Smart taxi security system design with internet of things (IoT)

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Abstract

Safety is an important thing in driving. Security in driving is aimed at the way of driving the vehicle or the security on the vehicle itself. Vehicle assets, especially cars, that are quite expensive or luxurious assets Therefore, safety protections for such vehicles are necessary. Taxi is a valuable asset for the company. To maintain the asset, a good security system is needed. With a good security system, the asset will be protected and the investments invested will not be reduced. By using the prototype method, a tool will be made in accordance to the wishes of the user. The Encludean distance method is used to calculate the distance of the incident and the nearest police station. By using the progress of technology, the progress can be utilized to help the security of taxi owned by a company or personal (online). The purpose of this study is to create a tool that can secure the taxi and its driver of crimes that might occur. IoT (internet of things) can help to secure a taxi since it is able to locate the incident's location precisely and accurately.

Keywords: embedded system, internet of things (IoT), security, smart taxi, technology

1. Introduction

Security in driving is aimed at the way of driving the vehicle or the security on the vehicle itself. Vehicle assets, especially cars that are quite expensive or luxurious assets. Therefore, safety protections for such vehicles are necessary. Taxi is a valuable asset for the company. For that, a good security system to maintain the asset is needed. With a good security system, the asset will be protected and the investments invested will not be reduced.

The taxi security system has actually been regulated in the Regulation of the Taxi Industry [1]. With the development of increasingly advanced technology nowadays, it is necessary to improve the current security system. Crime within the taxi may occur on the driver or on the passengers [2]. There are two types of taxi in Indonesia, the official taxi and the online one. Crime on taxi drivers lately is quite common, especially with the opening of the online taxi service in Indonesia. As recently, there was a robbery and murder of a taxi driver in Sukabumi.

Technological progress has been developed so rapidly, as seen on its usages in the community [3, 4]. It is used ranged from the use of household appliances to mobile phones. When talking about mobile phones, there are so many applications contained in the phone, like WhatsApp, SMS and internet [5]. When talking about the internet, then the application from the internet is really vast. One of them, is by implementing the internet to control the equipment known as IoT (Internet of Things) [6, 7]. When we are talking about IoT, then there are many advantages that can be obtained from IoT [8]. Currently IoT has penetrated into all areas such as in the field of health, engineering, and security fields [9, 10]. By using IoT, a variety of devices can be communicated through the communication network. The device in question can be either smart devices or computers. By using IoT many benefits can be obtained, especially if the IoT is connected to a computer or Embedded System [11-13].

From security problems on Taxi and IoT (Internet of Things), the writers try to do a research about Smart taxi and IoT. The use of the existing mobile phone should be utilized by taxi owners to secure themselves and their assets. By using a short message via SMS or WhatsApp, one can find out where someone is located and tell the person's position. WhatsApp or SMS is a means for people to carry out communication [14, 15]. Thus, there are millions of

people that are already using this application [16]. By modifying the security techniques on the taxi, the researchers change the system by adding a communication tool using IoT (Internet of Things) that can be used to secure the taxi and driver of a crime committed by a person [17-19].

2. Research Method

Research design shown in Figure 1 is used in making this research. The prototype is used in this design in order to make it easier to design from the desired equipment [20-23]. The stages of the method performed are: the problems identification in the design by identifying the needs of the equipment required in research such as Arduino which is used for the brain of the design that stores and runs the programs used. GPS is used to tell the position of longitude and latitude. The design stage of the writers to create the design that the writers will make for both in hardware and software were done after those stages are done, the test stages of the design is made. The point is, when there is a crime, there will be a secret button located within the taxi that should be pressed by the driver. When the keystrokes occur, it will turn on the light on the top of the car telling the other taxi driver to help the taxi who has the problem and arduino will catch a command signal from the button stating that there is a crime in the taxi and will send the position to the nearest operator and police station. The operator will get the full data, such as the driver's identity, location, coordinates, and maps of events. With this method, it is expected the driver is much safer from the crime. To determine the event that calls the nearest police station, the euclidean distance method can be used [24]. The euclidean distance method used is that which has two nearest coordinate points (two vectors) [25].
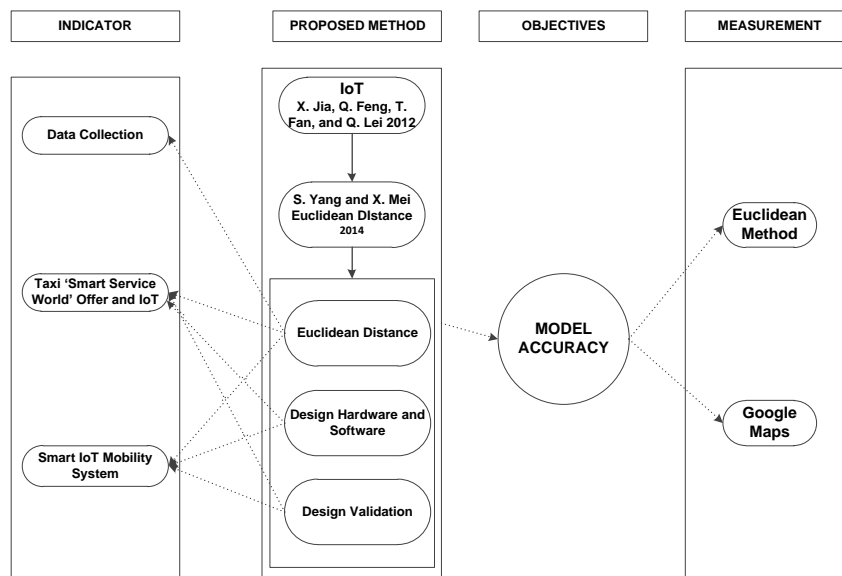

Figure 1. Research design

The euclidean formula is one of the formulas used to measure the distance from two points by using a mathematical calculation (heuristic method). Euclidean space was introduced by Euclidean, a mathematician from Greece around the year 300 B.C.E. to study the relationship between angle and distance. Euclidean is related to the Pythagoras theoreme and is usually applied to 1, 2, and 3 dimensions. Euclidean method is a method of proximity search distance value of 2 pieces of variables. Except for it is easy of use, this method is also not time consuming, and the process is fast. Euclidean is a heuristic function obtained based on barrier-free direct distance such as to obtain the value of the length of the diagonal line on the triangle. But before getting the result of both points, they must be represented into 2 dimensional coordinates (x, y). Two point's $p1=(x1, y1)$ and $p2=(x2, y2)$ into the following equation (Euclidian formula) [26-28]:

$$Euclidean\ Distance\ (d) = \sqrt{(X2-X1)^2 + (Y2-Y1)^2}\ x\ K \qquad (1)$$

where
X1, X2 = Initial Coordinates
Y1, Y2 = Final Coordinates
d = Distance Mapping
K = Coefficient of One Degree of Earth in Kilometers = 111,322 KM

3. Results and Analysis
3.1. Block Diagram

Block diagrams are used to facilitate the explanation. This is shown in Figure 2. In Figure 2 it is shown that in the left chart is a security system for the taxi that are still using a conventional system (both online taxi and conventional). Based on the law no. 46, 2014, there is an agreement between the police and the taxi owners that the alarm lights are mounted on the top of the taxi. If there is a danger, then the driver turns on the alarm light by pressing a secret button on the taxi. If the crime occurs in a quiet area, then it becomes a problem because it is difficult to get a quick help and the police becomes difficult to do their crime investigation.

By modifying and adding a microcontroller (arduino), the security of the taxi can be improved. Microcontroller will execute the programs that has been determined by processing the signals from the sensor pressed, configuring the position of the taxi who was criminalized, and conducting the process of sending the message where the position to the nearest police station and taxi operators. GPS (Global Positioning System) will send the coordinates of the taxi. GSM Shield sends messages to the police station and operators. The nearest police station will receive a message and then broadcast it to the police who are close to the scene. The police will receive messages via the internet then see google map and soon heading on the scene of the crime. Taxi operator who receive the messages will search for driver identification data and then combine with their database to transmit reporting events to the central police office and store the crime data that occurs in the database.
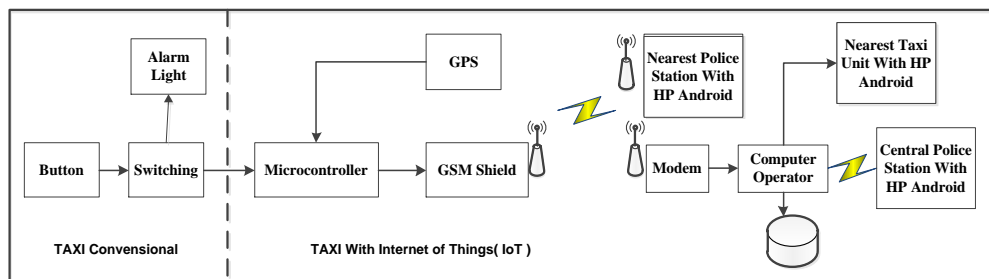

Figure 2. Smart taxi circuit block diagram

3.2. Designing the Hardware and Software

In this design, the arduino microcontroller is combined with GPS module. This GPS module will provide the coordinate numbers of the taxi that experienced the incident. This can be seen in Figure 3. Since the voltage supply in the GPS module requires less than 5 Volts, then a voltage divider is formulated by:

$$Vout = Vin.\frac{R1}{R1+R2} \qquad (2)$$

where
Vout = Variable Output
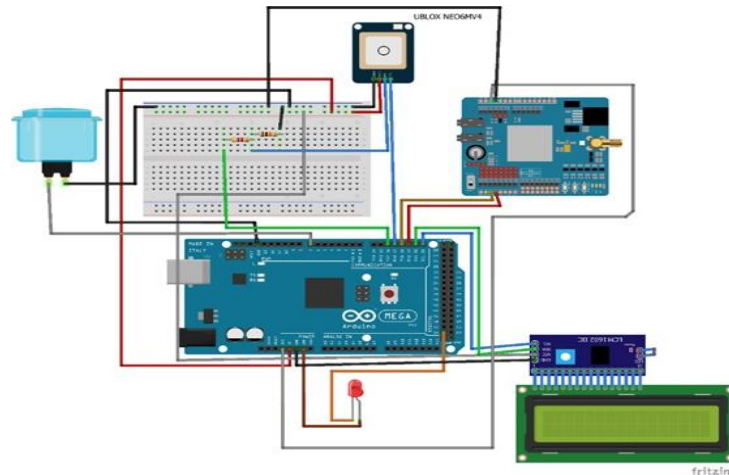Vin = Variable Input
R1 = Resistor 1
R2 = Resistor 2

Figure 3. GPS series picture

When the button is pressed the GPS will send coordinate signals which are adjusted to the location of the crime. It was tested it using the streets around Jl. Duri Kosambi, Cengkareng, West Jakarta. In the tool, the coordinates detected are 6.169385, 106.722954. This is shown in Figure 4.
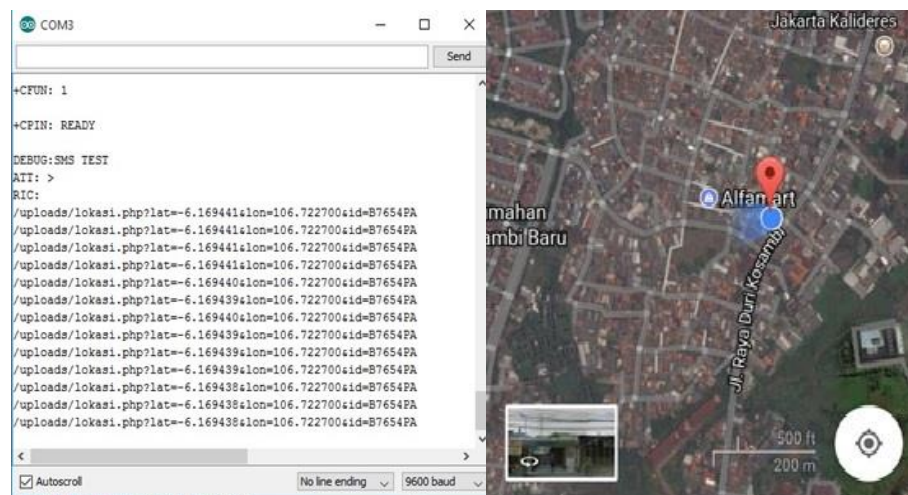

Figure 4. Duri Kosambi coordinate

By using the euclidean distance method the nearest distance search can be done easily. By comparing the coordinates of each closest police station, the nearest police will be obtained. For example, Kebon Jeruk Police Station is at -6.1990169, 106.7647924 coordinates and Cengkareng's Police Station is at 6.1460617, 106.7289833 with the incident position -6.169385, 106.722954. The calculation of the distance obtained are:

Jpol kebonjeruk $= \sqrt{(-6.169365 - -6.1990169)^2 + (106.7227954 - 106.7647924)^2} \; x \; 111,319$
$= 5{,}72$ km

Jpol Cengkareng $= \sqrt{(-6.169365 - -6.1460617)^2 + (106.7227954 - 106.7289833)^2} \; \square \; 111,319$
$= 2{,}68$ km

Based on the distance obtained, then the closest distance from the scene is the Cengkareng Police Station. If we are using google map, we will get images like shown at Figure 5.

If we compare between the google map and the results of the Euclidean method, the distances will be presented as Table 1. In Table 1 and Figure 6, showing the results of the test using the euclidean method, on the device that created, the result has a high accuracy with google maps.

Figure 5. Google maps distance images

Table 1. Comparison between Euclidean Method with Google Maps

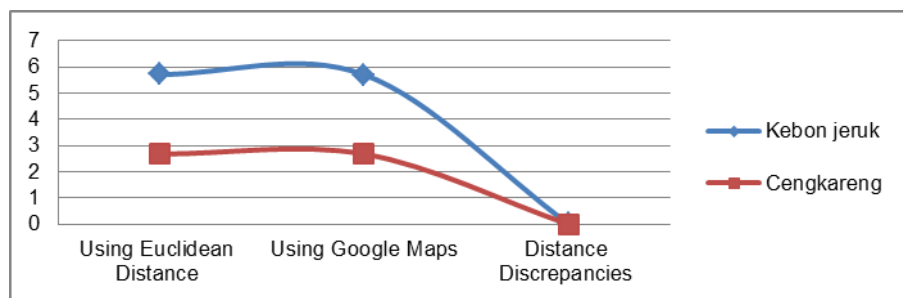| From the Scene to	Using Euclidean Distance	Using Google Maps	Distance Discrepancies
Kebon jeruk	5,72	5,71	0,01
Cengkareng	2,68	2,68	0,00

Figure 6. Resulth between euclidean method with Google Maps

4. Conclusion

By using Internet of Thing (IoT), the position of the taxi drivers can be detected based on its coordinates sent via GPS. The security of the taxi can be improved using a smart-based tool system. This is because the tool will directly contact the nearest police station and operators. The operator can quickly give the driver's identity to the police and coordinate events to the police. Policemen can view the mapping sent via the google maps. The operator will receive the coordinate data so it can store the data in the existing database. The Euclidean distance method can be used to help find the nearest police station so that it will speed up the action and the crime can be handled accordingly.

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