CHAPTER 4

METHODOLOGY

4.1 INTRODUCTION

Prior research and development paved way to a number of techniques that can determine whether a cell phone was in a moving vehicle or not based on GPS, handoffs, cell phone signal strength or by using a digital speedometer. Once the cell phone in a moving vehicle was detected it will either block incoming and outgoing call or transfer the call to voice messages in order to prevent the driver from getting distracted, but till now no research has been carried out in real time to determine whether the cell phone used in the vehicle was either by the passenger or the driver. According to NHTSA report on fatal analysis reporting system as indicated in Jie et al (2011) nearly 38% of automobile trips involved passengers who are safe to make or receive calls. The first challenge is to identify the cell phone user in a vehicle who is either by the driver or the passenger in a real time environment.

4.1.1 Driver Vs Passenger Challenge

An electronic circuit as shown in figure 4.1 has been designed for automatic detection of the cell phone use from the driver’s seat. Though various commercial systems do exists for detecting the use of a cell phone. The trouble is that, these commercial systems do not have the ability to distinguish between cell phone user was either the passenger or the driver. Even under extreme condition i.e., when all passengers use the cell phone
except the driver, this circuit is able to distinguish that it is not the driver who use the mobile phone. This circuit will be triggered ON once the vehicle gets started and it will get switched OFF when the driver stops the vehicle.

The RF amplifier circuit is used to detect the incoming or outgoing calls and use of the Internet even if the mobile phone is kept in silent mode. The circuit uses a 0.22μF disk capacitor to capture the RF signals from the mobile phone. The disk capacitor along with the leads acts as a small gigaHertz loop antenna to collect the RF signals from the mobile phone.

![Figure 4.1 Mobile Phone Detection Circuit](image)

The combinations of both an antenna and a rectifier produce direct current. Op-amp IC CA3130 is used in the circuit as a current-to-voltage converter, with the capacitor connected between its inverting and non-inverting inputs. The rectified DC voltage is amplified using voltage amplifier IC LM324 and it is stored in a large capacitor and then digitized by an analogue–digital converter (ADC) for subsequent storage and processing using a PIC16F917 microcontroller. The voltage obtained with this system depends on a number of factors: distance of the phone from the antenna, and the relative orientation between the antenna and phone. This part of the circuit is placed inside the vehicle on the top of the driver’s seat to receive the RF radiation emitted by the mobile phone. This set-up facilitates more trustworthy discrimination of driver use of mobile phone than any other
developed systems. The placement of mobile detection circuit inside a vehicle is shown in Figure 4.2.

![Figure 4.2 Mobile Detection Circuit inside Vehicle](image)

The output of RF amplifier stage is given to PIC16F917 microcontroller which executes the driver vs. passenger also known as energy analysis algorithm. Furthermore, the algorithm’s output is transmitted to a laptop for recording purpose using MAX232, which is an integrated circuit that converts signals from an RS-232 serial port to signals suitable for use in TTL compatible digital logic circuits is carried out as shown in Figure 4.3.

![Figure 4.3 RS-232 to TTL Digital Logic Convertor](image)
4.1.2 Results

The microcontroller is programmed in such a way that, once the voltage level obtained from the RF amplifier stage is greater than the value of the voltage stored in EPROM of microcontroller, it identifies that the driver is using the cell phone and not the passenger. The system has been tested in a Maruti Omni on the roads, and used Blackberry 8520 hand held phone with GSM connection to carry out the experiments.

The mobile detection circuit is placed on the top of the driver seat such that antenna pointing towards the drivers head. Even, when the driver adjusts the seat by moving forward or backward, the system is able to identify the usage of mobile phone. The detection unit is installed such that, the distance between detection unit and the head of the driver was (22 +/- 2cm). This device can be installed on all types of vehicles by maintaining this distance.

The practical experiment has been carried out to identify the effective operation of the system. The experiment has been performed by 5 volunteers of different heights (168 +/- 7cm) and the vehicle is driven in a speed between 40-50 Km/h. The first experiment has been carried out by making a call to the driver when the vehicle is moving and the call is maintained for few seconds. An antenna placed above the driver’s seat will start capturing energy from a mobile phone and it is recorded in a laptop for analysis. The experiment is further carried out by calling to the front-seat passenger, then to the rear-seat passenger behind the driver and finally to the rear-seat passenger behind the front-seat passenger. The energy captured during each experiment is depicted as in Figures 4.4 (a)-(e) and it is also transferred to laptop for analysis. When the mobile phone is not in use, (i.e., When the driver keeps his mobile in his shirt pocket) the energy captured by the antenna of the detection system is minimal and it ranges from 3mV-5mV as shown in Figure 4.4 (a).
Figure 4.4 Energy Absorbed by Mobile Detection Circuit Under Various Conditions

Note: In all these cases, energy or voltage captured includes the fluctuations during the call was initiated or before the phone ring.
When a call is made to the driver, and during the conversation on the phone, an antenna placed above the driver’s seat has been started to capture the energy from a mobile phone and it ranges from 75mV-150mV as shown in Figure 4.4 (b). When a call is made to the front-seat, rear-seat passenger behind the driver and to the rear-seat passenger behind the front-seat passenger in all these cases the voltage obtained during the call is below 75mV as shown in Figure 4.4 (c)-(e) respectively. Therefore, the voltage obtained by the antenna will be above the threshold voltage of 75mV, only when an incoming/outgoing call is made from the driver seat, since the distance between the cell phone and antenna is small. In all other cases, voltage captured by the antenna would be low since the distance between antenna and their cell phone is too far.

When the signal received by the antenna exceeds a threshold value of 75mV it indicates that the cell phone is used by the driver, not the passenger. Further, one more experiment has been carried out, where all the passengers make use of the cell phone except the driver, and captured the voltage obtained during this activity. Even in this situation, an antenna captured a voltage of less than 75mV which is great enough to identify that the mobile phone was operated by the passengers, not the driver. Figure 4.5 shows the voltage absorbed by the detection unit when the driver and passengers received the calls.

![Figure 4.5 Driver Vs Passenger Under Extreme Condition](image-url)
Furthermore, to avoid transitory situations that might trigger false alarms, a low-pass filter is programmed to eliminate voltage peaks and smooth out the input signal. A factor which has been considered during implementation of the algorithm is, it ignored the voltage captured by the detection circuit during first 3 seconds in-order to avoid false activation of the system because there is a chance that the driver’s cell phone can emit more voltage (i.e., above 75 mV) while performing hand-off, which normally completes its operation within 2-3 seconds. In general, hand off occurs when mobile was moved from one cell to another.

4.2 AUTOMATIC RESTART OF MOBILE PHONE USING RELAY

When the system identified the driver is using the mobile phone, the PIC16F917 microcontroller will immediately trigger a relay unit whose operating voltage i.e., the Vcc is 12V. Normally, relay is used to control high current circuit using small current flow circuit. In this system, it is used to control mobile phones (Switch OFF and ON) using NPN transistor. Relay will be energized (ON) when the current flowing through the control coil creates a small magnetic field which will cause the switch to close. The switch, which is a part of the load circuit, is used to control a mobile phone connect to it. Therefore, the mobile phone will be OFF once relay is energized. After a few seconds of delay, the relay will be de-energized i.e., the current will stop flowing through the control circuit resulting in no magnetic field. So, the switch will be open, which in turn switch ON the mobile phone as shown in Figure 4.6.
Once the cell phone restarted, the cell phone is automatically loaded with a safety application named Cellphone Accident Preventer (C.A.P.) which is developed using a J2ME on the driver’s cell phone will help in eliminating the risk of an accident which is discussed in the next section. The reason behind the use of relay unit to switch OFF and ON the cell phone is to reduce the unnecessary workload and power of the mobile phone i.e., if the C.A.P. application is already installed and started, it would be running in the background which would impact the performance of the cell phone and consume unnecessary battery power. In order to overcome these losses, relay is used to restart the cell phone, such that C.A.P. application will get started automatically once the cell phone is restarted. The Figure 4.7 shows the snapshot of the demo system.
4.2 INTRODUCTION TO MOBILE APPLICATION

Before going into the detail, on how Cellphone Accident Preventer (C.A.P.) is developed using J2ME (Java 2 Micro Edition). It’s an essential prerequisite to know J2ME’s configuration, profile, package and application for better understanding.

Previously, when application developers want to build an application for a mobile computing device, their options are limited. Typically they are forced to use proprietary development tools that required them to have an intimate knowledge of both tool and operating system, which inevitable restricted their application to a particular device type. Now a day, application developers have greater choice through the advent of new development tools that free developers from dealing with low level
hardware/operating system details, and enabling them to focus on enriching their applications regardless of device type.

J2ME is a Java platform from Sun Microsystems that allows programmers to use the Java programming language and related tools to develop programs for small devices with a limited processor power and small memory size like mobile phones, personal digital assistants etc., To support a wide variety of device types, J2ME technology adopts a modular and scalable architecture. The Figure 4.8 shows the different bundles of J2ME Anna and Hao (2008). At the heart of J2ME are three core concepts: configurations, profiles and optional packages. A configuration defines the Java language and virtual machine features and minimum class libraries that a device of the same category should have. It specifies a JVM (Java Virtual Machine) that can be easily ported to devices supporting the configuration. A configuration also defines a minimum platform for a horizontal category of devices, each with similar requirements on total memory budget and processing power.

![J2ME Layers](image)

**Figure 4.8 J2ME Layers**

J2ME defines two Configurations, the CLDC (Connected Limited Device Configuration) and the CDC (Connected Device Configuration).
CLDC provides core services for a broad category of devices. CLDC is designed for devices which have memory and processor power constraints. It is reported by Prithwi et al (2011) that the CDC, on the other hand, includes a full JVM and a much larger set of core classes, so it requires more memory than the CLDC and a faster processor. While, CLDC devices consist of very small UI, memory of about 160 KB to 512 KB, 16 to 32 bit processors. CDC devices consists of a large range of UI, 2 to 16 MB memory and 32 bit processors.

A profile like Mobile Information Device Profile (MIDP) supports higher-level services common to a more specific class of appliances. It means that profiles are more specific than configurations and consist of class libraries which are more domain-specific than the class libraries provided in a configuration. A profile is based on the top of a configuration and adds APIs for user interface, persistent storage and other classes needed to develop running programs (James Keogh 2003). A profile is for specific needs of a vertical market segment or device family. The main goal of a profile is to guarantee the interoperability within a certain device family or domain by defining a standard Java platform for that market. Each family of devices has its own profile that represents a particular market within a given configuration. For example, the profile for the cell phone vertical market is separate from the profile for the PDA vertical market, but both profiles are based on the same mobile device configuration. One device can support multiple profiles.

According to Sing and Jonathan (2006), optional packages add special services that was useful on devices of many kinds, but that are not necessarily available on all of them. Usually, applications are based on a configuration appropriate to the desired category of target devices and on a
profile that supports the software’s basic functionality and optional packages which support needed specialized functions like messaging or multimedia. A profile is based on top of a configuration and adds APIs for user interface, persistent storage and other classes needed to develop running programs. One device can support multiple profiles. All that is implemented on a device like configuration, profile and optional APIs is called a stack. For instance, a device stack could be CLDC/MIDP + Mobile Media API. This organization supports both reuse and efficiency and enables developers to put together a software stack that fits both the capabilities of target devices and the resource needs of applications.

4.2.1 Cellphone Accident Preventer (C.A.P.)

C.A.P. is a mobile application designed to prevent road accidents which occurs due to the cell phone use while driving. It is automatically load on the driver’s cell phone when microcontroller detects the use of a cell phone by the driver. C.A.P. comprises of various stages, (1) Measure the current speed of the vehicle on which the mobile phone is used (2) Compare the current speed with predefined threshold speed (3) Capture the incoming call event, and block the call even before the phone ringing once the speed exceeds beyond a threshold value. (4) Send the message to the caller once the call is disconnected (5) Before Step (3) it checks whether the call is Emergency. Emergency call is one wherein the caller is calling from the same number thrice within the duration of 5mins from the 1st call. (6) In case of emergency, the C.A.P. will allow the call, and transfer the controller to microcontroller (7) not allowed any outgoing call irrespective of threshold speed or when the vehicle in motion is detected. The Figure 4.9 shows the C.A.P. application setting panel which contains the following:
Figure 4.9 C.A.P. Setting Panel

- Driving Profile : This is set to enable by default
- Driving Time : This is the maximum time taken to reach the destination, this can be set by the driver
- Threshold Speed : This is set to 2 m/s by default during which C.A.P. application will start functioning.

4.2.2 Measuring Current Speed

There are few techniques proposed by Chew et al (2006), Krzysztof et al (2006), Anthony (2008) which is based on either the handset or network based techniques to obtain the speed of the moving cell phones. Handset based technology requires installation of client software on the handset to determine its location. This technique determines the location of the handset using signal strengths of home and neighboring cells or the latitude and longitude using GPS. While, network-based techniques utilize the service provider's network infrastructure to identify the location of the handset. The advantage of network based techniques (from mobile operator's point of view)
is that they can be implemented non-intrusively, without affecting the handsets. There is one more method available called handoff technique using which the speed of the moving handset is founded by Thajchayapong et al (2006). This techniques measure speed by calculating the time between two handoffs. In general, handoff is defined as, when a mobile user travels from one area of coverage or cell to another cell within a call’s duration, the call should be transferred to the new cell’s base station. Otherwise, the call will be dropped because the link with the current base station becomes too weak as the mobile recedes.

The technique proposed by Darryl and Michael (2010) was to measure the speed of the cell phone in motion using cell phone Bluetooth. This technique needs a Bluetooth reader on the roadside which logs the unique Bluetooth MAC address, along with its location and time of day when Bluetooth enabled device travels along a roadway. When the same MAC address was detected at distinct points on a roadway segment of a given distance, a travel time was determined by calculating the difference in detection times at those points. Using the known distance between the points along a segment, an average speed was determined. This technique requires extra cost to implement reader on the road and it also needs Bluetooth on the device to be ON.

By analyzing all these techniques, the use of both network based technique along with GPS (Global Positioning System) technology is chosen to measure the speed of the moving cell phone in a vehicle. The study carried by Linda and Helen (2011) show, though large numbers of current generation mobile phones have GPS (Global Positioning System) built-in it is not adopted by all the subscribers. The GPS satellites are continuously transmitting a radio message which contains information. The GPS receiver fitted in mobile phone receives that information and calculates its current position and the speed. Though, GPS can provide very accurate speed
estimation on most roadways it will result in fast battery drain on the mobile phone due to frequent sampling.

The research carried out by Krievs (2002) showed the techniques to determine the speed from the cell phone signals, which was particularly useful because it does not incur high infrastructure cost, but it was least accurate when compared to GPS. This research also showed how to improve the accuracy of the speed in a network based cellid techniques by using fading phenomena and/or predictive techniques. It compensates the fading effects by carrying out multiple distance estimations between MS and different BTS’s. This method does not increase the complexity of the networks, but improvements in accuracy were strictly correlated to the quality of the propagation model. In our research, it is not essential to go in detail to measure the speed of the moving cell phone very accurately, because it is sufficient to make sure that the cell phone is travelling more than speed of walking or jogging.

The C.A.P. application is initially try to obtain the speed information from network based cellid technique because it is faster and consumes less power in indoor conditions when compared to GPS. The application will use GPS technology only when the C.A.P. application fail to obtain the speed using cellid technique beyond 90 seconds and the application will switch back to cellid technique once it able to obtain the speed information as shown in Figure 4.10.

To obtain the speed of moving the cell phone using cellid technique, J2ME RIM (Research in Motion) package GPRSInfo.GPRSCellInfo API is implemented. By using this API, mobile tower information through with the mobile phone connected is obtained. The information obtained through the mobile tower are Mobile country code (Mcc), Mobile network code (Mnc), Location area code (Lac) and Current cell id (Cellid).
Figure 4.10 Measuring Speed Technique using Cellid and GPS

Here is a code snippet to retrieve LBS (Location Based Service) parameters:

```java
Cell info = GPRSInfo.getCellInfo();  // Retrieves information on the current cell.
mcc = GPRSInfo.getHomeMCC();  // Retrieves mobile country code for the home network.
mnc = GPRSInfo.getHomeMNC();  // Retrieves Mobile Network Code for the home network.
lac = cellinfo.getCellid();  // Retrieves Location Area Code
Cellid = cellinfo.getCellId();  // Retrieves Value of the Cell ID
```

Using all of this information, query string has been created and sends it to the loc8.in API through HTTP get request. Loc8.in was an API which contains a database list of latitude and longitude coordinates corresponding to the cellid.
Here is a code snippet to do HTTP get request:

```java
httpConnection = (HttpConnection) Connector
                   .open("http://loc8.in/api.php?req=loc&mcc=404&mnc="
                   + mnc+ "&lac=" + lac + "&cellid=" + cellid +
                   "&token=68710-57935" + mdsConnectionURL);
```

The output response received in XML (Extended Markup Language) format from loc8.in is shown.

```xml
<?xml version="1.0" encoding="UTF-8"?>
<rsp stat="ok">
  <cell mcc="203" mnc="59" lac="0" cellId="14563"
      lon="22.2897075399231" lat="24.5715642160311"
    </cell></rsp>
```

Once output is received, it has to be parsed to fetch latitude and longitude of the location. From latitude and longitude, the distance between two correspondence latitudes and longitudes is calculated by using the Coordinates API’s method. Once distance is obtained, the speed can be calculated easily. The obtained speed value will be automatically updated for every 30 seconds.

When network based cellid technique failed to obtain the speed for more than 90 seconds then the application will switch over the option automatically to obtain the speed using GPS. The first step towards obtaining the speed using GPS is to select the mode of GPS. There are three GPS modes and each of them has specific properties. Based on the application requirements, mode has to be selected. The GPS mode are classified into three types namely,
**Autonomous** – Relies on the GPS satellite only. This mode uses the GPS receiver on the BlackBerry device to retrieve location information.

**Assisted Mode** – GPS satellite and servers on the wireless network only. This mode uses the wireless network to retrieve satellite information.

**Cell site Mode** – Geolocation service or the wireless network to provide, on the location information of current base station. This mode uses the wireless network to achieve the first GPS fix, and was generally considered the fastest mode. This mode does not provide BlackBerry device tracking information such as the speed and the bearing. An example application that can use this mode was a weather application.

In designing this application, Autonomous Mode is chosen. Once the mode is chosen, next step is to obtain Latitude, Longitude, Altitude and Speed. All this parameter is obtained using Location class available in J2ME.

Here is a code snippet to obtain the Latitude, Longitude and Speed.

```java
longitude = location.getQualifiedCoordinates().getLongitude();
latitude = location.getQualifiedCoordinates().getLatitude();
altitude = location.getQualifiedCoordinates().getAltitude();
speed = location.getSpeed();
```

### 4.2.3 Handling Incoming call Operation

When a caller initiates the call, request will be forwarded to BTS. This request will then sent to BSC to which it is connected. From BSC, request is then transferred to the MSC. Consequently, MSC will make a request to HLR in order to check whether the caller has sufficient balance to make a call, area of the caller etc., MSC will then establish a link between the
two parties once the HLR sends back the acknowledgement to the MSC. However, before the phone start ring and mobile stations get connected, Cellphone Accident Provider (C.A.P.) mobile application will check whether current speed of the vehicle is greater than the threshold speed, and also checks whether the call is an emergency call or not. If the vehicle speed is greater than a threshold and it is not an emergency call, then application will disconnect the call and SMS will be sent to the caller through Short Message Service Center (SMSC) as shown in Figure 4.11.

![Figure 4.11 Handling the Incoming Call](image)

Here is a code snippet to disconnect the call and to send SMS to the caller.

```java
```
By EventInjector, an END key event can be generated which acts same as manual option done by pressing physical END key of device.

```java
if (callScreen.callCount == 2) {
    msg = "User is Driving...So please call back after " +
millisecondToHourConversion(remainingTimeOfJourney) + " and if its emergency call 1 more time continuously";}
else { msg = "User is Driving...So please call back after " +
millisecondToHourConversion(remainingTimeOfJourney) + " and if its emergency call 2 more times continuously";}
```

The message sent to the caller is based on various conditions:

- If the caller calls for the 1st time then he receives the message: “User is driving... please call back after XX minutes, and if an emergency, call back two more time continuously.”

- If the caller calls for the 2nd time within 5 minutes from the 1st call made, then he will receives the message: “User is driving... please call back after XX minutes, and if an emergency, call back one more time”. As shown in Figure 4.12.

- In case, if the time interval between the first 2 calls is more than 5 minutes, then application will consider it as first call.

Here, XX is the difference between the total time of the journey (set in the setting panel) and the time of the incoming call.
If the caller calls for the 3\textsuperscript{rd} time within 5min of duration from the 1\textsuperscript{st} call, then application consider this call as an emergency call, and it allows the phone to start ringing as shown in Figure 4.13. The complete flow diagram on how the incoming call operation works is shown in Figure 4.14.
Hit the API GPRSInfo.GPRSCellInfo to get the cell information

Get Lat Long based on the Cell information gathered from above step

Calculate distance and then the speed based on the Lat Long data

EVENT LISTENER
Listens to incoming events

Incoming call? Yes

Is Driving Profile? No

Is calculated speed > Threshold speed

Yes

Is it an emergency call?

No

Send message to caller and disconnect the call

No

Allow the Call

Yes

Figure 4.14 Complete Incoming Call Flow Operations
During the incoming call operation, there is a possibility that the system can malfunction because energy is absorbed by the detection circuit even before the phone get rings. The Figure 4.15 shows the energy absorbed by the detection circuit before the phone get ring. The absorbed energy during this period is less than 45mV and it last for only 2-3 seconds. Occasionally, the energy absorbed will pass above 75mV for the first few seconds. This change is mainly depends on signal strength. So, the energy analysis algorithm is designed in such a way that, it will ignore the first 3 second of energy absorption which will help in eliminating the false activation of the system.

![Energy Absorbed before Phone Ring](image)

**Figure 4.15 Energy Absorbed before Phone Ring**

When the phone starts ringing, the mobile detection circuit is started to capture the radiation emitted by the phone. This time the PIC16F917 microcontroller activates the voice chip which warns the driver through the speaker “you have an emergency call. Please stop the vehicle in a safe place”. If the driver stops the vehicle within a predefined timed interval say 8 seconds, then the microcontroller allows the call else, it will activate the low range mobile jammer which covers only the driver seat when it detects both voice communication and vehicle in motion as shown in Figure 4.16.
Here, the vehicle in motion is detected using a photo interrupter sensor which is composed of an infrared LED emitter on one side and a photo-transistor on the other end. A beam of light will always pass from one end to other, once the object moves between the gaps, the light will be blocked, and the transistor base will be ON; hence gives a high output as shown in Figure 4.17. The PIC16F917 microcontroller will stand by waiting to see the rising edge of these pulses and it will keep track of how often that change occurs using a timer. From this, the instantaneous RPMs of a gear motor can be easily estimated.
The main reason behind the use of photo interrupter sensor instead of using existing cellid or GPS technique is, if either the GPS or cellid technique are used then there is a chance that the system can malfunction. Since, both cellid and GPS technique takes a minimum of 30sec for update the speed, during this time frame if the driver gets a call and even though the driver stops the vehicle to attend the call, there is a chance that the circuit can trigger false alert by considering that the vehicle is still in motion i.e., speed is greater than 0. The PIC16F917 microcontroller which is programmed waits for only 8 seconds to determine whether the vehicle came to rest or not. In case, if the vehicle is stopped within this time frame, microcontroller allows the driver to continue the conversation else, it will perform further functions that will be discussed later in this chapter. The Figure 4.18 shows the complete hardware diagram of the system.
Figure 4.18 Circuit Diagram of the System

Once microcontroller detects both the vehicle in motion along with voice communication and it will activate a mobile jammer. For the complete operation to take place, i.e., from the detection of mobile phone to the activation of mobile jammer takes approximately 25 seconds. Even during
this time period, the driver may get easily distracted. In order to avoid the driver from talking on the phone during this timeframe a PIC16F877A microcontroller along with a KST-TX01 transmitter used to transmit the vehicle number plate information to the receiver KST-RX806 which is placed on the signal post. A PIC16F877A is programmed to transmit its ADC data (RA0/AN0 channel) serially using its built-in USART hardware at 1200 baud with no parity. The PIC’s USART transmitter (TX) pin feeds the data into the data pin of the KST-TX01 which transmits it using 433 MHz ASK RF signal as shown in Figure 4.19. On the receiving end the KST-RX806 module receives the data and its output is connected to another PIC’s

![Figure 4.19 Automatic Transmission of Vehicle plate information to LCD](image)

USART input pin. The second PIC is programmed to read its USART receiver (RX) pin and the obtained data will be displayed on LCD attached on the signal post so that the traffic police may take legislative action against the driver.
4.2.4 Handling the Outgoing Call Operation

To get an outgoing call event, J2ME’s Phone Listener API is implemented which identifies all acts on the phone including events like call initiated, incoming call, call disconnection etc. The mobile application which is developed will block the user from making an outgoing call unless the driver stops and turn off the vehicle in a safe place as shown in the following Figure 4.20.

![Figure 4.20 Handling the Outgoing Call](image)

Here is a code snippet to block the outgoing call.

```java
    KeyCodeEvent.KEY_DOWN,(char)Keypad.KEY_END,KeypadListener.STATUS_NOT_FROM_KEYPAD)
```

By EventInjector, an END key event can be generated which acts same as manual option done by pressing physical END key of device. Finally, the C.A.P. application was automatically terminated or kills itself when there was no change in vehicle speed for more than 3 minutes by assuming the driver came to rest.
4.3 SUMMARY

The proposed approach which consists of both hardware and software mobile application to prevent driver from the use of cell phone is described in this chapter. The hardware unit designed is capable of differentiating the driver from passengers of using cell phone. The C.A.P. mobile application is capable to identify whether the call was an emergency or not, and it is the first application which provides this option to the driver to attend emergency call. While, the application developed till date would either send the call to the voice mail or the call will be blocked inside the vehicle. The application designed also sends the elapsed time to the caller. The hardware system designed also sends notifications to the police, once driver conversation on the phone is detected along with a vehicle in motion. Overall, implementation of the proposed system would help in reducing the accident from occurrences.