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Implementation of Smart Lock JT701 for Cargo Security System

Bakti Viyata Sundawa[1,*], Febrin Aulia Batubara[2], Tuti Adi Tama Nasution[3] & Eva Darnila[4]

[1,2,3]Electrical Engineering Department, Politeknik Negeri Medan, Medan, Indonesia.
[4]Informatic Department, Universitas Malikussaleh, Lhokseumawe, Indonesia.

Email address:
baktisundawa@polmed.ac.id
[*]Corresponding author

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Abstract: The freight forwarding business, namely transportation services from various modes of transportation (carrier) and arranging a series of shipments from several senders is growing rapidly during the pandemic and post Covid-19 pandemic. However, this business development is not without problems. Security disturbances during the cargo delivery process are a major problem, and this often happens in Indonesia. For this reason, this research will build a cargo delivery security system using automation technology and based on the Internet of Things (IoT). The system is a Smart Lock installed on the cargo. This smart lock can be monitored remotely, such as opening or closing the lock and the condition of the cargo in the field. Only the cargo owner can open or close the cargo lock. In addition, this system is also equipped with temperature and vibration sensors to maintain the quality of the goods in the cargo. The results of this research will be useful for the security system and convenience of the cargo delivery process and the digitization process will be easier to do in the future.

Keywords: Smart Lock, Cargo, Freight Forwarding, Internet of Things (IoT)

1. Introduction

Transportation is a business field that has had a significant impact during the COVID-19 pandemic. This is because the number of passengers has decreased dramatically due to restrictions on human movement [1]. This business field then underwent significant transformation. Fleets that are empty of passengers are then filled with shipments. These fleets can be maximized so that the company's cash flow [2].

This business is better known as freight forwarding, which is a transportation service that involves arranging a series of shipments from several shippers. Freight forwarding services are seen as a strategic business during the pandemic and post-pandemic because this business can save time, space, costs, and reduces unnecessary activities. People's online shopping habits during the pandemic are still carried over to the current post-pandemic period. So this brings good business prospects for companies engaged in this service.

The freight forwarding service business is experiencing very high growth. According to data published by the Central Bureau of Statistics in 2010, the growth rate of gross domestic product (GDP) increased by 4.2% from the previous year. Thanks to the development of this business, the world is perceived to be closer, and the community's economy will grow. Freight forwarding services are not seen as mere freight transportation services but have become a partner in the community's economic and business activities [3].

However, freight forwarding services are not free from problems. Problems that are often faced by freight forwarding companies are in the shipment process. In this process, there is often security disturbances resulting from

loading and unloading activities carried out. This service uses land, sea, and air transportation. There is often a change of place from land to sea and back to land again, or from land to air and back to land again. So in this condition, there are many loading and unloading activities and this makes the shipment of goods very vulnerable to security disturbances.

For this reason, further study is needed on the security system during the shipment process. With the development of automation technology at this time, it is hoped that it can help the security system during the process of shipping goods [4]. This automation technology can help humans and lighten the burden of human work, such as using robots when shipping goods. Robots can be controlled remotely using the Internet of Things (IoT) method [5].

Based on the above studies, this research will design a security system during cargo delivery using automation technology and the Internet of Things (IoT). The system is a Smart Lock installed on the cargo. This smart lock can be monitored remotely, including opening and closing locks and cargo conditions in the field [6]. Only the cargo owner can open or close the cargo lock. In addition, the system is also equipped with temperature and vibration sensors to maintain the quality of the goods inside the cargo.

2. Method

2.1. Research Stages

The prototype cargo monitoring system is built with four main components: implementation, which consists of hardware design, software design, prototype testing, and preparation of the final report. The parameters to be measured are the temperature and humidity inside the cargo, the distance and location of the vehicle, and the vibrations that occur inside the cargo [7]. Component requirements consist of smart lock components, cloud servers, GSM communication modules, and programming on the user side in the form of websites and Android [8].

The research was conducted at Telecommunication Laboratory of Politeknik Negeri Medan. The parameters to be measured in this research are the distance and location of the cargo car using GPS technology, the temperature and humidity of the cargo, and vibration detection in the cargo.

This research uses a GPS Tracker device that can detect the position and condition of the cargo sending car in real-time during the trip. The GPS tracker device is attached to the cargo car. This GPS tracker can connect to the server via a cellular network. In addition to the GPS tracker, this system will later be equipped with temperature and humidity sensors and vibration sensors to determine the condition of the cargo. This is related to the safety and condition of the goods delivered by the cargo [9].

The GPS tracker used is a Smart Lock JT701. This device is a multifunctional device. Apart from a GPS tracker, this device can also lock cargo or container doors that can be controlled remotely. This keeps the cargo safe until it reaches the delivery destination. The following is an image of the GPS Tracker smart lock type JT701, as shown in Figure 1. There are 4 main blocks, namely the GPS Tracker installed on the cargo vehicle, GSM/3G cellular network, server, and application to the user in the form of a website and Android program for smartphone users.

Figure 1. *Smart Lock JT701*

2.1. Research Model

This system is for remote monitoring of cargo delivery. The parameters to be measured are the distance and location of the cargo car using GPS technology, the temperature and humidity of the cargo, and vibration detection in the cargo. All measured data will be stored centrally on the server. The network used for data transmission is a cellular network. This network can reach almost all regions in Indonesia, so that information on the location and position of cargo cars and cargo conditions can be accessed online and seen in real-time.

With this monitoring system in place, we can ensure the safety and quality of the cargo items being shipped. In addition, we can also identify if there are irregularities during the journey when shipping goods [10]. All the information obtained will help interested parties analyze and take the necessary actions to solve the problem of shipping goods using cargo [11].

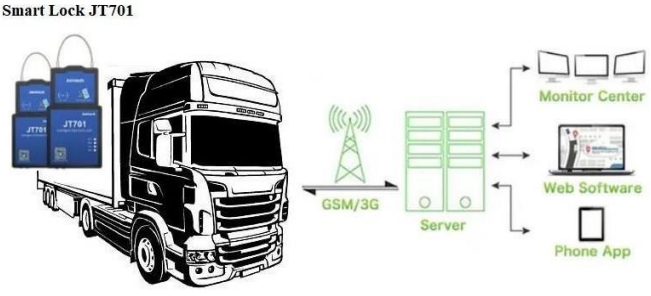

Figure 2. *Diagram Block of Research*

3. Data Analysis

3.1. Radio Frequency Identification (RFID)

Based on Figure 1, one of the parts of Smart Lock JT701 device. RFID is a technology composed of contactless and non-line of sightcapture technology by using tags that are used to catch sightless contact and designed to be an automatic process. It is a process similar to barcode scanning with more advantages [12], as the tagscan be programmed to store much more data, such as lot and serial numbers, customer order number, etc. RFID uses radio waves to identify objects [13], and track shipments and products [14]. It uses a unique identification code of products that needs to be transmitted to one or more receivers. The components of an RFID system are a transponder (tag), an antenna, and a reader [15].

RFID tags are classified into three categories of its products tag (active, passive, semi-passive also known as semi-active). The active tag contains both a radio wireless transceiver and a battery, which is used to power the transceiver. It works by gathering information from sensors available in its area, and then stores it in the readers [16]. The passive tags reflect the sign of an RF signal that is sent by the reader or transceiver and then adds the information by modifying the reflected signal. It doesn't use any battery to increase there flected signal power; each passive tag contains an antenna, which is required to collect electromagnetic energy in order to awaken the tags and reflect the energy portion to the reader. Semi-passive tags use radio transmitters as a source of energy for their transmissions, just like passive tags do. To preserve the memory in the tags, semi-passive tags can be fitted with batteries.

Active tags are the best option for tracking because of their ability to communicate over larger distances than one hundred meters. They can also read and write, which allows for the storage and transmission of a great deal of data other than just the tag code.

3.2. Global Positioning System (GPS)

GPS is a tracking system that provides location and time information for any shipment or product around the world, and it's a global navigation satellite system [17]. GPS technology determines the location of the shipment or product in real-time by using the numbered mobile communication network [18]. The way GPS operates depends on the use of between twenty-four and thirty-two medium-Earth orbit satellites that help GPS tracking devices to determine their location, direction, speed, and time. The GPS receiver receives signals from at least three satellites of the medium-earth active satellites to calculate the distance. The triangulation method is used to calculate the location by latitude and longitude. The satellites send signals at very accurate times and then the GPS tracking device determines the distance between each satellite; after that, the GPS receiver can determine the location in three dimensions [19]. .

3.3. Global Packet Radio Service (GPRS)

Based on Figure 2, GPRS is a tracking application packet-based that uses a mobile connection. It is part of the Global System for Mobile communication (GSM) networks and implement by sending short message service. The GPRS depends on the GPS system, which gives a good tracking and tracing for goods. Theoretically, GPRS can provide a high transmission efficiency up to 171.2 Kbp/s and it supports IP protocol and X.25 protocol [20][21].

GPRS is apacket-switched system that has an efficiency of 90% in data transmission, which provides information in high-speed wireless IP service. It has improved in the aspect of operational cost and reliability. GPRS uses an application to users for a public communication mobile network. By the wide and the huge coverage of the public telecommunications network, the user can always be connected to the internet and its high speed in terms of transmission. The wireless network that uses the public mobile network is low in cost, extendable, unrestricted, and has a low error percentage. Moreover, it is suitable for low data rates with high-frequency usage communication [22].

3.4. Analysis and Finding

The purpose of this paper is to design a security system during cargo delivery using automation technology and the Internet of Things (IoT). This paper is to investigate current shipping tracking technologies trends that are available in the market and to provide a better security system.

This will assist new organizations in the market to understand what technology to implement or to assign to their researchers to workin development. Most of these technologies depend on sending and receiving data related to shipment location and traffic situations to be analyzed in order to improve and smooth the process of delivering shipments from point A to point B. Beside that, the system is also equipped with temperature and vibration sensors to maintain the quality of the goods inside the cargo.

The tracking technologies presented in this paper are varied and can be used on land or sea. However, the main purpose of these technologies is tracking and collecting the required data in order to analyze it and use it for improvement purposes. Table 1 summarizes the advantages of technology used in this research on tracking system.

Table 1. *Summarizes The Advantages of Technology Used*

Technology Name	Technology Used	Advantages
RFID	Radio waves, tags contain radio wireless transceiver and battery.	Real-time product information and history
GPS	GPS receiver, satellites, Numbered mobile communication network	Real-time tracking of location, direction, speed and time

GPRS	Mobile connection GSM networks, GPS system	Provide high transmission efficiency, It doesn't require an additional network

4. Conclusion

Currently, undamaged delivery of packages is one of the most important services in order to gain customer satisfaction. Many companies in the world improve and develop their shipping services in order to improve customer service and gain their satisfaction and repeat business by providing ways and means of providing customers the status of the products, and the anticipated time of arrival to the specified location in good condition without any damage. The objective of this paper is to collect the tracking technologies available and discuss how every tracking technology works in tracking the packages and deliver it to provide error and damage-free service. There are also other benefits from tracking packages in the security realm as the companies can track their packages and check that the trucks, ships, and other modes of delivery are following the planned route and the scheduling plan.

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