IOP Conference Series: Materials Science and Engineering

PAPER • OPEN ACCESS

Cargo Vehicle Monitoring with Renewable Energy and Geofencing for Lane Restrictions

To cite this article: M F Wicaksono *et al* 2019 *IOP Conf. Ser.: Mater. Sci. Eng.* **662** 052007

View the article online for updates and enhancements.

You may also like

- Building the Design of E-Commerce
  E S Soegoto, M A S Marbun and F Dicky
- Technology-based education
  A Friyanto, I Prasetyo and C N Albar
- Web-based information system sales
  F S Suwita, S A Sholihat and N P Dewi

This content was downloaded from IP address 158.140.180.100 on 18/07/2024 at 16:21

IOP Conf. Series: Materials Science and Engineering **662** (2019) 052007 doi:10.1088/1757-899X/662/5/052007

Cargo Vehicle Monitoring with Renewable Energy and Geofencing for Lane Restrictions

M F Wicaksono[1*], Syahrul[1], Sutono[1], M D Rahmatya[2]

[1]Program Studi Teknik Komputer, Universitas Komputer Indonesia, Jl. Dipati Ukur 112-116 Bandung, Indonesia
[2]Program Studi Sistem Informasi, Universitas Komputer Indonesia, Jl. Dipati Ukur 112-116 Bandung, Indonesia

*mfajarw@email.unikom.ac.id

Abstract. The main objective of this research is to design a cargo vehicle monitoring system. The method used to limit the path is geofencing. The web application will limit the path to be traversed, so the warning alarm on the server will light up when the vehicle exits the specified paths. The advantage of this design is that the required power is taken from the battery, so there is no need to take power from the car battery. The battery will be charged by using a solar cell. On the hardware side, Arduino UNO is used as the main processor. Arduino will receive data from the GPS module then sent it to the server via the GSM GPRS module. On the software side, the data that has been received will be saved to the database, parsed, compared to the specified line limit and will be displayed on the web application. The results of this study are a model tool for monitoring cargo vehicles with the limitation of lanes and renewable resources. With this model, it is expected that it can help the entrepreneurs of goods delivery services to monitor their vehicle.

1. Introduction

This paper describes the making of a system for monitoring cargo vehicles. In this design, the tool will utilize solar energy as its resources and geofencing for path restrictions from the starting point of departure to the destination point.

The biggest challenge for logistics providers and service providers is crime related to cargo cars. This crime related to cargo has a very significant economic impact. According to industry experts, the losses incurred by this crime reach $ 30 billion annually throughout the world, of which $ 10 billion of losses occur in the US and $ 8.2 billion in losses incurred in EMEA (Europe, Middle East, and Africa) [1]. Theft occurs in various types of cargo. A cargo car carrying cigarettes, pharmaceuticals, electronic goods, and computers has the potential to become the target of this theft. These items have a high sale value on the black market.

One of the studies related to this topic has been done by other researchers is the design and implementation of vehicle tracking system using GPS / GSM / GPRS technology and a smartphone application in 2014 [3]. However, the design only focuses on the anti-theft system only and there is no geofencing and the power needed does not yet use renewable energy. Two years later, in 2016, another study entitled “GPS GPRS Control and Tracking System for Fuel Trucks via the Processing of Traveling

Content from this work may be used under the terms of the Creative Commons Attribution 3.0 licence. Any further distribution of this work must maintain attribution to the author(s) and the title of the work, journal citation and DOI.
Published under licence by IOP Publishing Ltd

Information" was carried out by other researchers [4]. The tools made in the study are good. However, the tool resources have not used renewable energy and the tracking process has not used geofencing related to the path to be passed. Other research conducted in 2016 by other researchers was Real Time Vehicle Tracking Using Arduino Mega [5]. In this study, the tool can detect the presence of vehicles. However, the system is made using Arduino Mega while the pins needed for making this system are still enough to use Arduino UNO. In 2017, another study with the title Vehicle Tracking System for School Bus by Arduino year was conducted by other researchers [6]. However, the results seen on the web display were only the endpoints of the vehicle's existence and there were no restrictions on the lane.

There are many other studies related to this topic, but in general no one has used renewable and geofencing to limit the path that cargo car will pass. The main advantage of the design offered in this study is the use of renewable energy so that the tracker does not need to extract resources from the car battery. Another advantage is the limitation of the path to be traversed so that when the car exits the track that has been marked, an automatic notification will be immediately obtained by the operator on the server. The main objective of this research is to design a cargo vehicle monitoring system. In accordance with the initial goal, this design can be used to monitor cargo vehicles with restrictions on the path that must be passed and use solar power for tracker resources.

2. Methods

The design of this system is divided into three main parts, namely the power supply design for a tracker that utilizes solar cell, GPS tracker design and web design on the server. Figure 1 below shows the block diagram of the system.

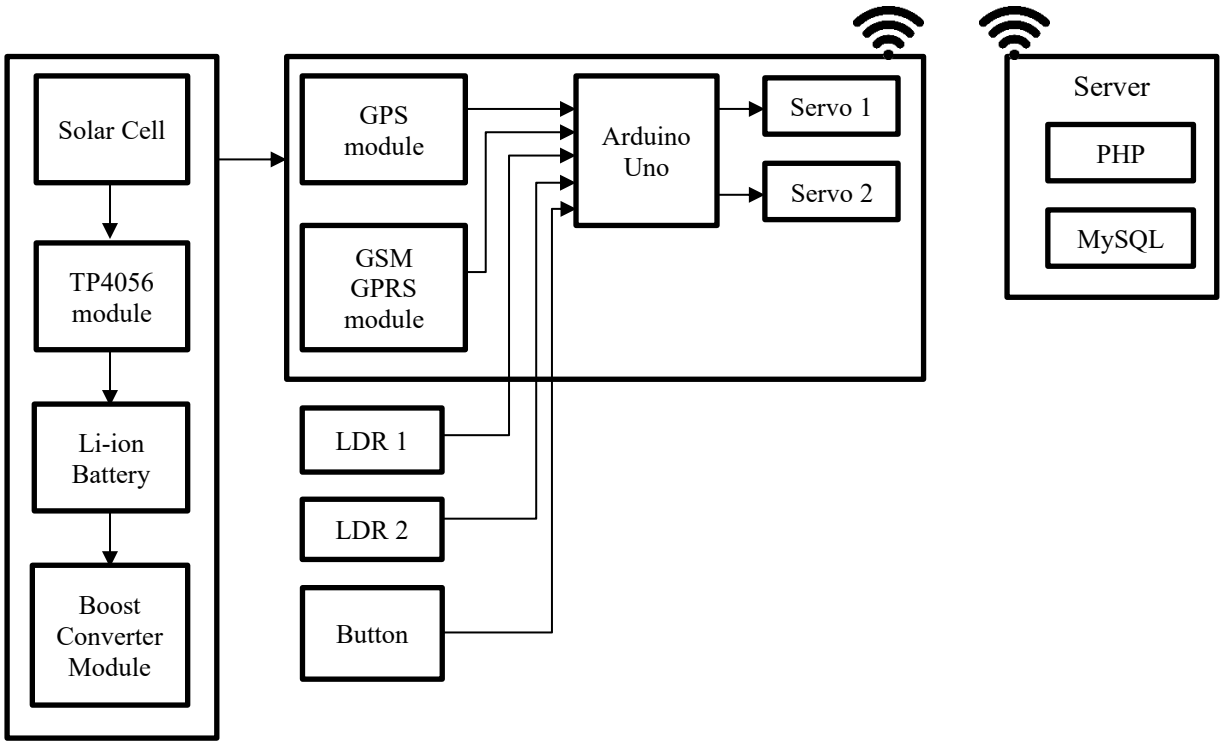

Figure 1. System block diagram

The tracker resource is used using a solar cell. Solar cells work on the principle of photovoltaic effects. The solar cell is a free energy source because it uses sunlight to produce power [7]. To charge the Li-ion battery, the TP4056 module is used. This module is a charging module that has a protection unit and can be used to charge battery 18650. When the battery is fully charged, the module will

automatically stop charging the battery [7]. The 18650 battery only has an output voltage of 3.7V, so a boost converter needs to be used to convert the 3.7V voltage to a 5V voltage. To do this, the step-up module MT3608 is used. The module has a range of input voltages that can be amplified between 2-24V DC [7]. The output voltage of the module can be adjusted via a potentiometer.

LDR 1 sensor and LDR 2 sensor are used to detect received sunlight. The LDR is a resistor whose value can change depending on the amount of light that illuminates the surface [8]. The placement of sensors is very influential on the intensity of light that will be received by the solar cell. LDR 1 sensor is used to detect the intensity of light from the east, while the LDR 2 sensor is used to detect the intensity of light from the west. In this tool, Arduino UNO is used as the main brain. Arduino UNO is an open-source microcontroller board based on ATMega328. The Arduino is equipped with 14 digital I / O pins, of which 6 pins can be used as PWM pins and the other 6 are used as analog pins [9]. This board provides a voltage source of 5V and 3.3V. The programming process can be done through Arduino IDE software [10]. Arduino UNO will compare the output values received from the LDR 1 and LDR 2 sensors. The results of the comparison of values will determine the movement angle of servo motor 1 and servo motor 2. In this tool, there is a button that is used as a panic button. The button can be pressed during an emergency and the result is an emergency notification will appear on the server.

In the data transmission process, Arduino UNO will send GPRMC data accompanied tracker ID and button condition storage variable. GPRMC data is obtained from the GPS GR-89 module. The GR-89 GPS module is a GPS module equipped with a 49MHz processor, 20 channel GPS and supports the NMEA-0183 format. This module has low power consumption [11]. The process of sending data from Arduino to the server uses a GPRS connection by utilizing the GSM GPRS module. The GSM GPRS module used is the SIM800L module. SIM800L is a quad-band GSM / GPRS module that works on GSM850Hz, DCS1800MHz, EGSM900MHz, and PCS1900MHz frequencies. This module is equipped with GPRS multi-slot class 12 / class 10 (optional) and supports GPRS coding schemes CS-1, CS-2, CS-3 and CS-4 [12].

The main advantage of this model is the use of geofencing. Geofencing is a virtual perimeter associated with a geographical boundary between one point and another that has been mapped [13]. Geofencing used in this model is polygons. The line boundary (latitude and longitude) is saved to the database. The data received by Arduino UNO will be compared with the specified limit. If the point that is compared is outside the boundary, then the notification on the server will be active.

3. Results and Discussion

Figure 2 shows the solar tracker control flowchart, reads the condition of the panic button, reads GPS data and transmits data via GPRS. Arduino Uno will read the LDR1 and LDR2 values. This value is used to determine the movement of servo1 and servo2. If the value of LDR1 is greater than LDR2, the servo motor will move to an angle of 165 degrees. At this angle, the surface of the solar cell will tilt eastward. If the value of LDR1 is smaller than LDR2, the servo motor will move to an angle of 15 degrees. At this angle, the surface of the solar cell will tilt westward.

The next process, Arduino will read GPS data. The GPS data taken is GPRMC data. The data will be broken down and only latitude and longitude values are taken. Next Arduino will read the condition of the button. If the button is pressed, the panic variable will be filled with a value of 1. If the button is not pressed, then the panic variable will be filled with a value of 0. After all variables are filled, the next process is the process of sending data to the server using a GPRS connection.

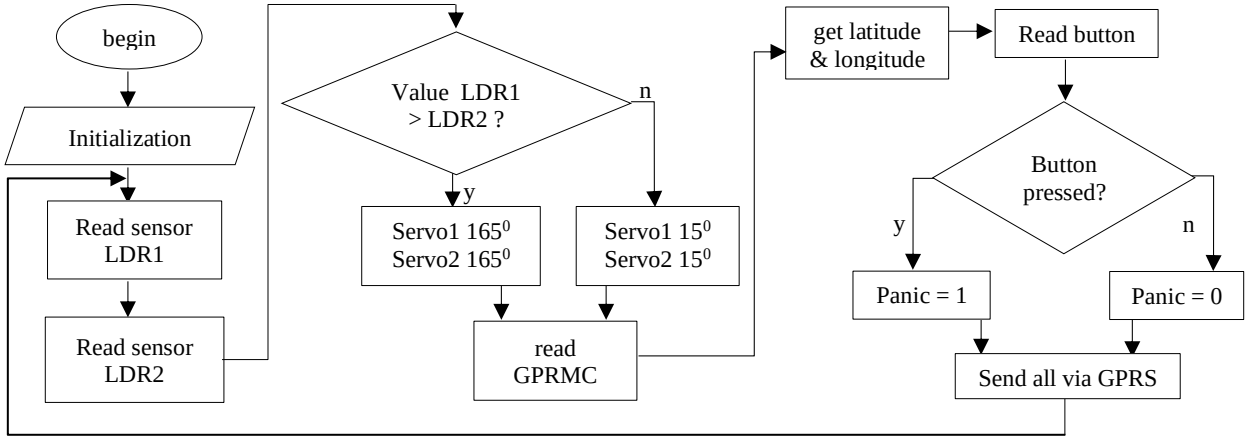

Figure 2. Flowchart Arduino Tracker

Figure 3 shows the flowchart to create the path to be crossed. Boundary making is done on the tracking page. On the page, the admin must fill in a form containing the vehicle id, the name of the departure point and the name of the destination point. The next process, the admin can create lane restrictions and save them to the related database tables.

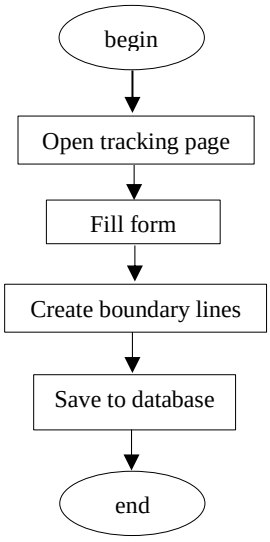

Figure 3. Flowchart create boundary

Figure 4 shows a comparison flowchart of data sent by Arduino with track boundary data stored in the database table. Special pages directed by Arduino will always be refreshed automatically. Data sent by Arduino will be directed to this page. On the page the data received will be compared with the related boundary data. Comparative data is taken from the database table. If the coordinates entered are outside the boundary, then the notification on the server will be activated automatically.

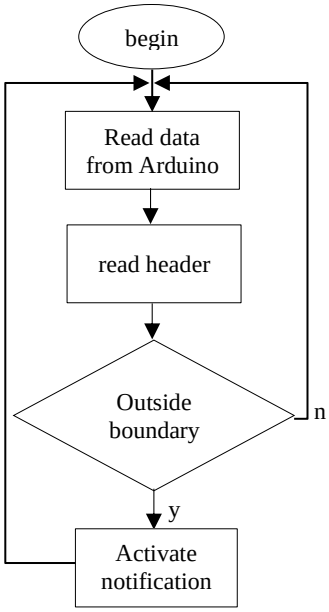

Figure 4. Flowchart Boundary Comparison

This design can help the entrepreneurs of goods delivery services to monitor their vehicle with restrictions on routes to be passed using the geofencing method and the tracker device using renewable energy. However, in previous researches, the tool resources have not used renewable energy and the tracking process has not used geofencing related to the path to be passed[4], the design only focuses on the anti-theft system[3], it only displays the endpoints of vehicles displayed in the web interface and there were no restrictions on the lane[6].

4. Conclusion

The design of cargo vehicle monitoring with renewable energy and geofencing for lane restrictions can be completed. It is expected that the design of this system will be tested both by laboratory testing and direct testing to the field. Field testing is carried out with shipping service providers (cargo) to get feedback regarding existing features and suggestions for adding other necessary features. With this model, it is expected to be able to help entrepreneurs of goods delivery services to monitor their vehicles.

Acknowledgments

Thanks to the Rector Universitas Komputer Indonesia and Head of the Digital System Laboratory, Department of Computer Engineering Universitas Komputer Indonesia who has helped provide the facilities in the laboratory.

References

[1] Global Initiative against Transnational Organized Crime December 2017 *Transnational Organized Crime and the Impact on the Private Sector: The Hidden Battalions*

[2] Federal Bureau of Investigation (FBI) 2010 *Inside Cargo Theft A Growing, Multi-Billion-Dollar Problem, https://archives.fbi.gov/archives/news/stories/2010/november/cargo_111210/cargo_111210*

[3] Lee S, Tewolde G, Kwon J March 2014 *Design and Implementation of Vehicle Tracking System Using GPS/GSM/GPRS Technology and Smartphone Application.* IEEE World Forum on Internet of Things (WF-IoT) INSPEC Accession Number: 14255652

[4] Sabbar B M, Ali A I 2016 *GPS-GPRS Control and Tracking System for Fuel Trucks via Processing of Travelling Information*. International Journal of Scientific & Engineering

Research, Volume 7, Issue 6 June 2018, ISSN 2229-5518

[5] Alshamsi H, Këpuska V, Alshamsi H 2016 *Real Time Vehicle Tracking Using Arduino Mega*. International Journal of Science and Technology Volume **5** No. 12, ISSN 2049-7318

[6] Salunke S A, Jagtap V B, Harale A D. 2017 *Vehicle Tracking System for School Bus by Arduino*. International Research Journal of Engineering and Technology (IRJET) Volume: **04** Issue: 03 March 2017 e-ISSN: 2395-0056 p-ISSN: 2395-0072

[7] Kumar K U, Chiranjeevi T, Fathima T, Rani K S, Maruthi P 2017 *The Portable Charger to Charge Any Electronic Gadget with Safety-Power Cube*. International Journal of Innovative Research in Science, Engineering and Technology Vol. **6**, Issue 3 March 2017 ISSN(Online) : 2319-8753 ISSN (Print) : 2347-6710

[8] Wicaksono M F 2017 *Implementasi Modul WiFi Nodemcu ESP8266 Untuk Smart Home.* Komputika - Jurnal Sistem Komputer Unikom Volume **6**, No.1 ISSN 2252-9039

[9] Patel1 P, Rauniyar S K, Singh T, Dwivedi B, Tripathi H 2018 *Arduino Based Child Tracking System Using GPS and GSM.* International Research Journal of Engineering and Technology (IRJET) Volume: 05 Issue: 03 March 2018 e-ISSN: 2395-0056 p-ISSN: 2395-0072

[10] Sidqi R, Rynaldo B R, Suroso S H, Firmansyah R 2018 *Arduino Based Weather Monitoring Telemetry System Using NRF24L01+*. IOP Conf. Series: Materials Science and Engineering 336 (2018) 012024

[11] Tailor K J, Jadav A R., Pandey G K, Vasava D B, Nadavana M B 2014 *Advanced Security System for ATM with Tracking & SMS Indication.* The International Journal Of Science & Technoledge Vol 2 Issue 4 April 2014 ISSN 2321-919X

[12] SIM800L Hardware Design 2013, *https://img.filipeflop.com/files/download/Datasheet_SIM800L.pdf*

[13] Dabhi M D 2016 *Geofencing: A Generic Approach to Real Time Location based Tracking System. IRACST – International Journal of Computer Networks and Wireless Communications (IJCNWC), Vol.6, No 6, Nov-Dec 2016 ISSN: 2250-3501*