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Data Mining Application with Fuzzy Logic Method for Monitoring Vehicle Position Based on Android

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Abstract. Cases of vehicles theft in the Central Java region occurred 869 cases, the percentage was 57.86% against other crimes. To prevent vehicles theft, the police need public participation by increasing awareness of their vehicles. Vehicle theft can occur due to owner negligence and lack of safety locks on the vehicle. This study aims to create data mining application as monitoring vehicle position. The transmitter WiFi 2.4 GHz placed on a vehicle, then measured the RSSI signal by an android application based on fuzzy logic. Indication of theft is that the vehicle is positioned away from the owner, so the signal RSSI is less than -90 dBm. Fuzzy logic monitors this change in distance. When the membership function is lost, fuzzy logic instruct android to activated the alarm . Fuzzy logic was able to make decision give a alarm to user when RSSI signal less than -90 dBm. RSSI signal is less than -90 dBm when the distance is 20 meters if there is a wall barrier, without obstacle the distance is up to 80 meters. RSSI signal is influenced by the measurement environment.

Keywords: Data Mining Application, Fuzzy Logic, monitoring vehicle position

1. Introduction

The high number of crime of theft of motorized vehicles in general makes people anxious, leading to large material and non-material losses for the victims. According to the National Police Chief in 2018 the number of cases of theft of motorized vehicles was more than the cases of crimes of theft, fraud and violence [1]. Cases of theft of motorized vehicles in the Central Java region occurred 869 cases, the percentage was 57.86% against other crimes [2]. Theft can occur due to negligence of vehicle owners and lack of vehicle safety locks.

Motorbikes are the type of motorized vehicles most targeted by thieves because motorbikes are more easily carried away than cars so they are easier to steal. One of the factors causing the high rate of motorcycle theft is the neglect of motorized vehicle owners by parking in any place without supervision.

Additional safety systems for motorized vehicles are additional safeguards in addition to the starter buttons on motorized vehicles. For that we need a better security system. The need for a vehicle security system can make it difficult for criminals to steal vehicles to be able to run motorbikes and give warnings to motor vehicle owners.



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2. Data Mining

Data processing needs are getting added value from the collected data, encouraging the application of data processing techniques from various fields of knowledge such as statistics and artificial intelligence. It turns out that the application of this technique presents a new challenge that ultimately leads to a new method called data mining. There are several definitions of mining data that are known from various sources, including:

1. Data mining is a search and analysis of large data techniques to find meaningful patterns and rules.
2. Data mining is the process of finding patterns and relationships in a data.
3. Data mining is an automatic or semi-automatic process for discovering new and potential knowledge from a set of data [3].

Based on some of these definitions, it can be concluded that data mining is closely related to the discovery of information or knowledge that is new, unpredictable in the database, both automatically and semi-automatically.

3. Receive Signal Strength Indicator (RSSI)

RSSI is a technology used to measure signal strength indicators received by a wireless device . In fact, there are many limitations obtained in direct mapping of an RSSI value measured by distance, because in the process, RSSI is affected by noise, multi-path fading, transmit power, interference, etc. that make fluctuations in the power received. A power received at an antenna (P_r) is separated by the distance d from a transmitter antenna with the known transmission power (P_t), then given the Friis equation as shown below.

$$P_r = P_t G_t G_r \left(\frac{\lambda}{4\pi d} \right)^2 \quad (1)$$

where G_t is the gain / gain of the transmitter antenna, G_r is the gain / gain of the receiving antenna and λ is the wavelength. States that channel models such as log normal shadowing provide RSSI values of the distance d from the transmitter given in the equation :

$$\text{RSSI}(d) = P_t(d_0) - P_L(d_0) - 10n_p \log_{10} \left(\frac{d}{d_0} \right) + X_\sigma \quad (2)$$

where P_t is transmission power, while P_L is path loss to distance reference and is path loss this exponent is influenced by the environment around the transmission media. Random variations on RSSI are modeled as random Gaussian variables where $X_\sigma = N(0, \sigma^2)$ n_p and σ values can be set according to the propagation environment conditions [4].

4. Fuzzy Logic

The fuzzy logic processes the measurements of RSSI using fuzzy method, resulting in the measurement recommendations used based on the position vehicle and the highest degree of fuzzy membership. Fuzzy is one of the best ways to map an input space into an output space. The starting point of the modern concept of uncertainty is that it is introduced about a theory that has objects of a fuzzy set that has imprecise boundaries and membership in a fuzzy set, and not in the form of logical right or wrong, but expressed in degrees . The function of membership is a curve showing the mapping of data input points into their membership value (also often called as membership degree) which has intervals between 0 and 1.

4.1. Triangle Curve Representation

The representation of triangle curve is essentially a combination of two linear representations (increase and decrease) as shown in Fig. 3.

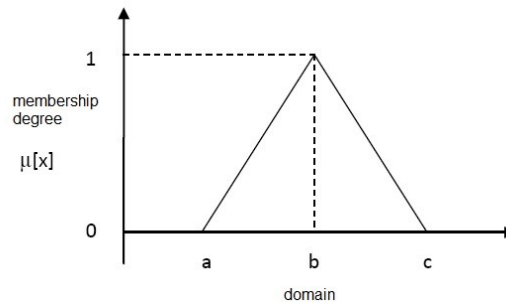


Figure 1. Triangle Curve

The function of membership is:

$$\mu[x] = \begin{cases} 0; & x \leq a \text{ or } x \geq c \\ \frac{(x-a)}{(b-a)}; & a \leq x \leq b \\ \frac{c-x}{c-b}; & b \leq x \leq c \end{cases} \quad (3)$$

Where:

a = the lowest value of domain which has membership degree of 0

b = the value of domain which has membership degree of 1

c = the highest value of domain which has membership degree of 0

5. Research Method

Research prevents vehicle thieves from turning on vehicles and detecting vehicle positions. So that if the thief will take the vehicle, he will lead the vehicle away from the parking location. If there is an indication of theft as it is called, the android application will monitor the position of the vehicle with fuzzy logic based on the RSSI signal received. The block diagram image will be like this.

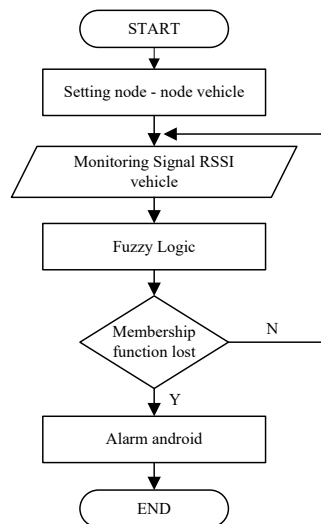


Figure 2. Block diagram system

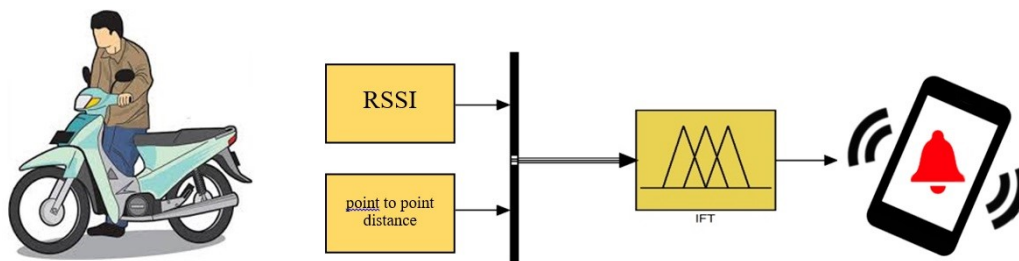


Figure 3. Data mining application system for monitoring vehicle position

The thief must guide the vehicle away from the parking location because the vehicle has an additional safety lock above. 2.4 GHz wifi transmitter placed on the vehicle, then the vehicle is monitored position by point to point android application with fuzzy logic by measuring RSSI.

5.1. Measurement location



Figure 4. a. The measurement location vehicle position with the obstruction of the wall.
b. Locations of measurements without obstruction in the parking area.

The research was carried out in the Sultan Agung Islamic University campus. The measurement of the first RSSI as shown in Figure 3 is carried out in the wall space to monitor the vehicle. Figure 3.b. is an unobstructed RSSI measurement carried out in the parking lot. The time of measurement is done in the afternoon when there is not much traffic activity around the measurement area.

5.2. Measurement samples

The measurement sampling technique determines :

- The initial coordinates of the access point placed on the vehicle as a 2.4 GHz WiFi signal transmitter, for setting point to point.
- Determination of the maximum range of WiFi signals that can be received by the RSSI measuring application with a wall obstacle and without obstruction.
- RSSI (Receive Signal Strength Indicator), analyzed by fuzzy logic to map into membership as monitoring vehicle position.

The RSSI measurement sampling test drive is useful for monitoring the position of a vehicle with the fuzzy logic method, the signal received will be determined in the category of very secure, secure, alert or lost. Determination of fuzzy membership if there is an indication of theft of the vehicle's position of the vehicle will change so that the RSSI signal decreases until it is lost. After membership is in the lost category, it means that the vehicle moves away until the lost RSSI signal then alarms the Android application activated. Previous research found that the Android application compared to the Windows application has a difference in the measurement size below 5% [5]. This study uses a wifi R206 mobile transmitter, then measured the RSSI with an Android application based on fuzzy method.

6. RESULTS AND DISCUSSION

6.1. Display of Android Applications

The wireless sensor network application for monitoring the position of the vehicle will result in some views being generated as shown below.



Figure 5. a. Display of membership Fuzzy Very Secure membership with RSSI -65 dBm
 b. Fuzzy Alert membership display with RSSI -86 dBm
 c. The membership display of Fuzzy Lost with RSSI is smaller than -90 dBm

Figure 5.a. is the measurement of the display of the android monitoring application of the vehicle in a position close to the owner's smartphone, measured by the RSSI of -65 dBm and membership fuzzy very secure. Figure 7.b. distance of 15 meters with RSSI of -86 dBm, membership fuzzy alert. Figure 3.c. is a distance of 20 meters so that the RSSI is smaller than -90 dBm and fuzzy lost ownership. Fuzzy lost membership will sound an alarm from the android application. The above display is the result of monitoring the position of the vehicle with the obstruction of the wall of the room. Measurements with locations without obstruction have a maximum distance of 80 meters with fuzzy lost membership and RSSI below -90 dBm.

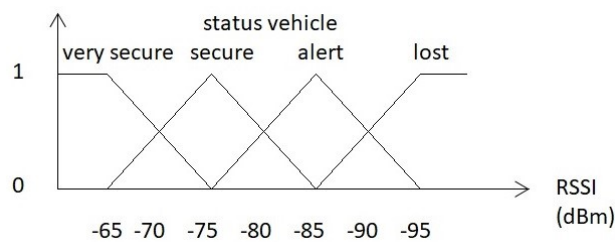


Figure 6. Membership function fuzzy monitoring vehicle position

6.2. Data Appearance

The first measurement was carried out in the room with the vehicle at a maximum distance of 20 meters from the user, the second measurement carried out in the parking area without obstruction of the wall obtained maximum measurements of RSSI reception as far as 80 meters.

Table 1. Membership Function of RSSI point to point with wall obstacles

RSSI (-dBm)	Distance (m)	Membership function fuzzy
-56	3	Very secure
-65	6	Very secure
-77	12	Secure
-86	15	Alert
-89	19	Alert
	≥ 20	Lost

From table 1 is the measurement of RSSI point to point with fuzzy logic. Measurements are made with wall obstacles. The results obtained are a maximum range of 20 meters and RSSI point to point is -90 dBm. When the distance ≥ 20 meters the membership function is in the "Lost" category so that it sounds an alarm on the android application to alert the vehicle owner.

Table 2. Membership Function of RSSI point to point with no obstacles

RSSI (-dBm)	Distance (m)	Membership function fuzzy
-60	15	Very secure
-66	30	Very secure
-73	45	Secure
-86	75	Alert
-89	78	Alert
	≥ 80	Lost

Table 2 shows the measurement of RSSI point to point without obstacles. When the distance ≥ 80 meters and RSSI -90 dBm, the membership function is in the "Lost" category, this condition turns on the android alarm so that the vehicle owner checks the position of the vehicle.

7. CONCLUSION

The conclusions obtained are as follows :

1. Data mining with fuzzy method is able to give a warning if there is an indication of vehicle theft.
2. Monitoring vehicle with obstacle walls has the farthest distance of 20 meter and RSSI -90 dBm.
3. Monitoring vehicle without obstacle walls has the farthest distance of 80 meter and RSSI -90 dBm.

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