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# Design and Implementation of IoT Based Vehicle Identification and Information Validation using ZigBee Technology

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**ABSTRACT:** Automatic control in the transportation system using embedded system proves to be a great investment. Automation reduces human effort and saves lot of time. The project describes a system which does the job of identification and validation of the information of the vehicles as they pass through traffic signals and tollgate using ZigBee as the identification technology. The vehicle related information and owner information is programmed into the device and is fitted in the vehicle, which can be read over considerable distance by using ZigBee device which is installed in tollgates and signals. So PC based application detect and identify that vehicle with device when it comes into the network of ZigBee, and validation of the information which is periodically transmitting by vehicle device can be done by PC based application and android application. This framework also presents a system to track the misused vehicles and theft vehicles.

**KEYWORDS:** IoT, ZigBee, CC2530 microcontroller, Coordinator, PC based application.

### I. INTRODUCTION

In the era of technology innovation most of the conventional systems are converted as automated system. Due to automation, less human interference is required so that the time and energy saves and efficiency will increases. The evolution in computer technology and embedded system, the intelligent transportation systems (ITS) has been started. This drastically improves the efficiency of road operation. ITSs coordinate traffic condition, enhance safety, decrease environmental effect, and make effective utilization of accessible assets. Intelligent transportation systems have turned out to be increasingly essential for people in general transportation, industries and service divisions.

Here the proposed a system using ZigBee wireless tags to identify and authenticate vehicles entering into tollgates and signals. Design consists of ZigBee vehicle tags containing authentication information for each vehicle, ZigBee detectors (coordinator) which are installed in such a premises and it must be connected to internet, the coordinator connected to pc acts as hub, a central database containing information about all vehicles authorized, PC based application for updating the information into database and android application for monitoring of the vehicle.

The ZigBee vehicle tags are placed into the vehicle. Tags consist of real time information about that particular vehicle and the owner information. Every time when the vehicles arrive in the range of ZigBee detectors (coordinators), the vehicles numbers will be displayed on the pc based application in the control room. The person in the control room select the vehicle number and the send the request to that vehicle about the particular information such as name, mobile number, chassis number, due paid or not etc. This information will be validating by comparing it with the information in the database. If it is valid data the vehicle will allows to go, otherwise further actions will take. The controller can also set the information into the tag through the pc based application, and that data will be updated into the database. Model of the system was demonstrated based on real conditions and results conclude that the proposed system is viable.



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## II. RELATED WORK

There are a few weaknesses present in existing framework. Because of existing frameworks people are facing the problem of traffic, and a large amount of rush. Now a days number of automobiles is increasing and in which many of the vehicles are not registered with their insurance, license etc and some people forgot to carry all the documents of their vehicles. And due to this, traffic police officers have to stop each vehicle and check public's legal documents of their vehicles and then vehicle is allowed to move ahead. Because of this, public's as well as police time gets wasted and traffic becomes congested. So to conquer these constraints of frameworks we proposed another framework. Our framework is completely automated system which is capable of carrying the documents all the time. Also this system verifies the information related to vehicle and owner.

## III. ZIGBEE PROTOCOL OVERVIEW

ZigBee is the most popular now a days because of its wireless mesh networking standard for connecting sensors, instrumentation and control systems. ZigBee is an open, global, packet-based protocol and specification in a wireless personal area network (WPAN) for communication. ZigBee with IEEE 802.15.4 protocols are wide range and low data rate wireless networking standards that can remove the costly and damage caused by wiring in industrial actuation applications. The ZigBee RF4CE standard enhances the IEEE 802.15.4 standard by simple networking layer and standard application profiles that can be provided to create interoperable multi-vendor user electronic solutions. The benefits of this technology are above the beyond, ZigBee applications include: Home automation, Medical monitoring, Low-power sensors, HVAC control and many other control and monitoring uses.

ZigBee wireless protocol provides means to network a set of autonomous devices each equipped with IEEE 802.15.4 standard RF transceiver to perform some networked task. The IEEE 802.15.4 wireless standard provides the Physical layer (PHY) and Medium Access Control layer (MAC) for the wireless communication while the ZigBee protocol working on top of it would perform the Network layer (NWK) and Application layer (APL) tasks. The PHY, MAC and NWK layers would handle how the underlying wireless data transmission would be carried out and how the network of RF transceivers would be organized while the APL layer would handle the tasks associated with each autonomous device. After power up, a set of ZigBee devices would involve in network formation. A device defined as a ZigBee coordinator would perform energy scans on the available wireless channels and select an interference free channel for communication. Other devices that wish to join the network would send out beacon requests in order to join the network of the coordinator. The newly joined child devices to the network can either work as end devices or routers where the coordinator is the parent. Routers can permit other devices to join it whereas end devices can't; i.e. they are leaf nodes of the network. In the proposed system a vehicular RF tag takes the role of a ZigBee end device while the tag reader & writer module takes the role of ZigBee coordinator. Different ZigBee devices implement different device profiles defined under the ZigBee protocol stack to suit the application in which they are being used.

## IV. ZIGBEE MODULES



Fig1. ZigBee Modules

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The ZigBee modules used in this project are based on the cc2530 microcontroller. The CC2530 is a true system-on-chip (SoC) and is solution for IEEE 802.15.4, ZigBee and smart energy applications. It has programmable flash memory of 256KB, 8-KB RAM, and more other features. There are 21 digital I/O pins that can be used as general-purpose digital I/O or as peripheral I/O signals connected to the Analog to Digital Converters, timers, or USART peripherals. The use of the I/O ports is fully configurable by user software through a set of configuration registers.

CC2530 features:

- It is TI's ZigBee stack
- Communication distance (open and wide operating environment):50-80m
- Frequency range is 2.4GHz
- Wide supply-voltage range is 2 V-3.6 V
- Serial port baud rate: 38400bps (default), different baud rates are also available by software configuration.

## V.METHODOLOGY

The main aim of the project is to design the framework for identifying the vehicles and validating the information related to vehicle owner and vehicle such as name, vehicle number, license number, due paid. This information has been transmitted from ZigBee tag, which is installed in the every vehicle to the Coordinator and that data will be uploading into the global cloud database through PC based application from where the information is validated in real time. The information can also be accessed through android application in smartphones. The proposed system is shown in the figure 2.

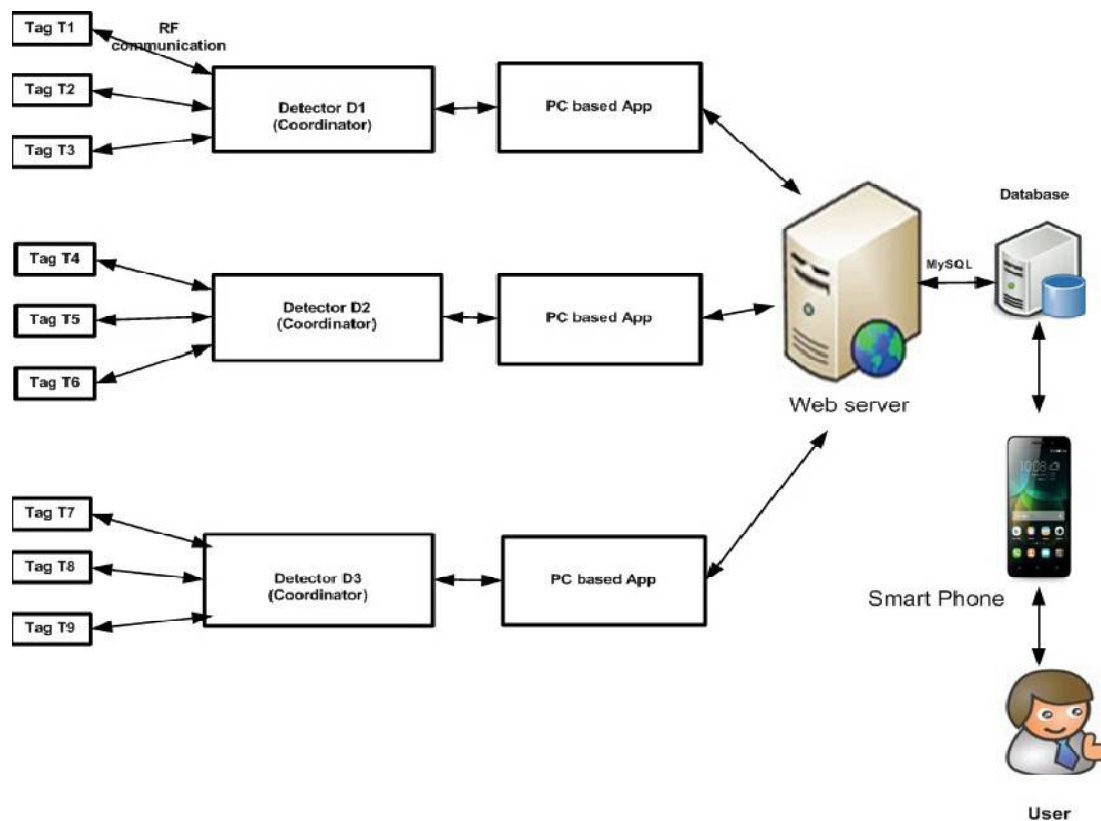


Fig.2 Block diagram of proposed system

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## A. Hardware Implementation:

Tag is electronic component which has the capability to announce the data periodically using RF signal. Basically tag is ZigBee based wireless device which is attached to the vehicle. Tag contains the information about the vehicle such as Vehicle Number, Owner Name, Mobile Number, Chassis Number, Registration Date, Vehicle Expiry Date, Due Payment, Due Last Date and Insurance Pending. Once the tag is required for the information from the Coordinator (connected to personal computer), tag will announce that respective required data. Tag also have some features to update the some field such as Due payment, Due last date and Insurance pending. So that whenever vehicle owner breaks the laws and insurance is not paid can be updated into the Tag . And it is updated by the Coordinator. Hence Tag will solve the burden of carrying all the documents with the vehicle.

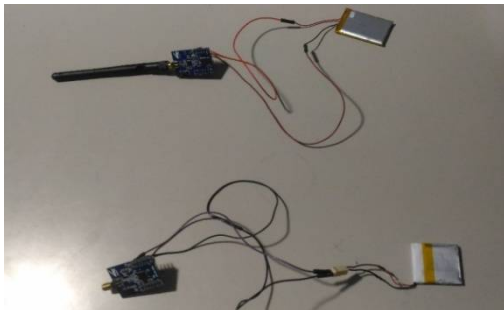


Fig3: Tags connected with power supply

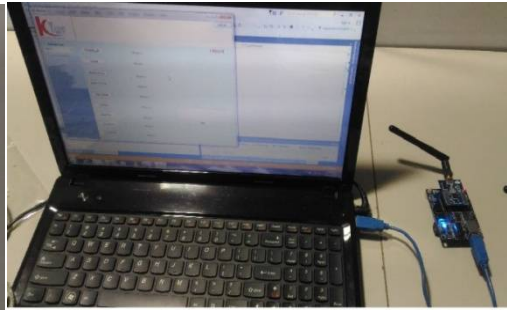


Fig 4: Coordinator connected with PC

Coordinators are nothing but the ZigBee modules which are connected to pc which in turn connected to internet. In the networking structure of ZigBee, coordinator plays a very vital role. It acts as central hub that means all the tags are communicate with it. It receives the data from all the tags those are in the range of it and it transfer all the received data into the PC based application that is designed to handle the data as well as request for some new data. Whenever user requests for the new data from specific tag, the coordinator will pass the request to that tag. In general Coordinator acts as Router which holds the address of the tags

## B. Software Implementation

Software implementation consists of three parts, those are design of PC based application, android application and database implementation.

Design of PC based application:

The PC Based Application is developed in the Visual Studio 2015 using C# language. It is software application developed to handle the data which is received from the Coordinator, which is connected to computer. In the PC based application the information of the vehicle is processed and verified from the database information. This PC based application is designed in such a way that it receives the data available at the port, and extracts the data and stores in structured manner. First it identifies the device addresses which are in the vicinity of the coordinator. It chooses one of the address from which it wants the details such as owner name, mobile number, chassis number, registration date etc. and update these information into the database. If any of the information of the vehicle has changed then from the application it is updated into the vehicle tag as well as database.

Design of Android Application:

Android Application is developed by android studio IDE. In this proposed system android application is developed for accessing the database information in smart phones. Android application is created in such a way that, if the authorized person has select the any of the vehicle number from vehicle list, that vehicle related information will display on the smart phones. So vehicle information can be easily verified.

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## Database Implementation:

In the proposed system there is need to store the data and have to maintain the current location, current time and date of the vehicle spotted at particular zone. Also have to store the information related to vehicle. So that user can get to know the current status of the vehicle by using database. By using database user or the RTO or police can able to access the information through android application even though it is not in the range of Coordinator.

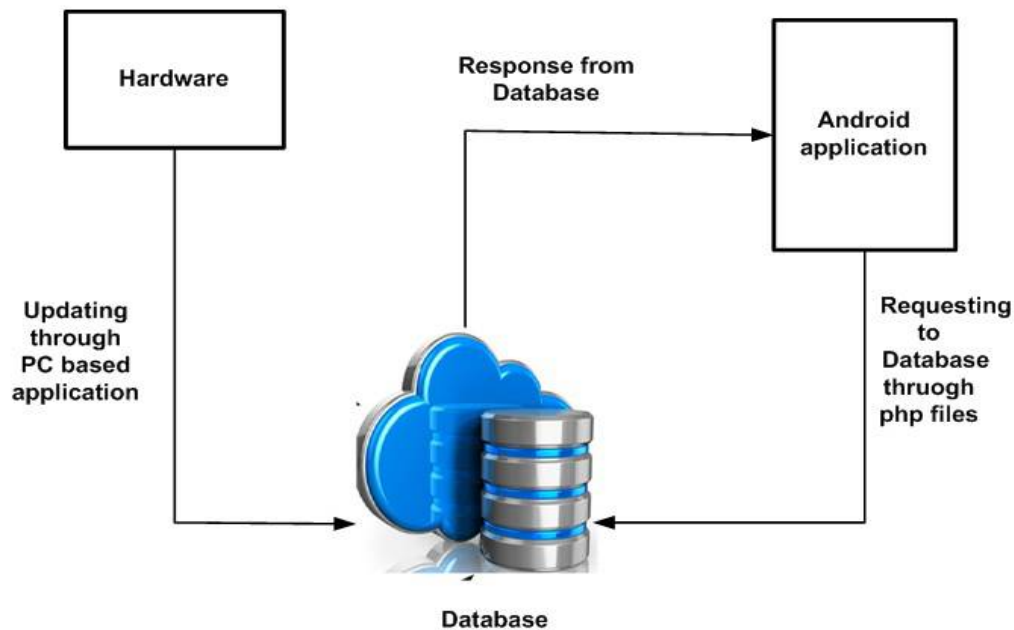


Fig.5 Database Connection

Database connection is shown in the figure5. From the hardware the information will update into the database by using PC based application. PC based application will connect to database through PHP page. Inside the PHP username, password, database table name and query is written. In this project database is created in the public Go.Daddy website to register the domain. MySQL is used to execute the query such as insert or update.

## V. RESULTS AND DISCUSSIONS

In order to establish a serial communication between the Coordinator and PC, this page is created which is shown the figure 6. The user has to choose the port for serial communication to which Coordinator is connected. Once the port is enabled, whatever comes to the coordinator, that will write into the application through that serial port.

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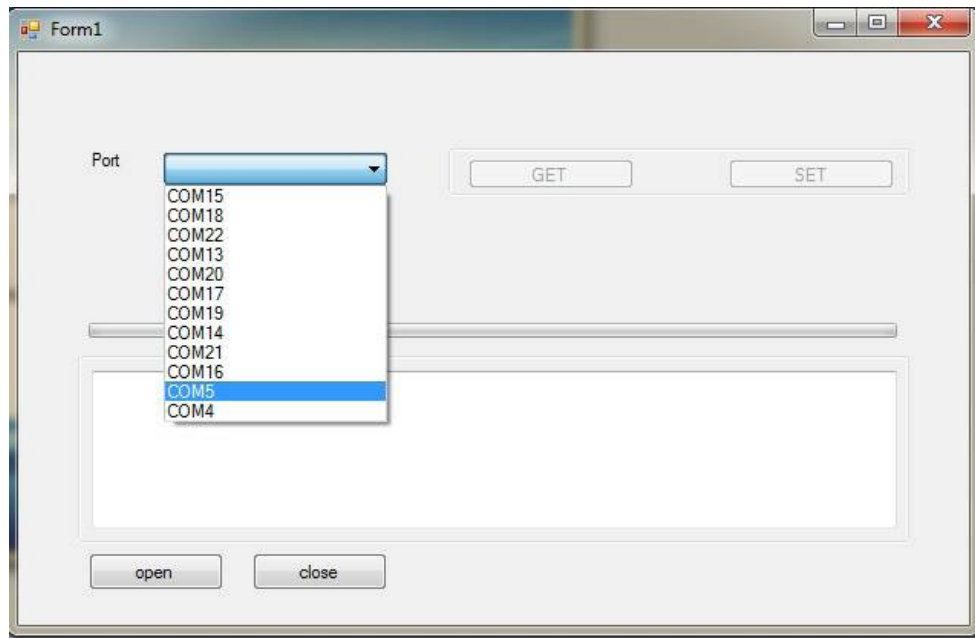


Fig.6 Port settings page of PC based application

The page shown in the figure 7 is created for access the information from the vehicles wirelessly. All the vehicles which are in the range of Coordinator will start transmitting their vehicle numbers, those will start appearing in the vehicle list in this page. Once after selecting the any of the vehicle number from the list and clicking the buttons such as name, mobile number, and registration number etc. those information will appear on the screen. This information will update into the database also in the respective columns which is shown in the figure 8. There are radio buttons available in the application to choose the which information has to change, once after clicking on the radio button (small round buttons) shown in the figure, there is one textbox to write what data has to change then by clicking the set button the data will update in the tag as well as database.

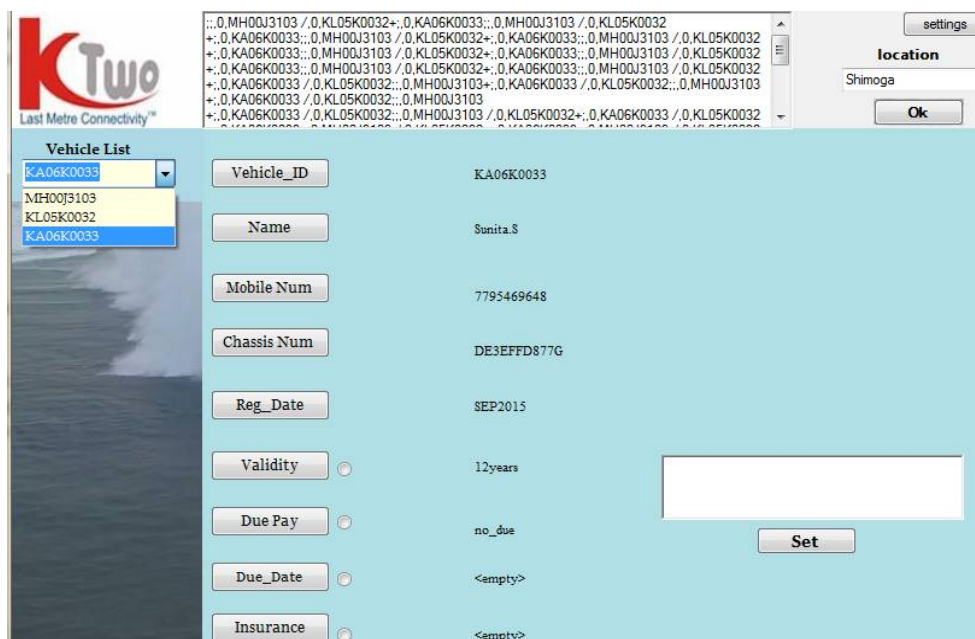


Fig .7 Get operation performed by pc based application



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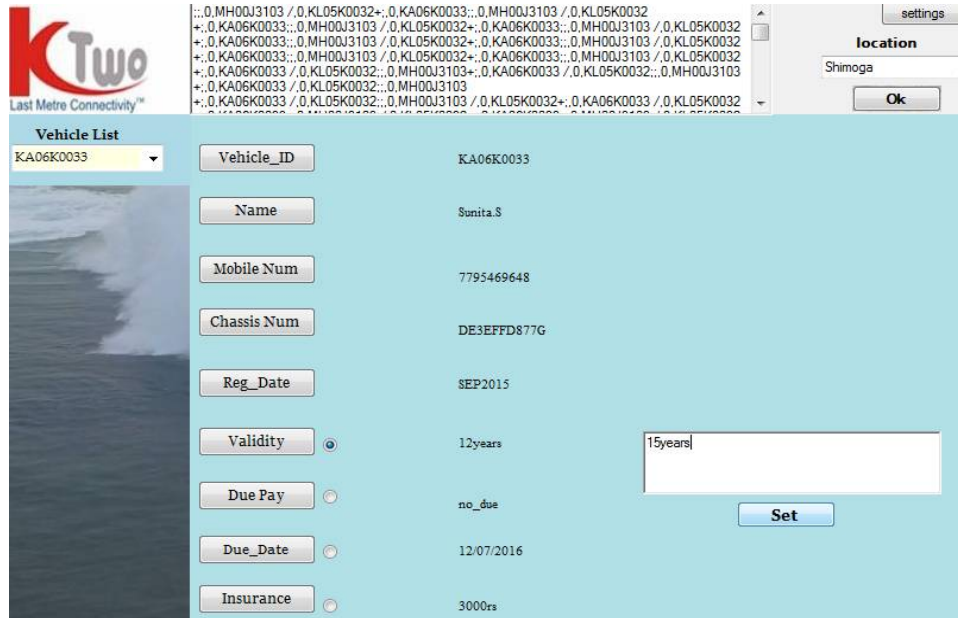


Fig.8 Set operation performed by pc based application

Database is used to store individual vehicle data. Data is updated into the database table from PC based application. PC based application is connected to php page through mysql driver, where sql query is executing to insert the data into the table that is shown in Fig. 9.

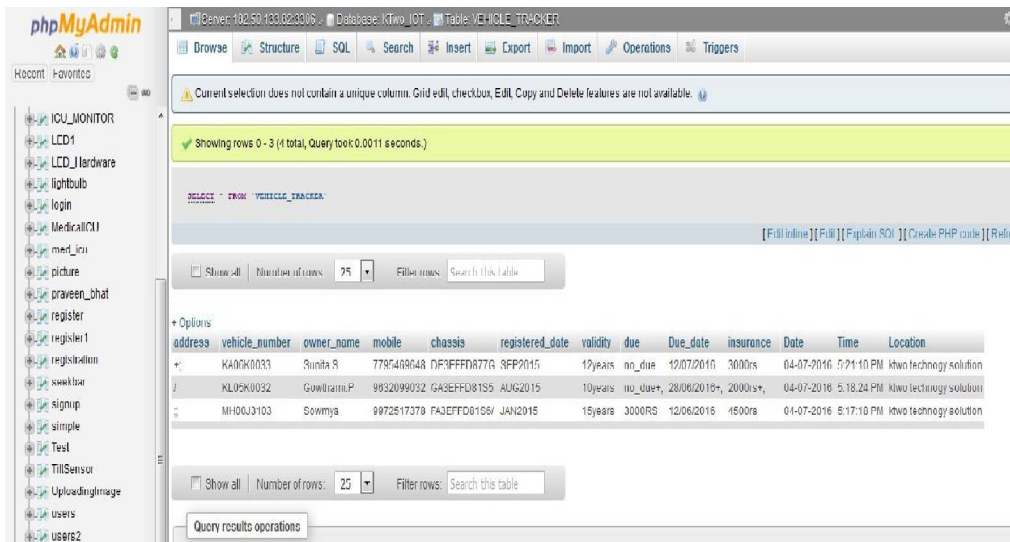


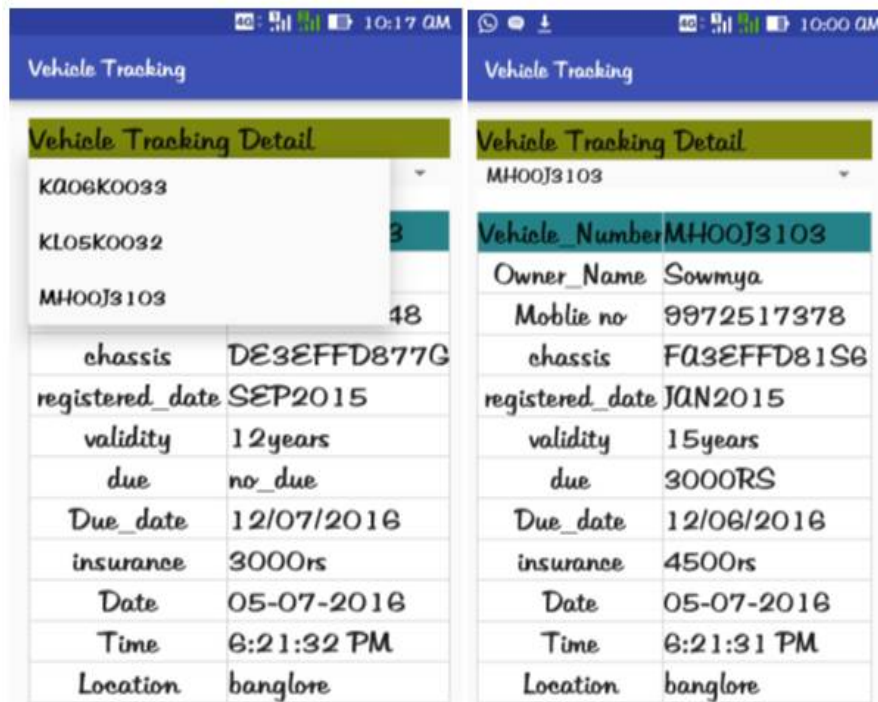
Fig .9The received data is updated into the database using PC based application

In this project android application is developed to see if any of the data of the database has changed, the police or authorized person can view those changes through his mobile which is shown in the figure 10. Once the application is opened, there is a list box to choose the vehicles, After selecting vehicle, that vehicle details will appear on the screen.

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Vehicle Tracking Detail	
KA06K0033	
KL05K0032	3
MH00J3103	48
chassis	DE3EFFF877G
registered_date	SEP2015
validity	12years
due	no_due
Due_date	12/07/2016
insurance	3000rs
Date	05-07-2016
Time	6:21:32 PM
Location	banglore

Vehicle Tracking Detail	
MH00J3103	
Vehicle_Number	MH00J3103
Owner_Name	Sowmya
Moblie no	9972517378
chassis	FA3EFFF81S6
registered_date	JAN2015
validity	15years
due	3000RS
Due_date	12/06/2016
insurance	4500rs
Date	05-07-2016
Time	6:21:31 PM
Location	banglore

Fig.10 Android application for accessing the database information in smart phone

## VI.CONCLUSION

In this proposed system, ZigBee technology based vehicle identification and validation of the vehicle information is successfully done. This system is improvement over the existing system because this system uses ZigBee protocol and cc2530 microcontroller devices. Implementation of hardware is done by using IAR workbench and the data transmission from the hardware is in fraction of seconds in real time system and it is long range communication. This improves the efficiency of road operation. Design of PC based application for process the data , manipulate the data and update the data into database is done successfully in the Visual Studio 2015 IDE. Android application also developed for access the vehicle information in smartphone from the database by using Android studio.

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