PASSENGERS TRACKING SYSTEM FOR SMART SCHOOL APPLICATION USING IOT

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ABSTRACT

The school shuttle system facilitates the students to go home from school. Hence a development should be made for monitoring the students. This paper explains the development of school shuttle system with IoT concept to apply Smart School application. The system will be designed which uses a reader that identifies the identity card of students using Bluetooth Low Energy technology and a localization sensor to regulate the position of the vehicle. Location information and passenger lists will be displayed in real-time mobile applications which can be accessed by parents. The results show that all we propose, In the system will use the algorithm selecting beacon node with rule based expert system approach, to select Cubeacon brought by students in the vehicle. From the testing results, Reader will select Cubeacon based on the beacon search algorithm, with the restriction value RSSI -54 dBm. And the duration taken is 1 minute to declare whether the student is active or inactive in the vehicle.

Keywords—Iot , Monitoring, School Shuttle, Smart School, Tracking.

I INTRODUCTION

Many advanced technologies are being used by the schools in order to help the school activities. This improves the quality of education in schools. But there are some issues remains unsolved. The parents should always monitor their children as they starts going to school from the age of 6.Parents need to drop their children to school and pick up from school and sometimes they need to wait in the school till the child comes. Hence parents always need to pay attention towards their children.

Internet-of-things (IoT) provides a framework for interconnecting edge computing devices, sensors, smart phones and cloud computing platforms for flawless interactions [1]. Smart School is a one of the approach from IoT and it will be a solution for education. As the problem has been explained previously, Smart School will make it easier for teachers, parents and school to monitor their students. With the features of the smart school that is Real Time Vehicle Detecting and Passenger Monitoring they can solve the problems explained previously.

In this paper will be explained about the technology of the iBeacon Bluetooth transmitter which is then named Cubeacon. Bluetooth Low Energy chip or Bluetooth 4.0 inside Cubeacon that can reach a mobile device within a radius around 100 meters and uses a battery with an estimated durability of upto 2 years [8]. With Beacon shaped cards as the identity for each personality. Beacon card is used by students from home to school and vice versa. The card that are carried by the student will emit Bluetooth that are received by Raspberry Pi as a Reader that are installed in the classroom, at school until the vehicle picks up and drops in home. The Bluetooth receiver reader is also integrated with the server that will display information via the web and those mobile applications containing information about Passenger Monitoring ie the list of passengers(students). Parents can also ensure the existence of the location of the vehicle that picked up and escorted his child through the Vehicle Tracking feature in Real Time. The vehicle, also equipped with GPS mounted on Raspberry as the gateway position to send GPS data to the server. The students can determine the departure plan and pick up for effectiveness during the trip.

In this system, a rule based expert algorithm is used to select beacons based on limitation areas. By knowing the value of RSSI that is outside the vehicle, which is the limit for Reader to select Beacon. With this algorithm, the Reader will select Cubeacon which is only in the vehicle. So, students are only detected when they enter in a vehicle. And if the students get out of the vehicle, declared inactive. The rest of this paper is organized as follows. Related works are provided in section II. The system model and problem definition are described in section III. Measurements and Experimental Evaluation are discussed in section IV. Finally, section V concludes the paper.

II RELATEDWORKS

In general, vehicle tracking systems uses a node consisting of a microcontroller and a tracking sensor[2-4].Nodes are also integrated with data transmission modules. In this research, the tracking sensor and module sending data merges into one module. In the study, the proposed algorithm incorporate a Kalman Filter with Mean-Shift[5]. The features of passenger monitoring are also applied in tracking system. This research use RFID as passenger identification [2]. Bluetooth Low Energy is used in research as an automated presence. The attendance system is displayed in the application [6]. To make the use of Bluetooth Low Energymore effective, in research [7] using data channel selection algorithm. By looking at previous research, where vehicle monitoring is implemented is good for the public. In this research, the proposed principle of the node which is almost the same as combining Bluetooth Low Energy as personal identification. Bluetooth Energy functions are used for identifying the presence of passengers in vehicles automatically. Coupled with the beacon selection algorithm using the restriction of RSSI value or distance. Overall, this system is implemented in shuttle school system.

III SMART SCHOOL ARCHITECTURE

Smart School is a system that can improve the quality and effectiveness of schools by using intelligent technology. With a variety of devices and integrated with each other. Activities ranging from departing, learning to teach, assignments, and home can be monitored by parents through mobile devices. Auto Attendance, Real Time Vehicle Tracking, Passenger Monitoring that will provide information on activity data from departing school to return home. Bluetooth Low Energy is used as the ID card for each student's identity.
The architecture smart school tracking is generally shown in Fig 1.

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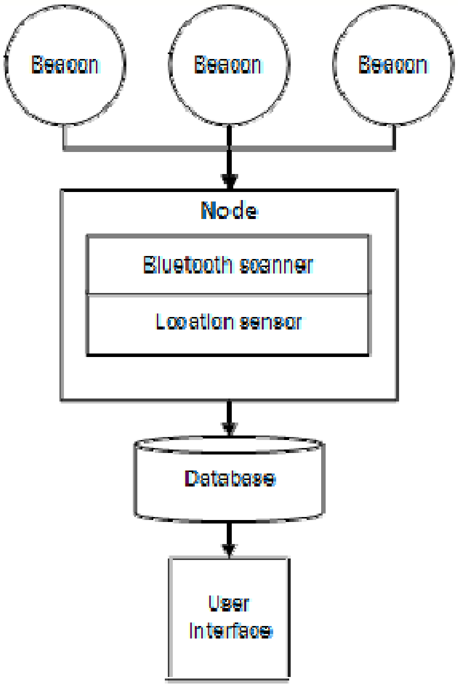


Fig. 1.Smart School Tracking Architecture

The node in this system is a RaspberryPi3 microcontroller. It has 2 functions. The functions of this microcontroller is to read beacons and receive coordinate data with the location sensor. Raspberry Pi 3 already has Bluetooth that support low energy Bluetooth. The location sensor used is USB GPS Receiver. Data from the node is sent to the database. There are two main data transmitted, the list of passengers and the location of the vehicle. List of passengers sent based on beacons already registered in the system. And location data is longitude and latitude.

IV SELECTING BEACON NODE WITH RULE BASED EXPERT SYSTEM APPROACH

Cubeacon is a Bluetooth transmitter with iBeacon technology that has a broadcast area up to 100 meters. With a long distance then the Reader can hold the Bluetooth signal from a considerable distance as well. In order to be the optimal system, then the rules need to be used in Beacon scanning. So, Reader only prefer Beacon in that vehicle. If there is no selection, the data sent is all Beacon data readable by Reader. In the implementation, the mechanisms in Beacon selection are only those in the vehicle. The smallest RSSI or the farthest distance indicates that the passenger is already outside the vehicle. Therefore, algorithm and testing that can be applied in the system. Fig. 2 is an example of distance limitations.

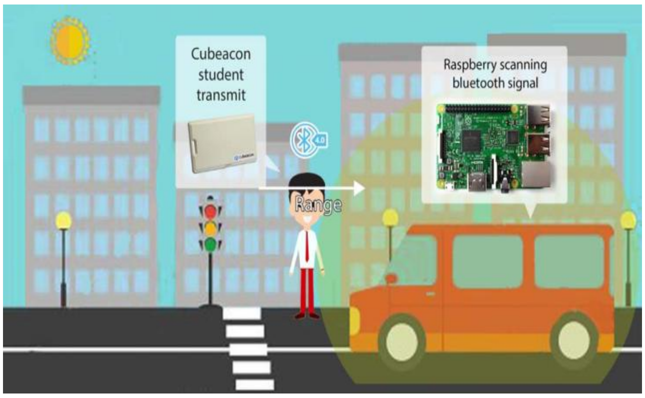


Fig. 2. Limitation distance

So the selection of Cubeacon whether inside or outside the vehicle indicated its mechanism in Fig. 3.

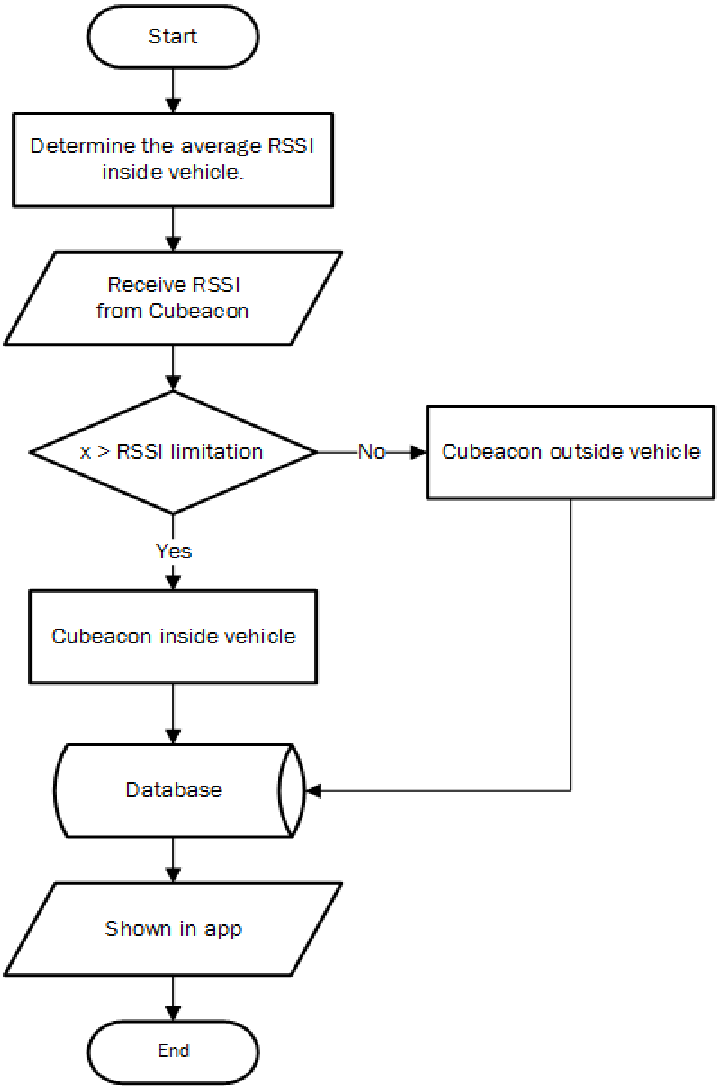
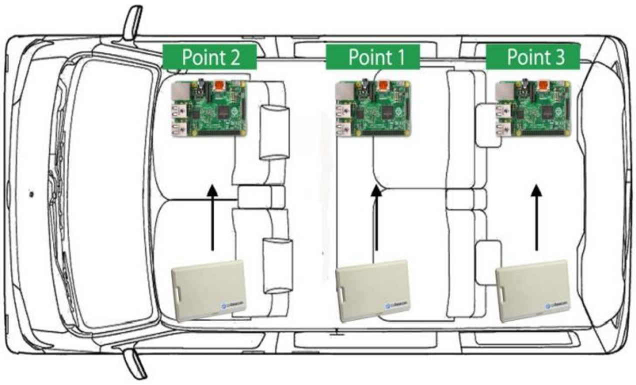


Fig. 3. Flowchart to selecting Beacon

4.1Hardware Implementation

In the implementation phase of the device is done the installation of the device on the vehicle. Each device has its own function ,Raspberry as Reader, LCD Display as Raspberry display, GPS as a gateway to coordinate the



position of the vehicle and Modem to send all data to the server processed with the database. As shown in Fig.4.

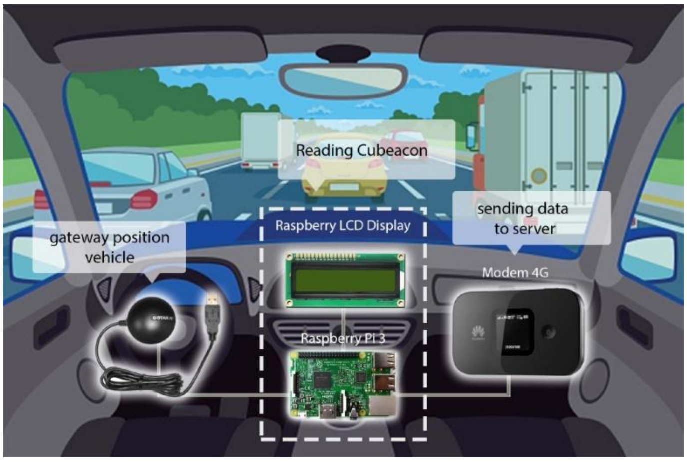


Fig. 4.Hardware design in vehicle

4.2 User Interface Implementation

At this stage, an Android-based app is created that will be used by parents, teachers, and drivers of school vehicles. This Android app will be connected to a database hosted so that it can be accessed anytime and anywhere. To access the information, the user must login first. Each different user has its own menu, so there are accounts for parents, teachers, and drivers of school vehicles.

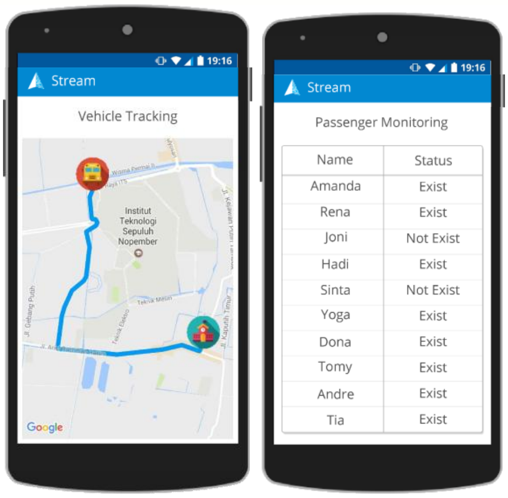


Fig. 5. User interface on Android

Applications for the Website will also be created that will be used by the admin as a user interface to process data from the Smart School System. With the website, admins can control the information thoroughly.

V MEASUREMENT RESULT AND ANALYSIS

In this research, there are tests to know the performance of the system. The focus of this test is to know the performance of Readers to choose Cubeacon. By testing using Selection Beacon Node method with Rule-Based Expert System Approach. The first test gets the average value of RSSI on the vehicle. The vehicle used is a type of MPV vehicle with a passenger capacity of 7 people.

Tests on vehicles are done in three parts: inside, around and outside. Differences in place to support the difference in the value of RSSI that Reader received. Inside the vehicle is done at three points. Around the vehicle is done in front, rear, on the left and right side. Outside the vehicle with mileage ranges from 1 meter to 10 meters. The RSSI value will be used as a limiting value for Cubeacon selection. Tests conducted on MPV type vehicles. Here are the results of testing in the RSSI value taking inside, around and outside the vehicle.

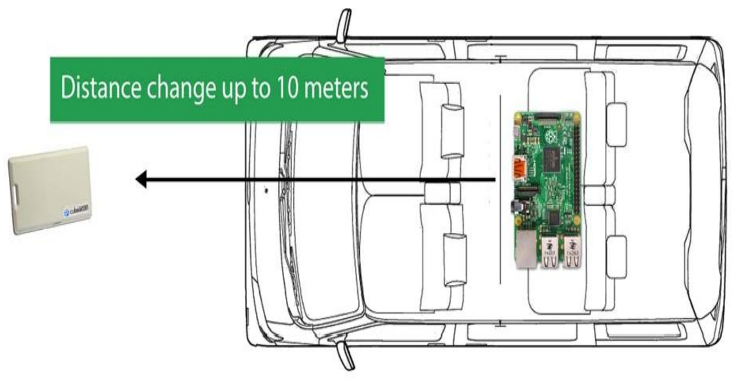


Fig. 6.Testing average RSSI around vehicle

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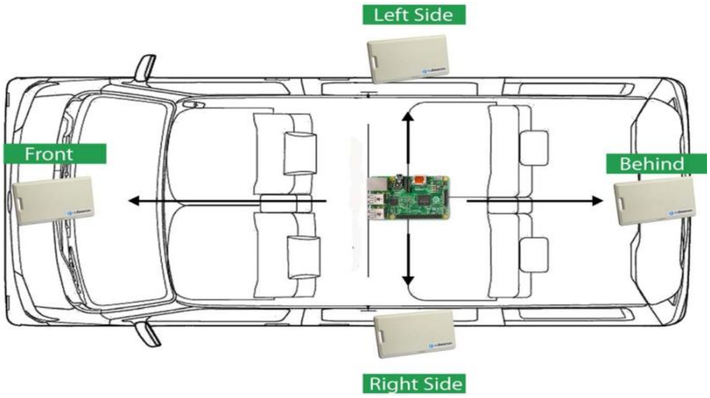

Fig. 7. Testing average RSSI inside vehicle

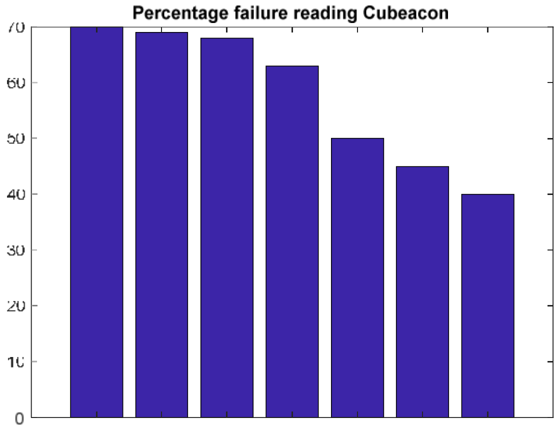

Fig. 8. Percentage failure reading Cubeacon around vehicle

TABLE I.AVERAGE RSSI INSIDEVEHICLE

	Point 1	**Point 2**	**Point 3**
Average	-56	-50	-55
Overall Average			-54

TABLE II.AVERAGE RSSI AROUNDVEHICLE

	Left Side	**Right Side**	**Front Side**	**Behind Side**
Average	-72	-71	-71	-71
Overall Average				-71

TABLE III.AVERAGE RSSI OUTSIDEVEHICLE

Distance (meter)	**RSSI**
1	-77
2	-78

3	-83
4	-84
5	-83
6	-85
7	-86
8	-84
9	-86
10	-88

So, from the test results of success, the time range used in reading is 1 minute. Because the percentage of failure is less than10%.Within a duration of 1 minute, if it is not detected the application will be declared inactive. The next test is Cubeacon reading with Cubeacon in around vehicle. The purpose of this test is to find out whether Cubeacon is still reachable even outside the school vehicle. With a duration of 1 minute, then observed what percentage Cubeacon read by Reader. Fig. 8 show the percentage failure reading Cubeacon around vehicle.

Cubeacon can still be read. The chips used are still not stable. To increase the percentage of unreadability when Cubeacon is present it must continue large.

V CONCLUSION AND FUTUREWORK

In this paper, we propose the IoT implementation based on passenger monitoring for smart school applications using the Low Energy Bluetooth card. The goal of this system is to provide monitoring facilities on the school shuttle process. Based on the algorithm used and the test results, it used -54 dBm as the selection limiting value. In order for all Cubeacon to be legible and have valid data, then the duration used is 1 minute. The future work will use the algorithm to optimize limitation distance with any environment, so system can adaptive. And also image recognition to verify all students in the school vehicle.

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