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Notification System of Student Presence on a School Bus based on SMS

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Abstract

School bus is one of the transportation facilities provided by several regions in Indonesia. The school bus is used as a means of public transportation for school students to go to school. This study aims to improve school bus facilities by adding monitoring features that can help parents monitor their child's presence on the bus. Notification is given in the form of a SMS containing departure and arrival information including status, student name, time, date and location. The system is built using Raspberry Pi and using Gammu to provide a notification message. Based on testing, the system can provide notifications in sms form properly. The system can send notification when student get in and off the bus based on RFID tapping.

Keywords; *Notification, student presence, School Bus, SMS*

I. INTRODUCTION

Technology has been an important aspect that cannot be separated from daily activity in today society. The field of transportation is one of them. Various advanced technology has been implemented in this field to add more functionality and comfort to all of it user.

Buses are one of the most common types of public transportation and one of its main users is students. Several regions in Indonesia have implemented school bus transportation systems for their region schools. This aims to reduce congestion and provide low cost alternative transportation for common people, especially students.

Some of the school buses in Indonesia are equipped with facilities that support the activities of students. Their operational time and routes are adapted to the time and location of the school and some of them are already includes Wi-Fi facilities.

Studies in this field mainly targets on parents, as one of the subject that is greatly helped by the school bus facilities. The object is to advance these facilities with additional monitoring feature to enable parents to get information regarding their kids while traveling by using a school bus, such as their time of departure and status.

A previous research on bus facilities was proposed by GaikWadPrameshwar. In his research, the bus was equipped with GPS sensors and GSM communication systems. The purpose of his research was to improve bus service management based on GSM-GPS. Messages are sent to passengers waiting for the bus when the bus leaves the last bus terminal. The system also provides automatic passenger counting facilities [1].

Other studies have also been done in this field especially in IoT Technology. Sridevi, et.al, has made a smart tracking bus system using GPS and IOT. This tracking is using Android application for its user. Maninikumbar use IOT with web applications [2]. Samsul Kamal Ahmad Khalid

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introduced the system called UBAIS (University Bus Arrival Information) which has the ability to update the estimated time of arrival data on the route to the next stop terminal continuously [3].

Yogyakarta, Blitar, Malang and Bandung are several cities in Indonesia that already partially implement school bus system for students. A social research done by UswatulFitrah has mentioned that the service of school bus transportation in Blitar city has been going well and is very effective [4]. Other similar research done by Toni Prasetyo also mentioned the same positive outcome in Malang city [5].

The regulation no. 29 from the minister of transportation in 2015 mentioned that the effectiveness in transportation was measured based on factors of safety, comfort, affordability, equality and regularity and it is very important to improve these five factors in the matter of improving school bus services [6].

There are many researcher study about how to enhance a feature of scholl bus. Minu, et al proposed real time college bus minitoring and notification based on IoT[7]. Judy Thyparampil Raj proposes monitoring school bus based on IoT [8]. Other researcher propose school bus tracking, monitoring and security system [9] [10]. Another IoT based monitoring system on school bus proposed by Raja Godwin

application used is Gammu. The information sent includes the student's identity, the time data, and the location of GPS. This information is sent to the parents' cellphone every time the student entering or leaving the bus.

[11].

Other study which use the same platform is proposed by Abishek, et,al. They used raspi as a prosesor but the used raspi camera to do monitoring [12]. Another researcher has the same feature notification but they used different platform [13] [14][15].

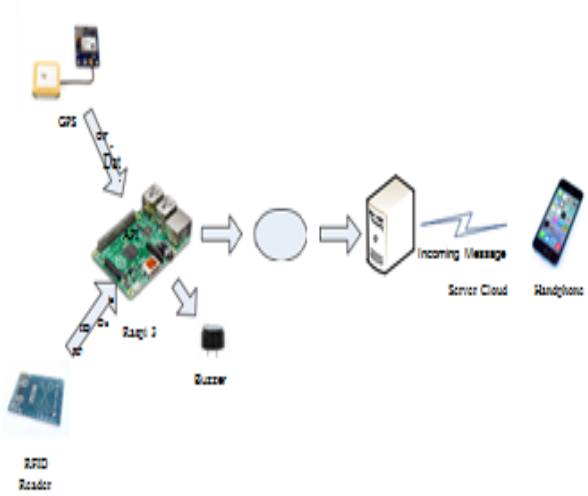

Fig. 1. Block Diagram System

In this study we developed a system based on researchers that had been done before and adapt it to the situation and conditions in Indonesia. To increase the effectiveness of the system, an additional component was implemented to increase the security, safety and comfort factors. This is applied by adding notification facilities to the presence of students on school buses.

The notification system used a free Short Message Service (SMS) based on IOT. With this notification, parents can ensure the status of their son and daughter in their way to school by having the information of the identity for the bus that is used, the departure and arrival time and also their location.

Section 2 on this paper is focus on proposed design and implementation of the smart notification on school bus. Section 3 is discussing about result and discussion based on system test. Section 4 is representing the conclusion.

II. PROPOSED A SCHOOL BUS NOTIFICATION SYSTEM

School buses in Indonesia currently have not implemented smart notification and smart tracking systems. Commonly, parents are using cellphone individually to monitor their children whereabouts. Based on this condition, we think that it will be

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better if this monitoring job is included in the transportation system itself so it could be more reliable to all parents. Therefore, this system needs to be able to:

- Identify the presence of the student inside the bus.
- Detect the location of departure and arrival of the student.
- Send notification that contains the information mentioned to parents.

Based on the above requirements analysis, a system is made as shown in Figure 1. The system is equipped with an RFID Reader which is the identity of each student who uses school bus transportation. The use of an RFID card can take the form of a student card or a school bus membership card. The GPS sensor is used to detect the location of the bus when students take the bus or get out from the bus.

The notification system made using API (Application Programming Interface) which used to send SMS. The

The specifications of the prototype are as follows:

- Using U-blox GPS module 7 m to detect the location
- Using Gammu as application to send SMS
- Buzzer is used to notify RFID card reader
- Raspberry Pi 2 Model B is used as a processor and wife to connect to online server [12]
- RFID Reader Mifare RC522
- Using LAMP (Linux, Apache, My SQL, PHP) to process, transfer and save data to Raspi 3
- SD Card to save Raspi Operation system, data and application[12].

The identity of RFID card of each student and parent's phone number is assumed have been previously stored at the time of registration process. So we need a database to store and manage data stored in SD card. This system use My SqL and PHP to manage and to store data. Student will do RFID tapping every time they entering and leaving the bus. This activity will trigger the sending of notification to the parent.

There are several processes that performed in building the system, which are:

- Installation Raspbian Wheezy
- Installation and configuration of U-blox GPS modules 7m
- Installation and configuration RFID Reader and Buzzer
- Prepare database of student ID and parents phone number
- Installation Gammu and programming notification delivery

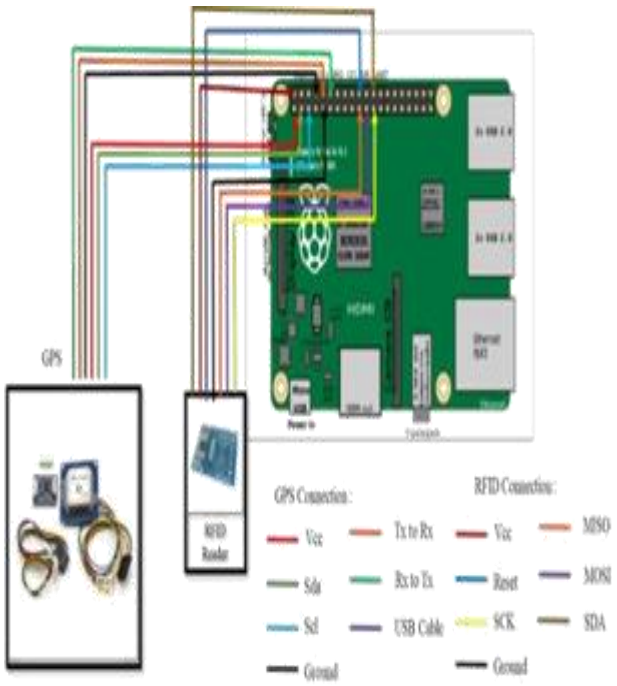

Fig. 2. GPS, RFID and Raspberry Pi Configuration

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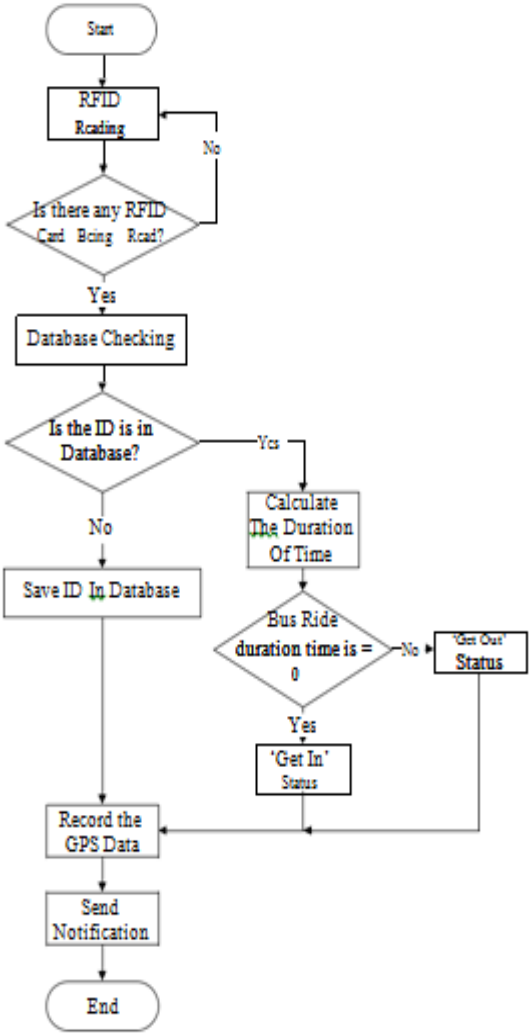

Fig. 3. Flowchart A School Bus Notification System

Figure 3 describe flowchart of the whole system. System will read the RFID card continuously. If an RFID card being read, the system will check its database. If the data matches the data base then system will calculate the bus ride duration time. If the bus ride duration time is equal 0 then the state is change to ‘get in’ the bus. Otherwise if the bus rides duration time more than 0 then the state changes to ‘get out’ from bus.

System then will check student ID data and calculate bus ride duration time. As mentioned, this duration time will distinguish between the ‘get in’ and ‘get out’ notification. The raspberry Pi then record the GPS data and sending a notification to parents which consist of Student Name, Time, and GPS data location.

The database is prepared by installation MySQL and python_mysql dB server in Raspberry Pi. The first database is a Student Database consisting of Student ID, Student Name, Parent Name, and Parent Telephone Number. RFID data base stored in the second table consists of RFID_Code, Student_ID, and Create_Date. Figure 4 represent result of RFID data Storage.

III. RESULT AND DISCUSSION

A. Testing The Prototype

Database is prepared by installation mysql- and phyton-

mysqldb server in Raspberry Pi with the command "apt-get install mysql-server" and then running my sql server with the command "my sql -u root -p". The following step is to make database. The first database is a Student Database consisting of Student_ID, Student Name, Parent Name, and Parent Telephone Number. RFID data base is in the second table consist of RFID_Code, Student_ID, and Create_Date. Databse testing is done by storing data into tables and observing the result. Figure 3 represent result of RFID data Storage.

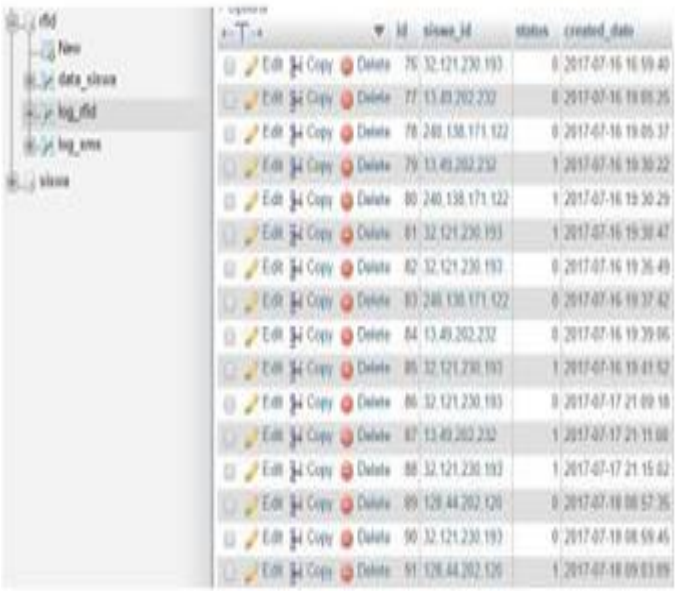

Fig. 4. Result of tapping RFID storage

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The configuration between Raspi, GPS and RFID describe in Figure 2. Data exchange between GPS and Raspi is connecting through serial TX and RX pin. While the data exchange between RFID Reader and Raspberry Pi is performed through MOSI and MISO Pin.

The Installation of RFID Reader is start with the installation and setting for SPI and then clonning the MFRC522-python folder. The function of RFID reader then tested by running MFRC522.py which is the library of RFID

reader in python. The detection of RFID card to RFID Reader will get the result as shown in Figure 5.

Fig. 5. RFID Reader test result

The GPS module test was performed in Telkom University Applied Science school area. This test aim to find out whether GPS module can work properly and provide accurate GPS data. The command and GPS test result is shown in figure 6. Figure 7 represent GPS data checking using Google Map. AS shown in Figure 7, the GPS data pointing to faculty of applied science at telkom university. Figure 8 show the result of GPGGA data from GPS sensor which give an acurate location in Google Map.

The following test is buzzer and RFID Read testing. Buzzer is used to indicate wether the Studen_ID is already inside the database or not. As shown in Table I, the result of buzzer and RFID read testing shows that Buzzer will sound short beep 2 times and the Student RFID card is already stored in data base. Otherwise, the buzzer will sound a long beep sound if the data of student RFID card have not been stored in database.

Table I. Buzzer AndRfid Card Read Test Result

RFID card Read	Sound
Detected	ShortBeep2 Times
Not Detected	Long Beep once

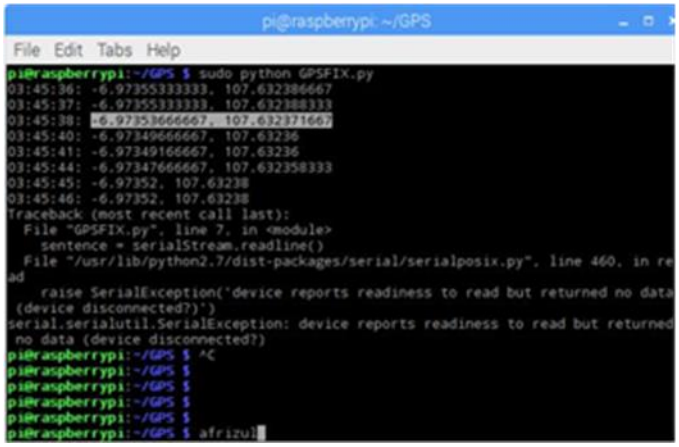

Fig. 6. GPS Data test instruction

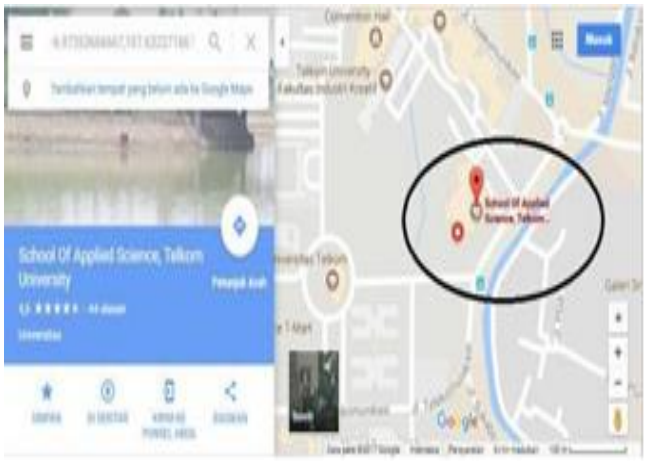

Fig. 7. GPS Data test result with google maps

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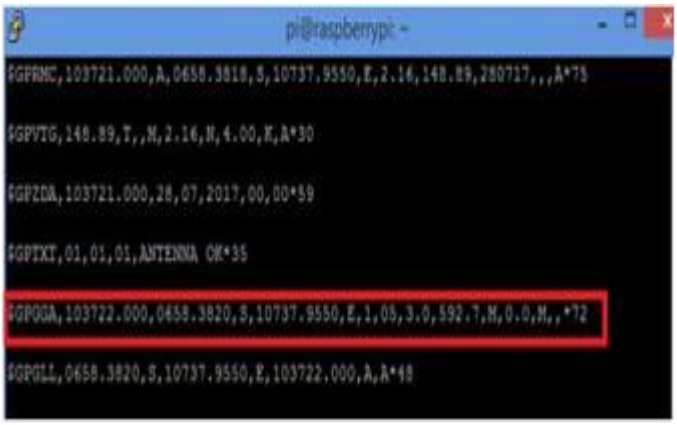

Fig. 8. GPGGA data from GPS

The final test is the integration test for all the module of school bus notification system. The test scenario is performed by attaching RFID card to RFID reader frequently with different duration between first and second attachment and so on. Then the respon of system observed. The goal this test is to determine that the function of notification delivery will work properly.

As shown in Table II, if we attach RFID card to RFID reader once or twice less then two minutes, system will send notification that the student get in to bus. So if RFID reader scan RFID card twice or more accidentally, it will still be clasify as get in to bus process. This is a variable added to avoid duplication or redundant messages sent because of the accidently double reading of the same RFID card.

After two minutes, if the system detect the ‘get in’ RFID it will change it status as ‘get out’ and send the student aparture notification. This ‘get out’ RFID will also have 2 minutes time out variable so it will not get any ‘get out’ notification before the nor identified as new ‘get in’ within this time out period.

Figure 9 shows the notification sent to mobile phone. This notification includes student name, status, date and time, and GPS location code. The message sent through Gammu application installed with free charge but still need internet connection.

Fig. 9. Notification Message to Parent

Table II. Buzzer AndRfid Card Read Test Result

TABLE II. BUZZER AND RFID CARD READ TEST RESULT

Test Activity	Response based on the existence of data in database	
	Defined	**Undefined**
Attaching RFID card to RFID Reader (First RFID card Reading)	• Sending message • message telling student get in to bus • buzzer sound short beep 2 times	• Not Sending message • Buzzer Sound Long Beep once
Attaching RFID card to RFID Reader (second RFID card Reading before 2 minutes)	• Sending message • message telling student get in to bus • buzzer sound short beep 2 times	• Not Sending message • Buzzer Sound Long Beep once
Attaching RFID card to RFID Reader (third RFID card Reading before 2 minutes)	• Not Sending message • buzzer sound short beep 2 times	• Not Sending message • Buzzer Sound Long Beep once

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Attaching RFID card to RFID Reader (First RFID card Reading after 2 minutes)	• Sending message • message telling student get out from the bus • buzzer sound short beep 2 times	• Not Sending message • Buzzer Sound Long Beep once
Attaching RFID card to RFID Reader (second RFID card Reading after 2 minutes)	• Sending message • message telling student get out from the bus • buzzer sound short beep 2 times	• Not Sending message • Buzzer Sound Long Beep once
Attaching RFID card to RFID Reader (second RFID card Reading after 2 minutes)	• Not Sending message • buzzer sound short beep 2 times	• Not Sending message • Buzzer Sound Long Beep once

IV. CONCLUSION

The prototype of a school bus notification can send a notification to parents which consist of student name, time, date, GPS data of location and the state of get in or get out from the bus.

The RFID is already able to detect each student and linked them to their corresponding parent's phone number. The GPS data location of the bus is also having successfully detect and sent.

In future development, this prototype could be improved by adding an android application for registration system and includes Google Map tracking system.

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