hauling roads must keep their distance the vehicle/unit is safe not less than 50 meters from the vehicle/unit in front of it (Fig. 2). Especially for double trailers, the vehicle/unit safe distance is not less than 180 meters from the vehicle/unit in front. Drivers of vehicles/units in the pit area and mine road (mine road) must keep the safe distance of the vehicle/unit is not less than 40 meters from the vehicle/unit in front.

In addition to setting a safe driving distance between heavy duty-trucks in the mining area, Bowheer also requires that each heavy duty-trucks be facilitated by radio communication. This function is used to carry out two-way coordination between operators and field supervisors when they want to carry out certain activities, such as overtaking heavy duty-trucks in front of them, entering intersection locations, being at points that have potential accident hazards, and so on. Apart from that, the communication support infrastructure in mining areas is not as ideal as in public areas. It is very difficult to get an internet network to improve communication skills. In addition to using radio frequency signals, generally with the application of good mining practices to support production performance and ideal operational safety.

However, in reality, the conditions in the field are difficult for operators to determine and estimate the safe distance between heavy duty-trucks, whether visible or not. Operators are still limited to using radio communication facilities and signs provided in mining areas, while heavy duty-trucks have not been facilitated by technology to avoid collisions.

## II. METHODS

Research on the prevention of collision accidents in heavy duty-trucks by using an experimental mechatronic-based automatic warning system with direct simulation method on Komatsu Dump Truck HD785-7. The design of this study is an experimental design because wants to measure the work of the safe driving distance warning system, both from the distance information between heavy duty-trucks that is given to the operator and the audible signal according to the calculation considerations based on the maximum heavy duty-trucks speed variable permitted in mining and the respond time of an operator to the activating system on machine.

### *A. Conceptual Design*

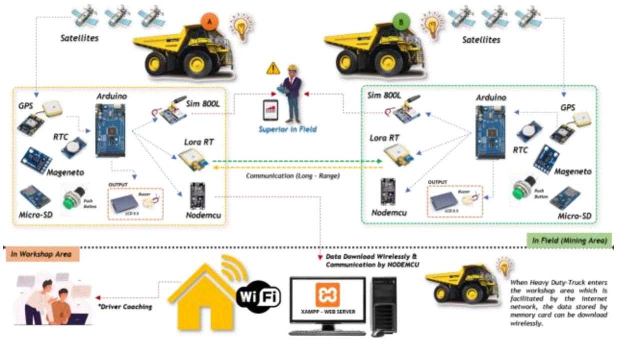


Fig. 3. Concept of how the system works

Based on the illustration in Fig. 3, it is explained that the series of tools in each unit of heavy duty-trucks. The way this tool works is that the GPS (Global Positioning System) sensor contained in the tool will read the position of the signal emitted by the satellite, then translate it into a location on the earth's surface in the form of longitude, latitude, and altitude data [3-7]. This data will be processed by the Arduino controller using the formula that has been entered into the program to calculate the distance. Each device will send a data signal obtained by the GPS Sensor using LoRa (Long Range) which will later be converted into the distance between connected or communicating heavy duty-trucks. After going through the calculation process, the distance between heavy duty-truck is displayed on the LCD TFT layer. When the distance between heavy duty-truck is within an unsafe radius according to the settings or menu selected, there will be a warning sound for the operator to anticipate early. The menu options for detecting safe driving distances are adjusted to PT Berau Coal's regulations, namely 40, 50, and 180 meters, but in setting the program uses a speed unit reference, namely distance to time as well as the response from the operator and the system response in the tool. Then take into account the maximum driving speed at 60 km/h and the accuracy of the GPS sensor accuracy level at an average of 10 meters. The calculation is as follows Table 2:

TABLE II
CALCULATION FOR PROGRAM SETTINGS ON ARDUINO

| Deskripsi Area | Mode (m) | Speed Max. (kph) | Akurasi GPS (m) | Rules (s) | Setting Program Arduino (m) |
|---|---|---|---|---|---|
| Pit/Mine Road | 40 | 60 | 10 | 5 | 93.6 |
| Hauling Road | 50 | 60 | 10 | 5 | 117 |
| Double Trailer | 180 | 60 | 10 | 5 | 421.2 |

The formula also uses the three-second principle, the driver must also know the human reaction and the mechanical reaction or system of the vehicle. Human reaction is when you want to stop or dodge or reduce speed. Starting from the eye to see, the brain processes, until stepping on the brakes takes approximately one second. While the mechanical and hydraulic reaction occurs when the brakes are applied, with an estimated time of approximately half a second. The conclusion from this explanation is that it takes min. 4.5 – 5 seconds to set the anticipated distance when driving so that if the vehicle speed is at 60 km/h with anticipation of 5 seconds, the minimum safe driving distance is 5 s times 16.7 m/s = 84 meters (minimum).

This tool is also equipped with several additional facilities, namely sending messages automatically to field supervisors via GSM (Global System for Mobile Communications) signals for information on unsafe distances from a heavy duty-truck when driving. In addition, a compass or magnetometer sensor component to determine the direction of movement of the tools installed in other heavy duty-trucks. Then, the distance data between heavy duty-truck is stored on a memory card and can be uploaded to a cloud system using nodemcu to be accessed and downloaded using the web server [8].

## B. *Flow and Block Diagram*

The work flow of this tool is when it is installed in heavy duty-trucks using a voltage source from the machines is shown in Fig. 4. However, also provides a source from three batteries (3.7 Volt per piece) as backup power when there is a problem with the voltage source in heavy duty-trucks.

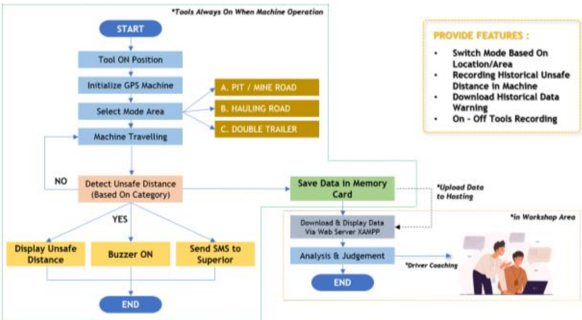


Fig. 4. Flow diagram of the tool system

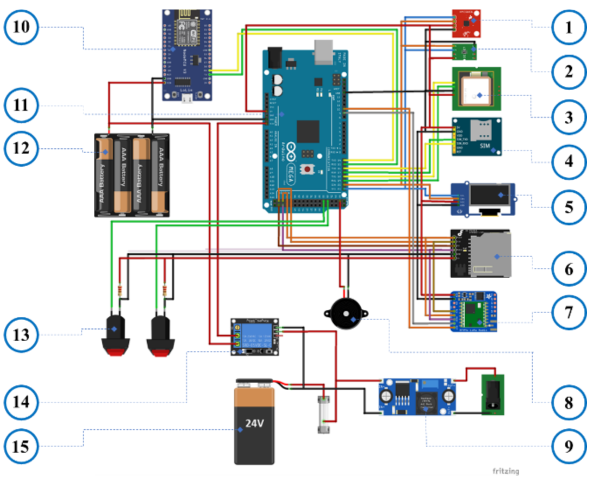


Fig. 5. Block diagram of the tool

Fig. 5 explains that the battery (15) is the main source of the device's core voltage from the heavy duty-trucks. The actual power supply is 24 volts with 4 batteries in series and parallel. the input connection to the microcontroller (11) is lowered using a step down (9) to obtain the working voltage requirement of the component. In addition, the input voltage to the microcontroller (11) was previously required to go through a 24-volt relay (14) as a component that functions to change the voltage to (12) a 11.1-volt (3 x 3.7 volt) series battery. This backup battery serves to replace power from the heavy duty-trucks battery when the voltage drop occurs (eg someone disconnects the voltage source) so that power can still be supplied to the microcontroller (11). With this, it has also put a program so that when this event occurs, there will be information that can be provided by the microcontroller (11) to the superior via the GSM module (4) and the data is stored in the micro SD card memory (6).

In the process of developing the Arduino program, namely the management data logger which aims to stabilize the process of sending and receiving unsafe distance data using LoRa and reducing the memory load from the Arduino mega process and memory card. The logical sequence plan is as follows in Table 3:

TABLE III
LOGICAL SEQUENCE OF LOGGER DISTANCE DATA AND MESSAGE VIA GSM

**Distance Data** — Mode : 40 Meter **Example*

| Distance (m) | Data Log | Remark |
|---|---|---|
| 50 | 1 | Send Data during 10 Seconds |
| 40 | 1 | |
| 39 | 1 | |
| 29 | 1 | |
| | | |
| 10 | 1 | Send Data during 10 Seconds |
| 5 | 1 | |
| | | |
| >40 | 0 | Reset |
| 40 | 1 | Re-send Data for 10 Seconds if Not Out of Mode |
| 38 | 1 | |
| 20 | 1 | |

**Message Data** — Mode : 40 Meter **Example*

| Distance (m) | SMS | Remark |
|---|---|---|
| 50 | 0 | No Message |
| 40 | 1 | Send One Time |
| 39 | 0 | |
| 29 | 0 | |
| | | |
| 10 | 0 | No Message |
| 5 | 0 | |
| | | |
| >40 | 0 | Reset |
| 40 | 1 | Back to Sending Only Once |
| 38 | 0 | |
| 20 | 0 | |

*especially the data received by LoRa will run continuously

## C. *Sensor Working Test*

Validation the core components before assembly process is carried out in order to avoid failure. Consist of GPS Sensor, LoRa Module, NodeMCU, and GSM Module. The testing process is carried out on a test bench (partial) as in Fig. 6 and using a standard program from the default Arduino IDE.

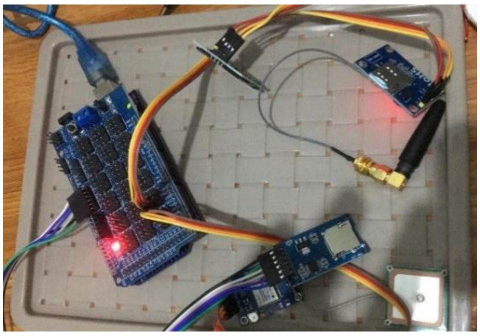

Fig. 6. Component test and evaluation before assembly

First of all, do a test on the GPS Sensor component using the Arduino IDE software. Obtained the following data as in Fig. 7.

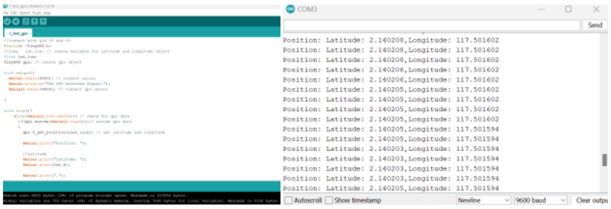

Fig. 7. Tes GPS sensor via arduino IDE

GPS managed to capture the position signal from the satellite and displayed on the Arduino IDE serial monitor. It is presented in the form of a location with details in the form of altitude and longitude from where the testing is carried out so that the GPS sensor is functionally declared good. Then, try to randomly validate the data read by the GPS sensor, the coordinates of latitude and longitude (2.140206, 117.501602), then enter it into a google map as in Fig. 8 to ensure that the GPS sensor reading is following the location of the test and evaluate the sensor.

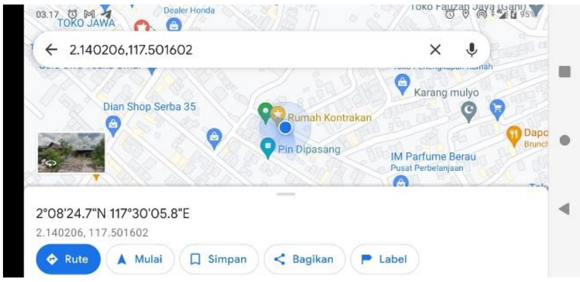


Fig. 8. Sample point conversion of GPS sensor readings via Google map

Second, conducted a test on the LoRa Module component. The type of LoRa used is a transceiver. LoRa can function as a communication tool by sending data as in Fig. 9 and by receiving data from other LoRa as in Fig. 10. It can be seen through the serial monitor display on the Arduino IDE that LoRa works well.

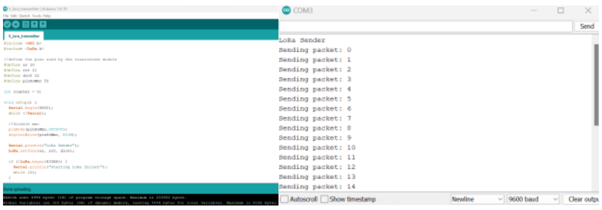

Fig. 9. LoRa communication sending data

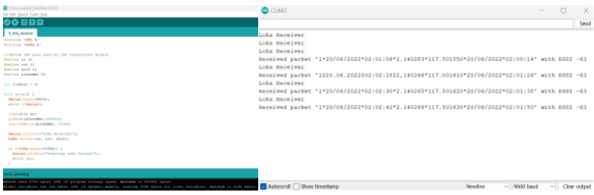

Fig. 10. LoRa communication receive data

Third, Tested NodeMCU connection with WIFI. On the serial monitor it can be seen that the NodeMCU has been connected to the IP Address of the WIFI which has been entered into the Arduino IDE program as in Fig. 11. It is hereby declared that NodeMCU is in good condition to perform the connection function.

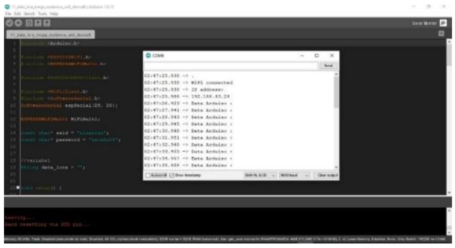

Fig. 11. NodeMCU connection function with WIFI

Fourth, based on this initial setting process, on the Arduino IDE serial monitor, it can be concluded that the SIM 800L is functioning properly and is ready to send messages to the specified telephone number as in Fig. 12.

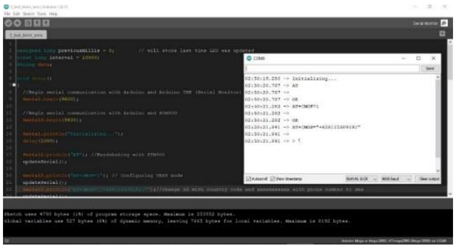

Fig. 12. SIM 800L connection function with arduino and phone number

## *D. Device Assembly*

Fig. 13 shows components are assembled in boxes with dimensions that are large enough and are fastened using screws along with the base. In addition, during the assembly process, the connection between cables is always ensured.

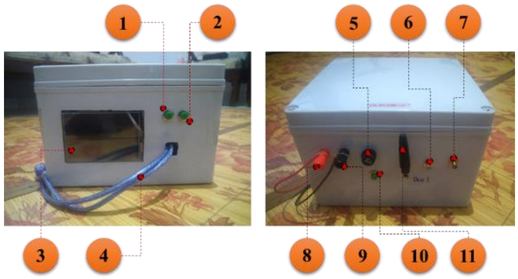


Fig. 13. Attribute description on hardware

Button (1) is used to select 3 variations of distance modes, namely 40, 50, and 180 meters. The button (2) is used to enter the data upload menu to the web server by pressing it three times to enter the menu and pressing it again to upload it. (3) is a 3.5" LCD TFT and (4) is a cable for program settings on Arduino Mega 2560 and NodeMCU ESP8266. The back of the device is (5) a safety fuse for the device in case of current that exceeds the threshold, (6) the connection port for the LoRa (Transceiver) antenna, and (7) the GPS antenna connection port. For (8) and (9) are connections to the 12/24 Volt heavy duty-trucks battery power source. The button (10) is used to reset the device in case of an error and (11) the

GSM SIM800L antenna. The following is a display of the tool's LCD TFT and its description is shown in Fig. 14:

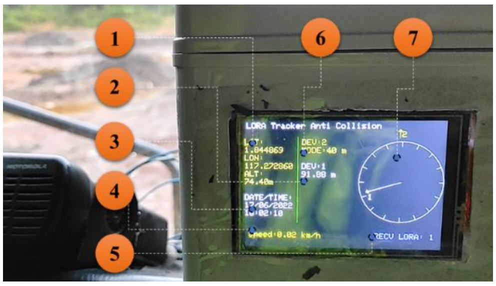


Fig. 14. Tool screen display via LCD TFT

Indicator (1) is a reading from the GPS sensor related to the location of heavy duty-trucks on which the device is installed. (2) is the distance between the device and the equipment installed in other heavy duty-trucks. (3) is the time presented by the RTC, (4) the speed reading of the heavy duty-trucks that is installed on the device, (5) the LoRa indicator for sending and receiving data, and (6) the distance setting mode according to the driving area, and (7) describing the position of other equipment against device installed in heavy heavy-trucks.

## III. RESULT AND DISCUSSION

The tool is installed directly on the Dump Truck HD785-7 (Fig. 15). The need to analyze the accuracy in tool placement will also affect the operator's performance when driving, especially regarding visibility. The tool is installed using a bracket that has been designed and measured in advance so that it can meet the expectations when it is implemented on the HD785-7 (Fig. 16).


Fig. 15. Installation process in dump truck HD785-7

Fig. 16. Tool ready in dashboard dump truck HD785-7

### A. *First State Result*

The overall function of this tool after being installed in the unit is in good condition and can work as planned. The size of the HD785-7, full metal, and the difficulty of internet signaling in the field has not had a significant impact on the performance of the tool as in Table 4.

TABLE IV
RESULT OF TOOL WORK IN A MINING AREA

| Component | Cabin Room Temperature – with AC (ºC) | Status | Remark |
|---|---|---|---|
| GPS Sensor | 27 | Good | Data Satellite Received |
| LoRa RT | 27 | Good | Data Send and Received |
| RTC | 27 | Good | Show Time |
| Distance | 27 | Good | Displayed |
| GSM SIM 800L | 27 | Good | SMS Sending |
| Compass | 27 | Good | Displayed |
| Buzzer | 27 | Good | Working |
| NodeMCU | 27 | Good | Working in Workshop |

### B. *Second State Result*

Entered an unsafe distance, in addition to getting a warning buzzer, then supervisors received a warning notification via an SMS message that entered the GSM card for the condition of the two HD785-7 is shown in Fig. 17. Supervisors can immediately contact the operator via radio channel to ask questions and remind them to maintain a safe distance while driving.

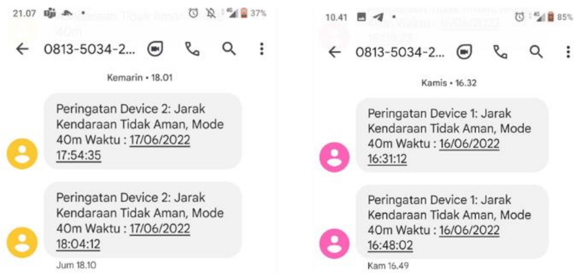


Fig. 17. SMS notification when distance is not safe

### C. *Third State Result*

experimenting to upload data on a micro SD card memory to hosting using a WIFI workshop. Then, use the internet network to access the XAMPP web server portal to download historical event data is shown in Fig. 18 and Fig. 19.

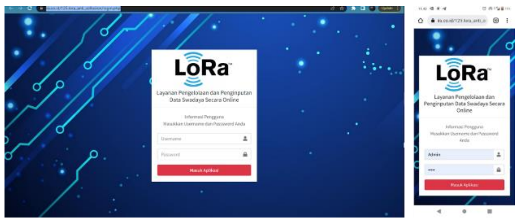


Fig. 18. Display XAMPP support download data

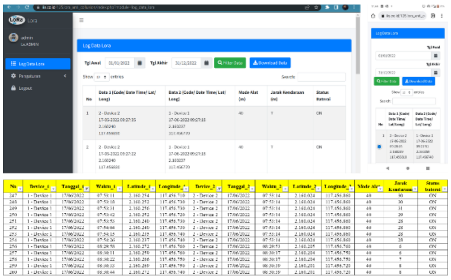

Fig. 19. Display in XAMPP and data download results

### D. *Fourth State Result*

During this testing, the operator felt that the sound produced by this tool was quite helpful in increasing alertness while driving. However, sometimes the sound is quite disturbing and this becomes input for the next experiment in setting the sound intensity through the Arduino IDE program. Then, there is a field constraint that have not received field data regarding the buzzer function when in 180-meter mode, because it is only allowed to take data with a limited area (max. 250 meters) as Table5 and Fig. 20.

TABLE V
CONCLUSION OF APPLICATION TOOL IN HD785-7

| Operator | Area Mode (m) | Setting (m) | Distance (m) | Buzzer | Remark |
|---|---|---|---|---|---|
| Mustofa | 40 | 93.6 | 25 | Active | Anticipation |
| Mustofa | 40 | 93.6 | 50 | Active | Anticipation |
| Mustofa | 40 | 93.6 | 75 | Active | Anticipation |
| Mustofa | 40 | 93.6 | 100 | Non-Active | >93.6 |
| Mustofa | 40 | 93.6 | 125 | Non-Active | Normal |
| Mustofa | 40 | 93.6 | 150 | Non-Active | Normal |
| Mustofa | 40 | 93.6 | 175 | Non-Active | Normal |
| Mustofa | 40 | 93.6 | 200 | Non-Active | Normal |
| Mustofa | 40 | 93.6 | 225 | Non-Active | Normal |
| Mustofa | 40 | 93.6 | 250 | Non-Active | Normal |
| Mustofa | 50 | 117 | <117 | Active | Anticipation |
| Mustofa | 180 | 421.2 | - | - | - |

Fig. 20. Description of tool works according to mode

## IV. CONCLUSION AND RECOMMENDATION

### A. *Conclusion*

This study aims to provide and test the safety distance information function through the display on the LCD TFT as well as a warning buzzer to the operator when in an unsafe driving distance between heavy duty-trucks.

According to the findings of the research, the GPS sensor has successfully read the position of the heavy duty-trucks. LoRa via radio frequency can function to send and receive data from other heavy duty-trucks. The warning buzzer function can work effectively when the distance between heavy duty-trucks is in a dangerous position. Notification of unsafe distance to supervisors in the field via message/SMS can function properly according to the data transmission order setting. Data stored on micro SD memory can be uploaded using NodeMCU and downloaded via the XAMPP web server.

Using the rules of 3 seconds of human response and a range of 2 seconds of system response on the machine mechanism, converted in coding on Arduino to become a warning sound when approaching an unsafe distance, can have a positive impact on operators to be more alert or anticipate maintaining a safe distance when driving.

### B. *Recommendation*

The use of components in this prototype needs to be improved in terms of specifications so that it is more accurate (Example : GPS sensor and LoRa).

The industrial quality of the components will also affect the durability of the tool so that it can increase user confidence and feel the benefits on an ongoing basis.

Currently the prototype is still standing alone to be able to work optimally. With the LoRa Gateway, it will ease LoRa's work in communicating between heavy duty-trucks and can also increase the communication range between large and simultaneous heavy duty-trucks.

LoRaWAN (Long Range Wide Area Network) is one of the options for additional tools in subsequent research for the development of a communication system on LoRa based on network protocols so that it can serve longer ranges and serve many nodes. A standardized tool so that it can interact and connect with product functions and other systems such as IoT applications through network servers in the cloud via backhaul in the form of ethernet, wifi, satellite, or cellular/GSM).

## REFERENCES

[1] Afonso, F., Faus, M., and Useche, S., A., “The closer… the unsafer: may the lack of safe distance be a silent contributor to the burden of traffic crashes in Spain?”, *Cuadernos Latinoamericanos de Administración*, 16 (30), pp. 1-13, 2020.

[2] Chen, C., Liu, L., Du, X., Pei, Q., and Zhao, X., “Improving driving safety based on safe distance design in vehicular sensor networks”, *International Journal of Distributed Sensor Networks*, 2012, pp. 1 - 13, 2012.

[3] Oklilas, A., F., Siswanti, D., S., and Rachman, M., D., “Accuracy of GPS readings on sndroid for location-based service (Case study: location information of SMA in Palembang)”, *Jurnal Ilmu Komputer dan Agri-Informatika*, 4 (1), pp. 1 - 5, 2017

[4] Leick, A., “Gps Satellite Surveying,” John Wiley & Sons, 2004.

[5] Gregory T. French, “Understanding the GPS, an Introduction to the Global Positioning System What It is and How It Works,” GeoResearch, 1996.

[6] Harry Patmadjaja, “Mencari penyebab kecelakaan di jalan tol Surabaya-Gempol dengan analisa frekuensi dan crosstabulation”, *Dimensi Teknik Sipil*, 1 (2), pp. 81-91, 1999.

[7] Pratap Misra and Per Enge, “Global Positioning System: Signals, Measurements and Performance”, Ganga-Jamuna Press, 2001.

[8] Sembiring, J. D., Baskoro, G., and Berchmans, H. J., “Design and simulation of engine operation temperature monitor and control system by using internet of thing,” Proceedings of The Conference on Management and Engineering in Industry (CMEI 2019), 1 (1), pp. 9-12, 2019.