Implementation of Vehicle Tracking using Radio Frequency Identification (RFID): vTrack

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Abstract

The paper aims at using RFID for developing tracking systems for vehicles. Vehicle tracking is one way to improve company or organization efficiency, increase profitability, especially in the business of large vehicle fleets. The automatic vehicle tracking facility delivers the flexibility, scalability, and responsiveness that today's organizations need. vTrack requires installing RFID tags on all vehicles and RFID readers on various junctions of location for tracking. vTrack aims to track vehicles that passing through premise's gate. vTrack provides a complete screening process for security requirements and assists the safety also can be used more easily and effectively.

Keywords*:Vehicle tracking, RFID, security*

1. Introduction

With the advance of globalization, transportation is playing an important role. Vehicle is a machine that is boarded by people to travel from one place to another which is known as the carrier. For a vehicle, it has its own identity number known as plate number. This plate numbers will be registered in a particular party in the name of vehicle owners who purchased the vehicle.

Normally, in some localities such as high-class place or a place with a high level of security (management library system, hospital management system, asset management system and much more), the number plate of the vehicle or a description of the vehicle itself will be known or ascertainable . This will ensure the safety of the place.

Vehicle tracking is a way to improve company efficiency and in effect, increase profitability, especially in the business of large vehicle fleets [1][2]. The tracking system is the advance technology, and is the key to release the value trapped in asset management. By its non-contact, scan-based data reading characteristics, it automates the asset tracking and data acquisition that facilitates an enterprise to locate vehicles and even uses location information to optimize services. With the help of tracking information, the manager is able to access one or more driver locations and gets their status information on a real-time basis for example checking if the drivers execute the order; if they follow the driving routes; and if there is any traffic congestion

To deal with this problem, recently developed technology provides an efficient way. Radio Frequency Identification (RFID) is an emerging technology that uses wireless radio to identify objects from a distance without requiring line of sight or physical contact [3]. RFID enables the user to capture real-time information in fast moving and bulky product flows with the aim of achieving a high degree of efficiency and assuring high quality. The components of a typical RFID system include an RFID tag, an RFID reader, an RFID antenna, an RFID middleware and the backend system. Nowadays, RFID were applied to inventory management, goods tracking [4][5], intelligent speed test [6], vehicle tracking [3] and gate guarding system.

The RFID tag is the identification device attached to the item to be tracked. The RFID reader and antenna are devices that can recognize the presence of RFID tags and read the information stored on them [7]. The aim of RFID middleware is to process the transmission of information between the reader and other applications after receiving the information [8]. Middleware is software that facilitates communication between the system and the RFID devices. vTrack provides statistical

analysis for future operation. It also provides accurate and powerful analysis features required to make better decisions faster. It is now widely recognized that real–time vehicle information will revolutionize the control and logistical organization with significant vehicle fleets. In a global marketplace where productivity is crucial to success, vehicle fleet operators use vehicle management systems as a formidable tool to drive down costs and increase the value of their service.

2. Literature Review

Mobile robot is one of some electronic devices that was used to track person or identify person in the crowded place by T.Germa et.al in vision and RFID data fusion for tracking people in crowds by a mobile robot [1]. The researchers address that the problem of realizing a human from the following task in the crowded place. Particle filters [2] that are in different scheme are used to investigate for person tracking in robotics and vision communities. Particle filters were proposed by Cielniak et al. that used thermal vision to detect people or human and the colour of images for capturing the appearance [9]. They have a problem to particle filtering framework that make heterogeneous data when they had data from their research. Also, when the robot were used to follow an identified person, the researcher faced difficulty to control the motion of the robot. So, they came up with the strategy to use mobile robot that contains a 360^{o} RFID detection system and active perception system that have camera mounted on a pan-tilt unit. It also have multi-sensor-based control strategy based on tracker output and RFID data. Benefit of using mobile robot with RFID is that the robot can follow the specific person in crowded places. Another research [10] that using RFID was implemented in shopping service system. These researches were made because it was easier for the customer to buy merchandise and the retailer to do their job. The problem statement is in the market, there are no system provided to recommend and promote the special items. There is no shopping route planning for the customer to make them easy to move to search out the items in the market and the guide for items location. So, the researchers make some strategy to use the system with RFID. They make the entrance and exit of retailer as the starting and ending point for route planning. Before they use the system, the data history of the customer had been recorded and knew the effectiveness of RFID location. RFID tag were placed at every shelf in the market. Personal digital assistant (PDA) mobile device used by customer. The shopping service system used in the computer at the retailer placed. Thus, with RFID-based shopping service system for retailer, the customer has no requirement to spend much time to browse merchandises that they dont want to. The customer can reduce the time pace for searching the merchandises and also they will know the direct shopping route.

Kai Lin [11] use an adaptive vehicle tracking algorithm (AVT) to track the vehicle. The question is how to achieve the precise vehicle tracking with minimized energy consumption. Relationship between position of user and time to search popular area, it [12] was found that the logic in movement rate and residence time was algorithmic normal distribution. Resource-constaint vehicle sensor networks (VSNs) tracks the movement of vehicle in the monitor area. It consists vehicle nodes and monitor nodes. Only monitor nodes can do the tracking tasks, but not all the monitor nodes that turned on at all time. Researchers have to predict vehicle movement and have to awake the nodes around the vehicle to track the vehicle. So the researcher used AVT that utilizes awakened area sector and sigmoid function. It reduces participated monitor nodes and decreases energy. If it like this, AVT can track the mobile vehicle and at the same time it can diminish energy.

Another method to track vehicle is by using camera. A research by Reyes Rios-Cabrera et al. [13]. By using multi-camera to detect and identify vehicle in a surveillance tunnel. it is because before the research, the images of vehicle were in poor quality with low resolution and interlacing effect, also the motion of vehicle were blur. Hence, the researcher made a research using AdaBoost cascade to detect and compact vehicle fingerprint on ground truth images. They implement vehicle detection, tracking and matching together. Therefore, they using non-overlapping cameras and the time is inder control.

3. A case study in UMT

University Malaysia Terengganu (UMT) is one of the public universities in Malaysia. Research shows many vehicles in violation of campus regulations at any given point in time. Not only that, manual compliance monitoring methods are usually depend upon other incident detection events, resulting in minimal sampling of the total vehicle population. Stolen vehicle case inside campus is risen year by year as number of vehicle are kept increasing.

The objective of this research project is to develop an affordable solution to these problems by using RFID auto ID sensors and wireless information networks for the collection of the real-time field data from a vehicle. It also provided some extra features to the recent system which are; making documentation process efficient and effective, provide safety in vehicle, and provide campus security administration wide variety of application. A prototype is used to illustrate how to implement the system under various scenarios within the campus.

Although security guards will make roadblocks or care in the main gate of UMT, but not as difficult to detect a suspicious vehicle in the event of a problem that cannot be resolved by using a vehicle tracking system by using RFID technology. However, security guards or staff on duty at the time will see on the computer screen to see any vehicle that is quite suspicious. The lecturers, staff and students of UMT will not have to stop or slow the vehicle prior to make security restrictions. From the observation of researcher, there are a few problems that emerge. The problem statements are:

i) Security guard overlooked vehicle which make mistakes when too many vehicles passing through the gate.

ii) The security guard had to write down the number plate identification of staff or students who make mistakes.

iii) When the weather is too hot or heavy rain made him more difficult to examine the condition of the vehicle.

4. Technology RFID

RFID is one way to determine the identity of an object, animate or animals that information automatically. RFID has the same concept with bar code technology but uses radio waves to detect the data from the tag. RFID consists of an antenna and receiver / reader (transceiver) that will read the radio frequency and transfer the information like serial number, name, and identity number in the tag is an integrated circuit containing the radio frequency circuitry and information as the same as the code delivered. The bar has a magnetic strip that will be detected by the reader or antenna. Electromagnetic or electrostatic in the radio frequency of the electromagnetic spectrum will alert the reader to identify information of an article.

Figure 1 shows the flow of data from the RFID tag to the computer. Tags will be sent to the reader and the next wave; the reader will capture data from tags and send it to the computer.

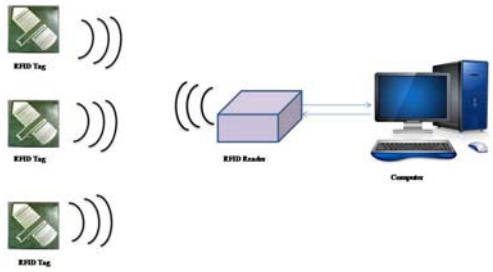

Figure 1. The flow of data from the RFID tag to the computer

4.1. Component RFID

There are three major components of RFID which is RFID tags, RFID readers and RFID middleware. These components are needed to improve the accuracy of the data obtained from an article. Figure 2 shows the process of electromagnetic flow detected by the reader and data movement.

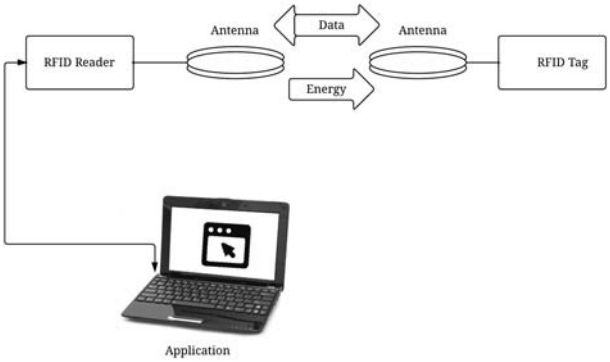

Figure 2. Electromagnetic flow process

4.1.1 RFID Tag

RFID tags come in many shapes, sizes and characteristics of different combinations. RFID tags used in vehicle tracking is passive RFID tag with radio frequency transmitted to the reader and the strength of the signal waves from the reader to the tag is high, while the strength of the signal wave from the tag to the reader is low. The distance of detection signal for this tag is in three meters or less depending on the passive RFID tag. It is also less expensive than active RFID tags, which operate at low, high frequency and ultra high frequency.

4.1.2 RFID Reader

Readers used is 4-port type CS61 EPC CLASS 1 GEN 2. Readers of this model type are the type of products and active RFID passive UHF frequency. The reader is supported by Impinj technology; with a very high level of preparation, speed tag and reader modes accurately. Readers of this model confirmed by EPCglobalTM Class 1 Gen 2 UHF RFID protocol. Among the features of this model the reader is: -

i) Unique and has a great function also organized for easy reading data.
ii) The coverage or comprehensive global frequency that can be used and endorsed by all country.
iii) Sophisticated data handling for efficient management of data tag on a Local Area Network (LAN).
iv) High configuration and tag filtering modes to reduce the data and ultimately reduce LAN traffic load.
v) Performance in situations readers is quite thick and dense.
vi) 640 Kbps data rate tag.
vii) Good in receiving the data that produced by different combinations of tags and types of rates.
viii) Support all Gen 2 tag types including write, lock and kill.

5. vTrack architecture

Design of a conversion process specifications to form a statement. It would be done after identifying the main functions of the system and aim to translate requirements specifications into structured form that can be used. Therefore, the design is very important for a system.

System architecture is divided into four parts as shown in Figure 3. The main function is as former rich virtual files in the file system where the digital data stored there, turn the computer as a tool that allows users to install a vehicle tracking system. Reader will detect the code inside the tag found in the stickers. Then the reader will send the information (any movement of the vehicle) to the computer. This information will be read by the software and will then call the data in the database and follow the instructions or produce output on a computer screen.

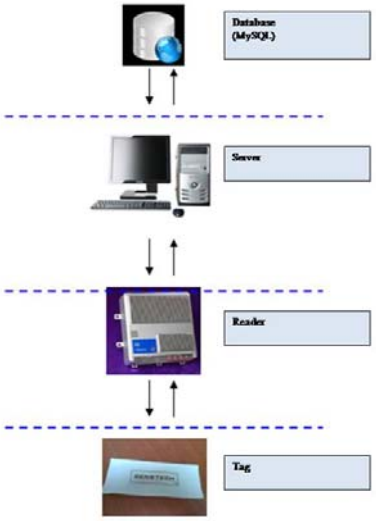

Figure 3. Vehicle Tracking System Architecture using RFID

6. Implement of vTrack

vTrack will be used in University Malaysia Terengganu (UMT). The system will be installed on the computer as a key component that will connect readers and antennas RFID (Radio Frequency Identification). This computer is placed at each gate in and out of UMT. With this, the vehicle lecturers, students, staff and vendors will be detected. RFID reader detects the tag to be affixed with stickers UMT.

vTrack comprises of three modules which are registration module, vehicle tracking and data analysis. UMT staff or students must register their vehicles to be used in UMT safety unit. Security officer will enter data into the system user of the vehicle which in turn will be stored in the database. Within a week, the sticker will be issued by the relevant consumer safety. Users will affix stickers on their vehicles. When a vehicle is registered through the front gate at UMT, antenna will track the vehicle placard and send the data to the system. Computer will display the data, then the security guard can see all user data is detected by the antenna as in Figure 4.

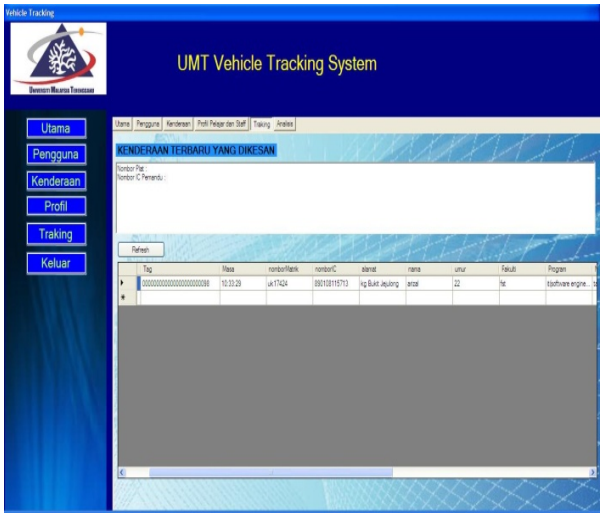

Figure 4. Information the user or owner of the vehicle plate

In addition, the security officer identify the peak period for the vehicle using UMT gate as shown in Figure 5. It also shows the interface for vehicle tracking system report. The graph shows the number of the most abundant type of vehicle through the main gate of UMT.

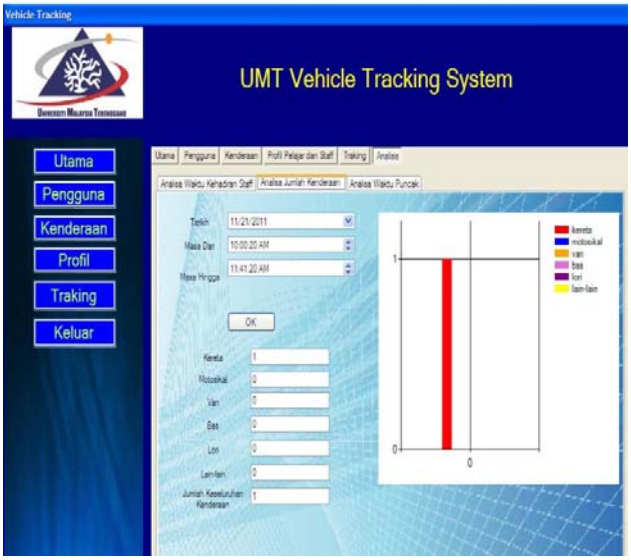

Figure 5. Statistical Analysis

Security officer can determine the number of vehicles passing through the gate of UMT in a day as shown in figure 6. All related data that being track will be stored in the database. Figure 6 shows the number vehicles passing of through the main gate UMT at a certain time and date. Most number of vehicles at a given time will be preferred ('text field' in red).

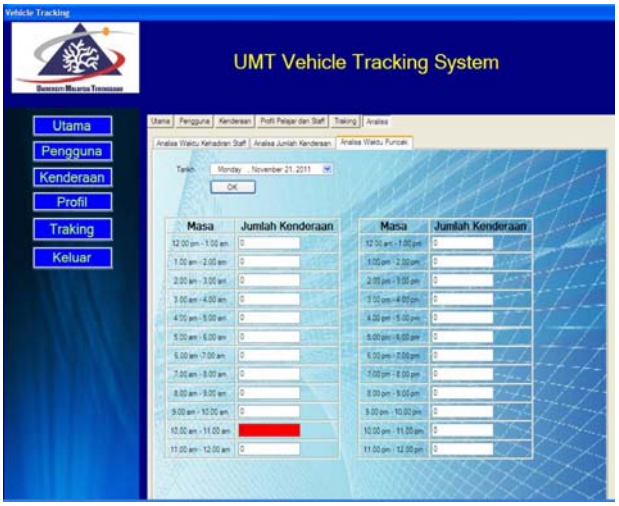

Figure 6. Number of vehicles passing

7. Conclusion

In this study, the feasibility of using RFID in the vehicle tracking is discussed. vTrack is useful because it can assist and facilitate the process of vehicle tracking, especially for the security department. This project is promising to improve the quality of safety in UMT. Some criminal cases such as theft, kidnapping and others can be controlled.
Apart from the operational benefit, the vehicle tracking system also provides the security department with statistics. By using the statistics, such as average operation time or frequency of traffic congestion, drawn from the system, the security department can have better future development. For example, the Operations Department can make use of the statistics in traffic congestion; control the traffic in order to construct better Yard Planning
In conclusion, Vehicle Tracking System using RFID technology can provide a complete screening process for security requirements for example in Malaysia. Vehicle Detection System detects vehicles entering information about the area and can be detected if there is a problem related. The system is required to assist the safety and can be used more easily and effectively. The system also needed to assist security officers in doing their daily tasks with easy and efficient highways. The system developed according to the needs of users in the careful planning and analysis.

8. Acknowledgement

This study was funded by Senstech Sdn. Bhd.

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