Jurnal E-Komtek
Vol. 7, No. 2 (2023) pp. 278-290
https://jurnal.politeknik-kebumen.ac.id/index.php/E-KOMTEK
p-ISSN : 2580-3719 e-ISSN : 2622-3066

Prototype of Riding Accident Detection System Using R3 SMD Microcontroller Based on GPS and IoT

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https://doi.org/10.37339/e-komtek.v7i2.1526

Published by Politeknik Piksi Ganesha Indonesia

Artikel Info
Submitted:
15-11-2023
Revised:
29-11-2023
Accepted:
30-11-2023
Online first :
12-12-2023

Abstract

The incidence of road accidents is quite high. This is due to driver negligence. Based on these problems, a driving accident detection system was created. The system uses vibration sensors, tilt sensors, and pressure sensors as inputs to detect driving accidents. The system is supported by an Arduino uno kit with an R3 SMD microcontroller as the brain to process data from vibration, tilt, and pressure sensors, and is equipped with GPS and ESP32. Then, the output to ESP32 will send notification information to Telegram by detecting GPS, so that it will automatically send notification of driving accident coordinates. From the making of this system, it can be concluded that, if a driving accident occurs, it will automatically send information directly to the victim's family quickly. The system will work if the sensor is detected and will send data to the phone number stored in the database. So that victims can be handled more quickly to avoid casualties.

Keywords: Arduino Uno, Driving Accident, Detection System, GPS, IoT

Abstrak

Kejadian kecelakaan di jalan cukup tinggi. Hal ini disebabkan karena kelalaian pengendara. Berdasarkan permasalahan tersebut, maka dibuatlah sebuah sistem pendeteksi kecelakaan berkendara. Sistem yang dibuat menggunakan sensor getaran, sensor kemiringan, dan sensor tekanan sebagai input untuk mendeteksi kecelakaan berkendara. Sistem ini didukung oleh kit Arduino uno dengan mikrokontroler R3 SMD sebagai otak untuk mengolah data dari sensor getaran, kemiringan, dan tekanan, serta dilengkapi dengan GPS dan ESP32. Kemudian, output ke ESP32 akan mengirimkan informasi notifikasi ke Telegram dengan mendeteksi GPS, sehingga secara otomatis akan mengirimkan notifikasi koordinat kecelakaan berkendara. Dari pembuatan sistem ini dapat disimpulkan bahwa, jika terjadi kecelakaan berkendara, maka secara otomatis akan langsung mengirimkan informasi langsung kepada keluarga korban dengan cepat. Sistem akan bekerja jika sensor mengalami pendeteksian dan akan mengirimkan data ke nomor telepon yang tersimpan dalam database. Sehingga korban dapat ditangani lebih cepat agar tidak terjadi korban jiwa.

Kata-kata kunci: *Arduino Uno, Kecelakaan, Sistem Deteksi GPS, IoT*

1. Introduction

Motorized vehicles in Indonesia have become public facilities that are often used as a means of daily transportation for people from the upper middle class to the lower classes who own motorized vehicles [1]. Every household has more than one motorbike. A traffic accident can be defined as a surprising and unintentional event that occurs on a highway, including vehicles with or without other road clients, which can cause loss of life or material misfortune [2]. One factor that triggers accidents is the driver's speed, road/environmental conditions and the driver's level of knowledge [3]. On the other hand, technological advances are possible in various ways and are connected to Android mobile devices, making it easier for users to do anything, including devices that can support information while driving [4]. This is one of the ideas for the author to research moving accident detection [5].

The design describes plans and sketches or arranges several separate elements into a complete and functioning unit. Thus, the definition of design is the activity of translating the results of analysis into the form of a software package and then creating the system or improving an existing system [6]. Motorbikes still dominate the number of traffic accidents in Indonesia. Based on data from the National Police of the Republic of Indonesia [7]. Based on accident data from the Kendal Police, throughout 2019-2021, there have been 341 accidents on national roads in Kendal Regency. Of the 341 accidents, 132 victims (32%) were declared dead. This shows that the fatality rate for traffic accident victims is still very high. Therefore, it is necessary to analyze accident-prone sections (blacklinks) on national roads in Kendal Regency to increase the level of road safety in Kendal Regency [8-9].

In this case, if a driving accident occurs, you don't know what the conditions on the road are like [10]. How can you ensure that when you fall, lose your communication equipment, have an accident, become unconscious or even cause death or material misfortune, the family immediately gets information with Maps supporting the location, which will automatically provide news to the closest family that a traffic accident has occurred to the vehicle user? The. The family knows the conditions in which a traffic accident occurs [11-12].

Therefore, researchers created an innovation, namely a GPS and IoT-based Driving Accident Detection System using a microcontroller as a sensor [13]. The microcontroller works based on the program (software) embedded in it, and the program is made according to the desired application. Microcontroller applications typically relate to reading data from outside and controlling external equipment [14].

If a traffic accident occurs, it will provide direct information to the family that a traffic accident has occurred [15]. Several sensors are used in the system, namely Pressure, Vibration and Tilt sensors. If a collision or fall occurs, these sensors will be detected and immediately inform the family [16] so that you can respond quickly to take care of your family when a traffic accident occurs and prevent undesirable things from happening.

2. Method

2.1 Prototype Design

To perfect the application that will be created, a method is needed to create a system that will later become software, which is used to be more efficient, environmentally friendly, and easily used by anyone. In doing this, system development is required, which can mean developing a new system to replace the old one or improve the existing one. The old system must be repaired or returned for several reasons [17]. The method used to create this application is the Research and Development (R&D) development method, and for the system, the Prototype method is used, which is shown in Figure 1.

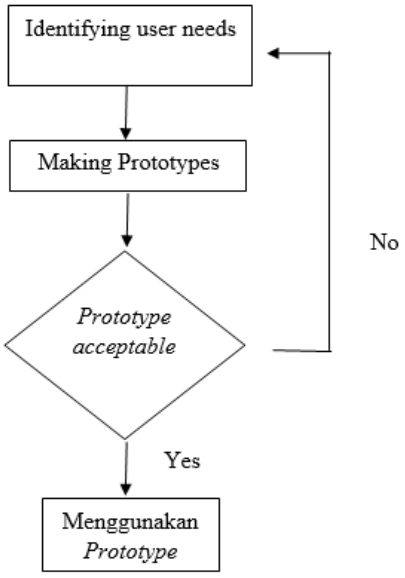

Figure 1. Flowchart of the Prototype Developer Model

Development of an evaluation prototype Figure 1 shows the four steps in creating an evolutionary prototype [18]. The four steps are as follows: Identify user needs—Development interviews users to understand the system's requirements. Creating a Prototype Developers use one or more prototyping tools to develop a prototype. Determining whether the prototype is

acceptable, the developer demonstrates it to users to decide whether or not it has provided satisfactory results. They are using a prototype to become a system.

2.2 Design Components System

The following is the flow of designing a GPS- and IoT-based accident detection system tool, as shown in **Figure 2**.

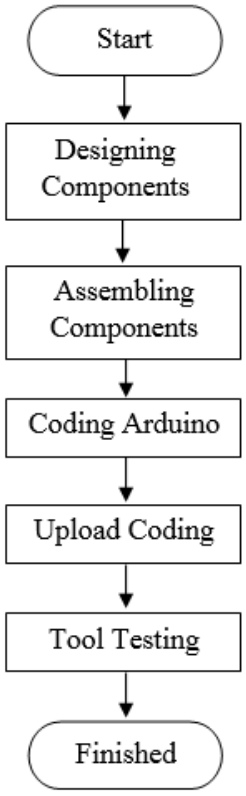

Figure 2. Tool Device Flowchart

The following is an explanation of **Figure 2**: The first step taken is to design components. To create elements in this system, use fritzing. The purpose of this planning is to minimize the occurrence of errors in making tools. The next step is assembling the components. Components are installed onto the pins according to the device specifications. They are starting from analogue pins, power pins and ground pins. To code these components, Arduino IDE software is needed. In coding Arduino, the C++ programming language is required. Every device connected to an Arduino must have variables defined according to the related pins so that you can easily code if there is a branching condition later. After the coding process is complete, the next step is the coding upload process. This step is carried out using the Arduino IDE software. Suppose an error occurs during the coding process of the tool. In that case, an error will occur during the coding

data upload process, and an error message will appear there according to the problematic coding line. The next step is the process of testing the tool before the tool can be mass-produced.

2.3 Prototype tool for development

The prototype for the development of a driving accident detection tool can be seen in **Figure 3**—the proposed system and how it works.

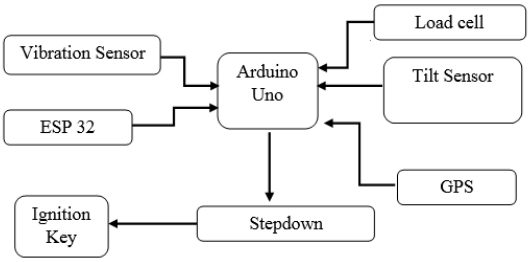

Figure 3. Prototype for the development of a driving accident detection tool

Description in **Figure 3**: The system flow starts from operating the driving accident detection system application, namely connecting Stepdown, Arduino Uno R3 SMD, ESP 32, GPS, Vibration Sensor, Pressure Sensor, and Angle Sensor, and this application will later inform the victim's family that a driving accident has occurred.

Project how the tool works: (a) When the vibration sensor system detects a vibration, it automatically sends information and location via WhatsApp or Telegram. (b) When the tilt sensor system detects a specified tilt on the motorbike, it will automatically send information and location via WhatsApp or Telegram. (c) When the pressure sensor system detects pressure on the motorbike, it automatically sends information and location via WhatsApp or Telegram. (d) Here, use stepdown to adjust the voltage on the Arduino Uno so there is no overvoltage. (e) If a driving accident occurs, which will detect the vibration, tilt and pressure sensor system simultaneously, it will send information and location via WhatsApp or Telegram

2.4 Schematic Component design

The schematic design describes a program created and explained to clarify what the program will look like. The following is a schematic design for a GPS and IoT-based driving accident detection system.

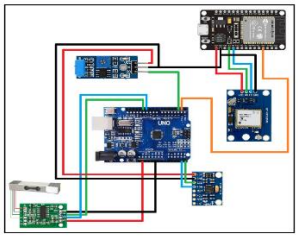

Figure 4. Overall Components

To design this tool, the application used is fritzing, the function of this application is to create a sketch or initial design of an electronic device in order to minimize the occurrence of errors.

The following are the components of the design above in **Figure 4**: Arduino is hardware that uses an I Microcontroller as the central controller of the circuit. Esp 32 is a WiFi module on a chip that supports building application systems for the ESP32 Internet of Things. SW420 Vibration Sensor: A vibration sensor is a device or device that converts physical quantities in the form of vibrations into electrical amounts, which can be in the form of voltage or current. The MPU6050 sensor is a sensor that can read the tilt of an object in the form of an angle based on data generated from the accelerometer sensor and gyroscope sensor. HX711 load cells, or load cells, are transducers that measure loads by converting force into electrical signals. GPS, or Global Positioning System, is a tool humans use to inform users of where they are on the Earth's surface-based satellites.

2.5 System performance design flow

Design of the performance process of a system which is depicted in a flow diagram or ERD and interface design. This design is carried out to determine the general condition of the system. The following is the system framework.

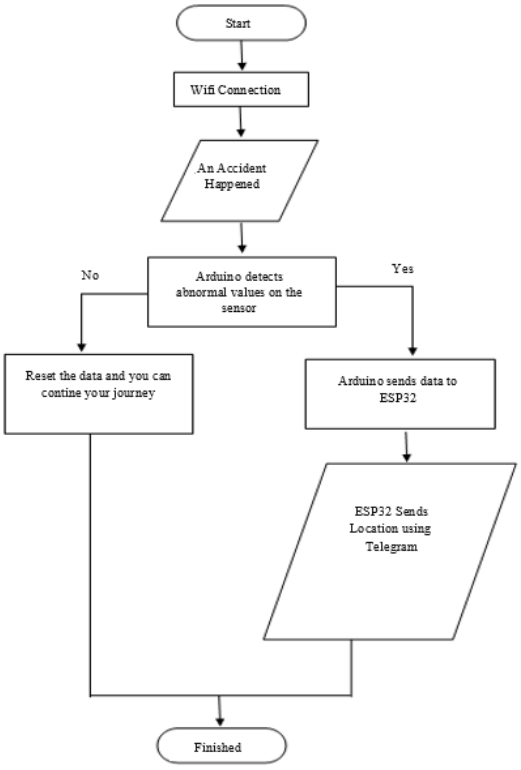

Figure 5. System performance flowchart

Based on **Figure 5**. it can be explained as follows: (a). If Arduino detects an abnormal value on the sensor, Arduino will send data to Esp32. (b). If Esp32 gets data from Arduino that exceeds the limit, Esp32 will automatically send information and GPS to the family using Telegram.

3. Results and Discussion

3.1 Component Discussion

The following components are needed to design a GPS and IoT-based accident detection prototype: Arduino Uno. This component is a type of microcontroller which functions to process input devices and produce output. All sensors will be connected to Arduino pins; the following is an overview of the Arduino Uno SMD R3 microcontroller in **Figure 6**. Arduino Uno components..

Figure 6. Arduino Uno Components

In **Figure 6.** The SW420 Vibration Sensor is a tool that detects vibrations and converts vibrations into electrical signals. MPU6050 Tilt Sensor This tool is capable of reading tilt angles based on data from the accelerometer sensor and gyroscope sensor.

Figure 7. Vibration Sensor Components and Tilt Sensor Components.

In **Figure 7**. Load Cell pressure sensor: this tool converts loads or forces into changes in electrical voltage. Esp 32 functions to connect WIFI and supports building application systems for the Internet of Things ESP32 and sending notifications to Telegram.

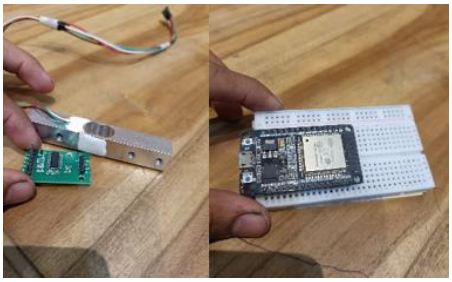

Figure 8. Load Cell Components and Esp 32 Components

In **Figure 8.** GPS Neo 6M functions to provide satellite-based location coordinates. The function of the jumper is to connect components and the Arduino Uno. This component creates temporary electronic circuits for testing purposes or prototypes without soldering. The overall results below are the results of all assembled components, as seen in **Figure 9**.

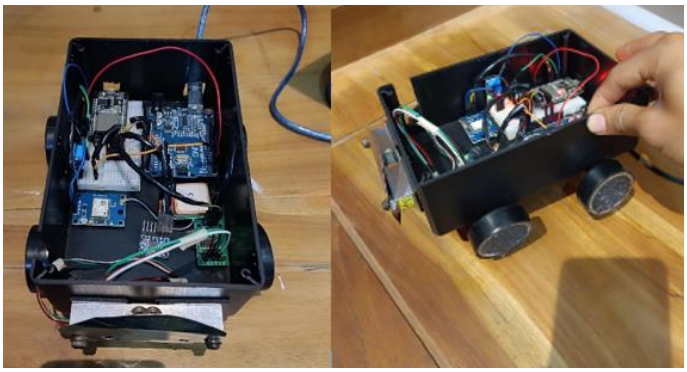

Figure 9. Overall system components

3.2 Software Design

Arduino IDE is software provided for writing program listings that Arduino developers have supplied. In software design, the Arduino IDE software will report the program listing and save it with a file with the extension. The idea is that Arduino Uno is a medium used to upload programs to a microcontroller so the microcontroller can work according to what has been ordered. There are steps to start running the Arduino IDE software and the process. After that, the program listing on ESP 32 for serial communication can be seen in **Figure 10**.

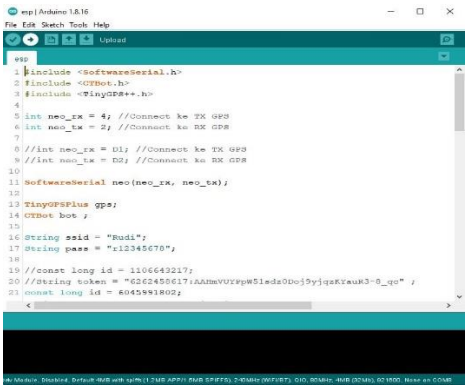

Figure 10. Program Listing on ESP32

3.3 Screen Display Results (notification)

The following is a notification screen display on the Telegram application when a driving accident occurs. The notification display when a collision occurs on a vehicle can be implemented in **Figure 11.**

Figure 11. Notification display during a collision

The notification display when a vehicle tilt occurs can be seen in **Figure 12**.

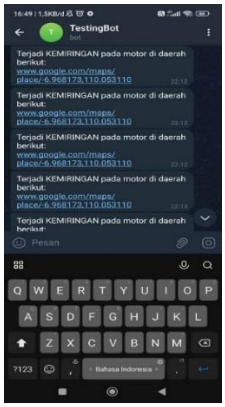

Figure 12. Notification display when tilting

The notification display when a vibration occurs in the vehicle can be seen in **Figure 13**.

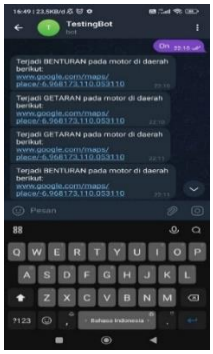

Figure 13. Notification display when vibrating

The display of GPS coordinates when a driving accident occurs by clicking on the link in the notification can be seen in **Figure 14**.

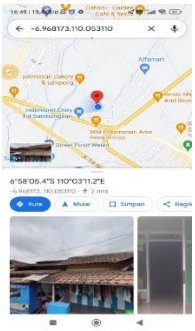

Figure 14. Display of GPS coordinates

3.4 System validation test results

After knowing the GPS and IoT-based accident detection system specifications, the following is a test table for the system. **Table 1** is as follows.

Table 1. Product Testing Table

No	Assessment	Testing				
		1	2	3	4	5
1	Test effectiveness				✓	
2	Test the accuracy of vibration sensor detection.				✓	
3	Test the accuracy of the tilt sensor detection.				✓	
4	Test the detection accuracy of the pressure sensor.				✓	
5	Test the speed of the tool in providing information.				✓	
6	Product feasibility test				✓	

Based on **Table 1** of the assessment above, the product is capable of being used and suitable for operation in vehicles as an accident detection system.

3.5 Testing is a prototype.

To test the next stage is product testing. This testing was carried out in a simulation because this product is a prototype. The following are the stages in using the product:

a. It is necessary to press the sensor to create pressure on the sensor. If the pressure value is above the standard limit, it will send output to the ESP32, and the ESP32 will send notification information to Telegram.
b. It is necessary to vibrate the sensor to cause a vibration to occur on the sensor. If the vibration value is above the standard limit, it will send output to the ESP32, and the ESP32 will send notification information to Telegram.
c. Likewise, it is necessary to tilt the sensor. If the tilt value is above the standard limit, it will send output to the ESP32, and the ESP32 will send notification information to Telegram.

d. Meanwhile, for GPS itself, if the sensor detects a value above the standard limit, it will automatically send a notification of the coordinates of a driving accident.

3.6 Sensor Testing

The following is a table of testing pressure, vibration and tilt sensors to measure the accuracy and speed of reading data; see **Table 2**.

Table 2. Sensor Test Data

No	Jenis Sensor	Delay	Level of accuracy
1	Pressure	1 Second	80%
2	Vibrate	1 Second	80%
3	Slope	1 Second	80%

Overall tool testing, the following is a **Table 3** tests of all components:

Table 3. Overall Equipment Testing Data

Test	Delay	Notifications
1	2 Second	There is
2	2 Second	There is
3	2 Second	There is

Based on **Table 3** of overall component testing, it can be concluded that if the sensor gets an abnormal value, it will send a notification via Telegram, which has a delay of approximately 2 seconds.

4. Conclusion

With this GPS and IoT-based Driving Accident Detection System Design. The author can conclude as follows: To quickly send information to the family that a driving accident has occurred. Can detect driving accidents. Anticipate the occurrence of fatalities during driving accidents due to late medical treatment.

References

[1] Tri Wibowo, A., Salamah, l., & Taqwa, A. "Rancangan Bangun Sistem Keamanan Sepeda Motor Berbasis iot (Internet of Things)" *Jurnal Fasilkom*, vol. 10, no. 2, pp. 103-112, 2020.

[2] Simbolon, R. M., Saragih, Y., Sirait, P. W., & Waluyo, P. "PERANCANGAN DAN PENERAPAN SISTEM DETEKSI DAN PELAPORAN KECELAKAAN BERBASIS SMS". Jurnal Teknovasi, vol 9, no. 02, pp. 67-76, 2022

[3] Adika, Ibnu Adib, Djarot Suradji, and Mokhammad Rifqi Tsani. "SISTEM PERINGATAN

DURASI MENGEMUDI BERBASIS INTERNET OF THINGS GUNA MENINGKATKAN KESELAMATAN BERLALU LINTAS." *Jurnal Transportasi*, vol. 20. no. 3, pp. 191-200, 2020.

[4] PRATAMA, F. Y. "Analisis Ruas Rawan Kecelakaan (Blacklink) pada Ruas Jalan Nasional di Kabupaten Kendal" *Doctoral dissertation, Universitas Gadjah Mada.* 2022

[5] Wahid, Arief Rahman, Khozainuz Zuhri, and Fatimah Fahurian. "Prototipe Sistem Deteksi Jarak Kendaraan Roda Empat Untuk Mengurangi Angka Kecelakaan Berbasis Arduino. " *Jurnal Teknologi dan Informatika (JEDA)*, vol. 3, no. 1, pp. 45-53, 2022.

[6] Sholeh, N., Joni, K., & Ulum, M. "Sistem Monitoring Kondisi Kendaraan Motor Injeksi Berbasis Mikrokontroler". *Jurnal JEETech*, no. 1, vol. 1, 37-42, 2020

[7] Lonteng, I., Gunawan, G., & Rosita, I. "Rancang Bangun Simulasi Alat Pendeteksi Jarak Aman Antar Kendaraan Menggunakan Sensor Ultrasonik Berbasis Arduino". *JEECOM J. Electron. Eng. Comput*, vol. 2, no.3, 22-25, 2020.

[8] Afifudin, Adhy Prastyo. "RANCANG BANGUN SISTEM PENDETEKSI KECELAKAAN PADA KENDARAAN RODA DUA MENGGUNAKAN SENSOR GYRO GY-521 MPU6050". *Diss. Universitas Mercu Buana Bekasi*, 2020.

[9] Setiadi, Teguh, and Imam Nur Syafaat. "Sistem Informasi Pendeteksi Asap Rokok Menggunakan Sensor Mq-2 Pada Klinik Berlian Limpung Berbasis Arduino Uno. " *JURNAL ILMIAH SISTEM INFORMASI* (JUSI), vol. 1, no. 2, pp. 12-19 ,2022.

[10] Sibuea, S., & Saftaji, B. "Perancangan Sistem Monitoring Beban Kendaraan Menggunakan Teknologi Sensor Load Cell ". vol. 6, no.3, 144-156. 2020.

[11] Hamdani, Riyan, Heni Puspita, and Dedy R. Wildan. "Pembuatan Sistem Pengamanan Kendaraan Bermotor Berbasis Radio Frequency Identification (Rfid)", *Jurnal Industri Elektro dan Penerbangan*, vol. 8. no. 2, pp. 34-43, 2019.

[12] Setiadi, Teguh, Laksaman Haidar, and Muhamad Fadlan. "Prototype Rancang Bangun Sistem Lampu dan Kipas Otomatis Menggunakan Sensor PIR Gerak Suhu dan Cahaya Berbasis Arduino UNO" *Journal of Computer Science and Technology*, vol. 2. no. 2, pp. 31-39, 2022.

[13] Edilla, E., Akhyan, A., & Panjaitan, A. "Miniatur Smart Home Berbasis SMS dan Arduino" . *Jurnal Elektro dan Mesin Terapan*, vol. 5, no. 2, pp. 28-39, 2019.

[14] Simorangkir, Holder, and Andrew Yehezkiel Patasik. "Aplikasi Pengidentifikasian Kecelakaan Kenderaan Bermotor Menggunakan Internet Of Things (Iot). " *Technologia: Jurnal Ilmiah*, vol. 13. no. 2, 137-144, 2022.

[15] Maysarah, Khalda, Achmad Ali Muayyadi, and Brian Pamukti. "Monitoring Posisi Dan Kecepatan Menggunakan Sensor GPS Berbasis IoT Untuk Mendukung Sistem Keamanan Mobil. " *eProceedings of Engineering*, vol. 9, no.6, pp. 56-67, 2023.

[16] Wahid, Arief Rahman, Khozainuz Zuhri, and Fatimah Fahurian. "Prototipe Sistem Deteksi Jarak Kendaraan Roda Empat Untuk Mengurangi Angka Kecelakaan Berbasis Arduino. "Jurnal Teknologi dan Informatika (JEDA), vol. 3, no. 1, pp. 58-67 ,2022.

[17] Ilmadina, Hepatika Zidny, Dyah Apriliani, and Dega Surono Wibowo. "Deteksi Pengendara Mengantuk dengan Kombinasi Haar Cascade Classifier dan Support Vector Machine. " *Jurnal Informatika: Jurnal Pengembangan IT*, vol. 7. no. 1, pp. 43-54, 2022

[18] Goodman, Steven M., et al. "Lampost: Design and evaluation of an ai-assisted email writing prototype for adults with dyslexia. " *Proceedings of the 24th International ACM SIGACCESS Conference on Computers and Accessibility.* vol. 3, no. 2, pp. 1-18, 2022.