Cell Phone Accident Avoidance System While Driving

H. Abdul Shabeer, R. S. D. Wahidabanu

Abstract*— Every year, innumerable road accidents and deaths take place due to distracted driving. Large number of studies shows mobile phone usage while driving was the major reason for distracted driving. With the aim of preventing road accidents due to mobile phone usage while driving, we propose a highly efficient automatic electronic system for early detection of incoming or outgoing call, an antenna located on the top of driver seat used for detecting when the driver uses mobile phone and a low range mobile jammer with its range covers only driver seat which prevent drivers mobile phone from receiving signals from base stations.

Index Terms*—Mobile Phone Detection, Risk of using mobile phone while driving, Mobile Jammer.

I. INTRODUCTION

Over the past 20 years, hand-held mobile telephones have emerged as a road safety problem. Research (1, 2) has shown that the reaction time of drivers increases by 0.5 to 1.5 seconds when they are talking on handheld phones, and drivers have difficulty maintaining the correct positions in their lanes, maintaining appropriate speeds and judging and accepting safe gaps in traffic. Some evidence indicates that drivers who use hand-held phones face a risk of crash four times higher than risk faced by other drivers, imperiling themselves and other road users (*3*). Hands-free phones can also distract drivers, but the current evidence suggests that hand-held phones pose a greater problem (*4*). Many different studies have shown that when drivers use a cell phone while driving increases the accident risk (5, 6, and 7). This risk also extends to pedestrians (8, 9). For example, it is estimated that mobile-phone use for one hour a month increases accident risk by 400–900%. Other studies show that a high percentage of accidents among youngsters are due to mobile phone use (10). The increased accident risk is due to the fact that drivers using the phone are distracted from their main task, resulting in slower reaction time which leads to accidents.

World's largest telecommunication countries are China and India with billions of mobile phone subscribers. It is projected that India will have 1.159 billion mobile subscribers by 2013 overtaking china. But on the other side of the coin, both these countries also have recorded maximum number of road accident in the world. According to "Decade of Action for Road Safety 2011-2010" released by World Health Organization (WHO)estimate India will recorded maximum number of road accident overtaking china to reach No.1 position.

A. Global System for Mobile Communication

Globally, GSM is the most dominant mobile phone network. As mentioned earlier it is originally a 2G digital technology based on TDMA. GSM works on three frequencies 900 MHz, 1800 MHz and 1900 MHz. To make efficient use of frequency bands GSM networks uses combination of FDMA (frequency division multiple access) and TDMA (time division multiple access). GSM was first deployed in Europe in the early 1990's and was the first 2G technology to allow limited text messaging (SMS – short message service). Like CDMA, GSM has evolved into third generation (3G) extensions which allow for higher data rates. These extensions can be commercially recognized as GPRS (General Packet Radio Service), EDGE (Enhanced Data Rates for GSM Evolution), 3GSM and HSPA (High Speed Packet Access).

GSM Network Architecture:

The general architecture of GSM network is shown in figure 1. The GSM system consist of several functional elements including mobile switching centers (MSC), base stations (BSC) with associated base transceivers (BTS), an operation and maintenance centre (OMC) and gateway MSC.GSM mobile terminal or mobile stations communicates across the Um interface, known as the air interface, with a base BTS in the small cell in which the mobile unit is located. This communication with a BTS takes place through the radio channels. The network coverage area is divided into small regions called cells. Multiple cells are grouped together form a locations area (LA) for the mobility management.

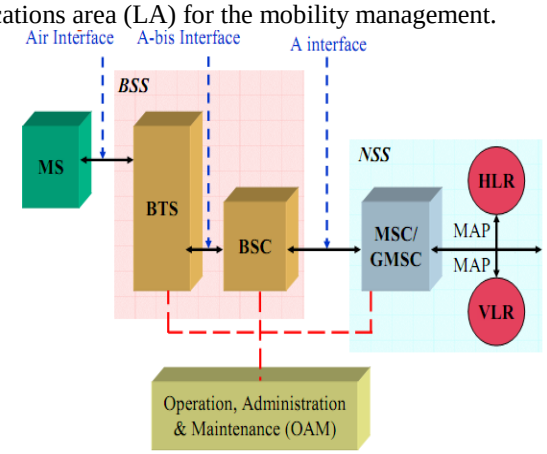


Figure 1: GSM Network Architecture

Manuscript received May 30, 2011.

H. Abdul Shabeer, Ph.D. Research Scholar, Anna University, Cimbatore, India, (e-mail: response@ijsce.org).

Dr. R. S. D. Wahid Abanu, Head & Processor, Department of ECE, GCE, Salem, India.

BSC are connected are connected to MSC through dedicated line or radio communication link. The BSC reserves radio frequencies, manages the handover of mobile station from one cell to another within the BSS (base station subsystem). MSC interface to the PSTN (public switched telephone network) is called the gateway MSC. MSC incorporate functions including home location register (HLR), visitor location register (VLR), authentication register (AuC) and equipment identity register (EIR) (13). The HLR and VLR together with MSC provide the call routing and roaming capabilities of GSM. The HLR stores information both permanent and temporary about each of the mobile station that belongs to it. The VLR register maintains information about mobile station that is currently physically in the region covered by MSC. VLR becomes important when user leaves the area served by his home MSC. The two registers are used for authentication and security purpose. The EIR is a database that contains a list of all valid mobile equipment on the network, where each mobile station is identified by its international mobile equipment identity (IMEI). It helps in security and prevents uses of network by mobile station that have been approved. The AuC holds the authentication and encryptions keys that are stored in each user SIM card for authentication and encryption over radio channel (12).

II. THEORETICAL BACKGROUND

Researchers and scientists proposed various ways like developing a model or devices or an application to prevent the usage of mobile phone during driving. But still each has its own demerits.

One of the proposed solutions is to use technology to fight distracted driving. Some of the gadgets that have already been introduced to the market or are in the planning stages include:

(1) *Anti Sleep Devices:* these devices require you to answer questions in order to ascertain a safe period of uninterrupted driving time;

(2) *Alert Systems:* these systems send audible alerts when you are changing lanes without a signal, crossing into other lanes, or driving too close to the edge of the road;

(3) *Collision Warning Systems:* these gadgets gauge how far you are from other vehicles, particularly the vehicle in front of you, and advise you to slow down and create a greater space to avoid a collision; and

(4) *Apps that Prevent Cell Phone Use in a Moving Vehicle:* these apps would prevent cell phones from functioning inside moving vehicles.

Companies have developed and invested in new technologies to prevent a driver from using a cell phone when the driver is behind the wheel and each came up with different innovative solutions. Some of them are listed below.

Illume Software's iZUP solution uses GPS to detect if you're driving on a highway. It runs in the background and comes to life when it detects you are moving faster than a preset velocity, typically 5 mph. Once it detects that the phone is moving more than the preset value, it interrupts the normal operation of the phone with the iZUP application. Subscribers cannot text or make phone calls while the car is moving.

DriveAssist by Aegis Mobility is a network-centric solution. It uses a phone's GPS to detect when the car is moving and it redirects all phone communications to a message center which explains that the caller is unavailable because they are driving. It also defers text messages (15).

ZoomSafer and iSpeech's Drive Safely focus on using text-to-speech technology to read text messages to you while you're driving. Safe Driving System's Key2SafeDriving and obdEdge's cellcontrol use a hardware dongle in the car that communicates with the user's cell phone via Bluetooth. When the phone gets within range of the dongle in the car, key2SafeDriving turns off the use of the phone and texting (14). Cell Control application installed on a cell phone will prevent incoming and outgoing calls while a car is in motion.

Phon Enforcer application which automatically turns off the cell phone when the user is driving. This patent pending process enhances driving safety by stopping mobile phone use (11).

III. DETECTION OF DRIVER USING MOBILE PHONE

The circuit is mainly designed to activate the low range mobile jammer (covers area of the driver seat) for a while whenever the driver gets any incoming call or he tries to make outgoing call. An electronic circuit shown in figure 2 was designed for automatic detection of incoming & outgoing call on driver's phone. Though various commercial systems do exist for detecting mobile-phone use indoors, and these could theoretically be implemented in a car. The trouble is that these Commercial systems are not able to discriminate mobile-phone use by a passenger instead of the actual driver. The biggest problem for the system is posed when phones are used by all passengers except the driver. In this case, the detection system was able to discern that it is not the driver who is using the mobile phone. This circuit will get triggered ON when the vehicle gets started.

In this circuit we need two power supplies. Majority of the ICs are worked on regulated DC power 5v with GND. While Relay drive worked on DC 12v with GND. This power supply unit consists of transformer, rectifier, filter & regulator. AC voltage typically 230v RMS is connected to a transformer which steps that AC voltage down to the level of the desired AC voltage. A Diode rectifier then provides a bridge rectified voltage that is initially filtered by a simple capacitor filter to produce a DC voltage. This resulting DC voltage usually has some ripple or AC voltage variations. The output voltage from the capacitor is more filtered and finally regulated using voltage regulator, which maintains the output voltage constant irrespective of the changes in supply variations, load variation and temperature changes. Here we use one fixed voltage regulator namely LM7805.The IC 7805 is a+5 voltage regulator.

The RF amplifier circuit can detect both the incoming and outgoing calls, SMS and video transmission even if the mobile phone is kept in the silent mode.

The moment the bug detects RF transmission signal from an activated mobile phone, the LED blinks and it continue until the signal transmission ceases.

Here 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.

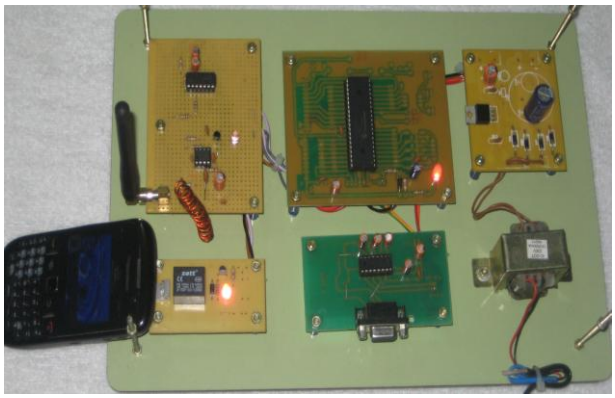
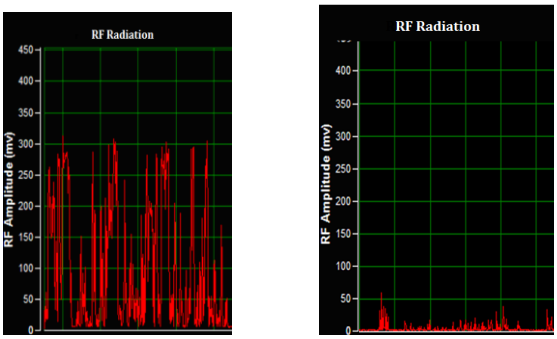


Figure 2: Mobile detection with energy capturing circuit

The combinations of both antenna and rectifier produce a direct current. Op-amp IC CA3130 is used in the circuit as a current-to-voltage converter with capacitor connected between its inverting and non-inverting inputs. The rectified DC voltage is stored in a large capacitor and is digitized by an analogue–digital converter (ADC) for subsequent storage and processing using a microcontroller. The voltage obtained with this system depends, among other factors like, Signal strength, on the distance of the phone from the antenna and the relative orientation between antenna and phone. This part of the circuit should be placed inside the vehicle; on the top of driver's seat to receive the RF radiation emitted by mobile phone. This set-up facilitates more trustworthy discrimination of driver use of mobile phone.

The output of RF amplifier stage is given to PIC16F917 microcontroller which executes the voltage analysis algorithm. The microcontroller is programmed in such a way that, once the voltage level obtained from the RF amplifier stage is greater than voltage value stored in EPROM of microcontroller, it will activate the jammer which will prevent cellular phones from receiving signals from base stations. Furthermore the algorithm's output is transmitted to laptop for recording and further analysis 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.



Graph 1 (a) & (b) shows the mobile phone from driver seat & rear seat passenger

In this experiment, a call was made to the rear seat passenger and to the driver when the vehicle was moving. A call was maintained for few seconds, an antenna which was placed above the driver's seat captures more energy from a mobile phone over various open-air distances when compare to rear seat passenger as shown in graph (a) & (b). When the mobile phone is not in use, the energy captured is minimal. When a call is made, this energy is inversely proportional to the distance between the telephone and the energy-capturing antenna. Here, we have set threshold value as 100mv, once the signal received by the antenna exceeds threshold value a jammer will gets triggered which will prevent cellular phones from receiving signals from base stations. In the above circuit we have used low filter to suppress the false signal. Figure 3 shows the vehicle's internal structure with energy capturing circuit along with mobile jammer.

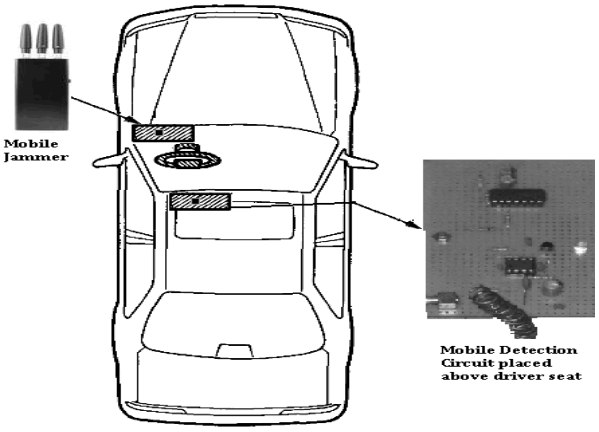


Figure 3: Interior vehicle arrangement with Jammer and Energy & Mobile detection circuit

IV. INCOMING CALL HANDLING OPERATION

When a caller initiates a call by dialing a number in his mobile it directly send a request to the BTS which he comes under. BTS there by sends the request to the BSC to which it is connected and from the BSC, the request is made to the MSC. Subsequently MSC sends a request to the HLR to check the information about the caller like account balance (if pre paid), area of the caller etc. After checking all the details the HLR sends a acknowledgement message to the MSC that the caller is O.K. to make a call or not. Once the message received by MSC it establishes an air link between the both parties and the call gets connected. When the phone started ringing it activate a jamming device which transmits on the same radio frequencies as the cell phone, which disrupt the communication between the phone and the cell-phone base station in the tower as shown in figure 4. Since the voltage captured by the energy capturing circuit exceeds threshold value it's a called a denial-of-service-attack.

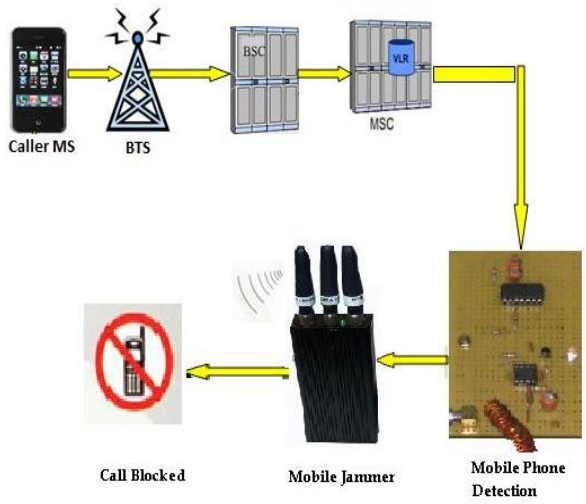


Figure 4: Incoming Call Handling Operation

V. OUTGOING CALL HANDLING OPERATION

Once the driver dials the number and press call button the mobile device will start transmitting more voltage. The energy capturing circuit captures voltage above the threshold value which results in activation of mobile jamming device which squeeze the RF signal as shown in figure 5. Which forces the driver not to use mobile phone while drive.

Figure 5: Outgoing Call Handling Operation

VI. CONCLUSION

This paper presents a low-cost, non-invasive, small-size system and a jammer which helps to detect the driver's use of mobile phone not the phone used by the fellow passenger in the vehicle. It also helps in preventing the road accident due to distraction to a large extent. Though Engineers, researchers or scientist innovate various new technologies, methods or system to prevent road accident, but still road accident continues. To overcome this type of situation all people must educate, realize and give more attention along with newly innovated technology to decrease the rate of road accident.

REFERENCES

1. Alm H, Nilsson L. Changes in driver behaviour as a function of handsfree mobile phones: a simulator study. Accident Analysis and Prevention, 26:441–451.
2. An investigation of the safety implications of wireless communication in vehicles. Department of Transport, National Highway Traffic Safety Administration, Washington
3. Redelmeier DA, Tibshirani RJ. Association between cellular-telephone calls and motor vehicle collisions. New England Journal of Medicine, 336:453–458.
4. The risk of using a mobile phone while driving. Birmingham, Royal Society for the Prevention of Accidents.
5. Walsh, S.P., White, K.M., Hyde, M.K., Watson, B., 2008. Dialling and driving: factors influencing intentions to use a mobile phone while driving. Accident Analysis & Prevention 40, 1893–1900.
6. Charlton, S.G., 2009. Driving while conversing: cell phones that distract and passengers who react. Accident Analysis & Prevention 41, 160–173.
7. Strayer, D.L., Drews, F.A., 2007. Cell-phone-induced driver distraction. Current Directions in Psychological Science 16, 128–131.
8. Loeb, P.D., Clarke, W.A., 2009. The cell phone effect on pedestrian fatalities. Transportation Research Part E: Logistics 45, 284–290.
9. Nasar, J., Hecht, P., Wener, R., 2008. Mobile telephones, distracted attention, and pedestrian safety. Accident Analysis & Prevention 40, 69–75.
10. Neyensa, D.M., Boyle, L.N., 2007. The effect of distractions on the crash types of teenage drivers. Accident Analysis & Prevention 39, 206–212.
11. http://turnoffthecellphone.com/
12. Kriegl, J. Location in Cellular Networks. Diploma Thesis, University of Technology Graz, Australia.
13. Scourias, Overview of Global System for Mobile Communications. http://www.shoshin.uwaterloo.ca/~jscouria/GSM/gsmreport.html
14. http://high-technology-market.com/2008/12/prevent-und