SLEEP ACTIVATED BRAKE CONTROL & CALL ASSISTANCE (SABCCA)

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Abstract

Due to high accident rate on our roads, it became necessary to find out the cause and to proffer solution. From Nigeria road safety point of view it has been established that majority of fatal accident is caused by tiredness which result in sleeping on the wheel. The National Sleep Foundation evaluation on adult who have sleep related problem in America is over 66.6% and in this value those that have fallen asleep on the wheel is about 23% [1]. This alarming data was gotten in late 1997 and early 1998 from national telephone survey from one thousand and twenty seven Americans. In Nigeria most transport company operating jumbo buses like driving at night. People who do not have the opportunity or deny themselves of sleeping well believe that they can still perform better with few hours of sleep. The effect of not sleeping well goes to the extent of affecting one's mental and physical performance which contributes to drivers sleeping on the wheel. [1]. Sleep activated brake control will cut down the menace of suddenly fallen asleep in the driving sector by using the pulse or blood pressure of the driver to cut the supply of fuel or the application of brake.

Keywords: *GSM/GPRS module, SMS, Microcontroller, Infrared Transmitter, Infrared Receiver, Accident, Driver Alert, VANET, Road Safety*

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1. INTRODUCTION

Sleep is extremely necessary in our lives, however not on the steering. Some persons go to sleep on steering as a result of not having enough of it. The National Highway Traffic Safety Administration (NHTA) estimates that one hundred thousand police-reported accidents are the result of driver fatigue every year. This leads to an approximate estimate of 1,550 deaths, 71,000 injuries, and $12.5 billion in financial losses. Estimate of one out of six fetal accidents involves a sleepy driver according to AAA foundation. Over 33% drivers in America have fallen asleep on steering.

It is possible to fall into 3 to 4 seconds micro-sleep without being conscious of it.

In some countries commercial trucks are made to take their turn at night because of traffic situation, this makes them to be prone to sleepy driving, as a result of this over 110,000 people are injured and more than 5000 are killed in automobile accident involving commercial trucks in the U.S.A. in Nigeria most transport company operating jumbo buses do more at night between the year 1995 to 2009. Pilots and train operators (20% and 18% respectively) also admitted that they make grave mistake due to tiredness. For each truck accident another four people are killed.

1.1 The Causes of Sleepiness/Drowsy Driving

- *Sleep restriction or loss*
  - *Job-Related Sleep Restriction*
  - *Personal Demands and life style decisions*
- *Sleep fragmentation*
- *Circadian factors*

In this light the development of sleep activated automobile control and call assistance was perceived. The emergence of automatic brake control is not new, many automobile company have come up with more than form to protect drivers, passengers, investment, property and environment. Little or no work has been published to the best of my knowledge in the method used by the time of writing this article, but there are some other technology used to provide brake control, which will be looked at. The technology behind automatic braking system is a combination of sensor and brake control to help avoid high speed collisions. Some of the design assists the driver's braking system while others vehemently activate the braking system. Some of them are designed to stop collision, while others are designed to reduce the speed of the vehicle. It is evident that high speed does more harm in accident than low speed, for this reason some organization have decided to run slow. Definitely automatic brake control will help to reduce death and injuries during accident. [2].

The brain behind manufacturing automatic brake control is sensor input, various OEM's have theirs. Some use radar, video information while others use laser technology. Algorithm is written to work together with these sensors to make decisions if there are any objects in the way of the vehicle. The system will adjust automatically if the speed is greater than the object found on the path, the difference in speed will give feed back to the system that collision is about to occur, triggering automatic brake control [2]. Some system can make use of GPS information, for instance if a

driver is supposed to stop at a stop sign and did not realize it, the system can activate the brake. [2].

The development of SABCCA is to cut down fuel from the throttle line or gradually apply brake, sound an alarm in the vehicle for passengers to hear, flash additional light for oncoming vehicle to take precaution, send signal to nearby vehicle through Vehicular ad hoc networks (VANETs) [3] and send call out or sms to transport control centers (TCC) of transport company.

In this paper I propose a new method to reduce accident while driving. The innovation of this paper lies in its exceptional application of using human pulse, and blood pressure values as sensor to the vehicle in question. Human pulse, blood pressure (systolic and dialysis) changes when awake and while sleeping, this is the basis of the paper.

The rest of this paper is organized as follows: section two present related works summarizes the related works in this field. Section 3 presents the methodology of data collection.

2. RELATED WORKS

2.1 Driver Alert Systems [4]

It is evidently accepted that tired and drowsy drivers suffer from increased response times, an outsized range of each fatal and non-fatal crashes occur throughout the nighttime and early morning hours according to research. The way out in reducing this problem is to give proper education to drivers and for them to have sufficient sleep according to study by NHTSA, driver alert systems offer a way to proffer solution to cut down drowsy or fatigued related accident.

The complexity of driver alert system is not far from lane departure warning system, lane departure spot any deviation from the lane whereas driver alert system is designed to detect driver's tiredness. There are some system that regularly checks the drivers face of tiredness.

2.2 How Does Driver Alert Systems Work?

Different manufactures with different technology. Nevertheless the way it functions is the use of front camera that can track both right and left lane makings, with proper algorithm if the vehicle is deviating from its lane intentionally will not cause for alarm. In addition to this some system monitors facial muscle slackness of the driver or sign of tiredness, though unpopular many manicures are coming up with superb technology to do the job. Once there is irregularity a beeping sound will occur and visible light on the dashboard. Once the driver control becomes normal the system resets itself, but if the driver continues in tiredness a louder alarm possibly will come on that needs the driver's attention to cancel. Some a designed in such a way that the cancellation can only be done by stopping the vehicle and either opening the driver's door or putting off the engine.

2.3 Driver Drowsiness or Awareness Detection

Various means are used to detect when driver is falling asleep. Most of the technology used is to check when driver's head nod in a telltale motion, while some use technology related to lane detection. [4].

2.4 Background of Sleep Activated Automobile Control & Call Assistance

The development of SABCCA is motivated by the desire to eradicate accident caused by sleeping on the wheel, disseminate driver's alertness information to transport control centers (TCC) and improve road safety. All data collected from the sensors attached to the driver's body on a vehicle can sound alarm in the vehicle while slowing it down and can be sent to transport control centers (TCC), the center can then call on the driver to ascertain his true condition. The sensor can be connected to Vehicular ad hoc networks (VANETs) [3] which will help in communicating with other vehicles on one hand and between vehicles and road side units (road safety agency), this is like a failsafe situation in the event where no one from TCC is responding and everyone in the vehicle is asleep, then other road users can receive this alert and road safety agency to timely intervene.

The rate at which the heart function varies significantly from individual to individual based on fitness, age and genetics. It fluctuates according to the need of muscles to take oxygen and give out carbon dioxide during exercise [5] or sleep [6].

Samples of human pulse were taken before and during sleep, it shows that, the human pulse is higher while awake and lower when asleep. Table 1 and 2 shows the values respectively.

2.5 Blood Pressure and Heart Rate Data of Four People before and During Sleep

Table -1: Awake data

awake data				
No	**Age**	**Systolic**	**Diastolic**	**Pulse**
1	39	132	77	68
2	30	136	90	84
3	24	107	76	90
4	9	113	76	103
5	4	104	75	116

Table -2: Sleep data

Sleep data				
No	**Age**	**Systolic**	**Diastolic**	**Pulse**
1	39	132	77	68
2	30	125	85	73
3	24	98	70	81
4	9	98	63	75
5	4	84	62	88

One of the wrist band heart rate monitor was used to get the data as shown in the figure below

Fig -1: wrist band digital lcd blood pressure monitor

3. METHODOLOGY

3.1 Characteristics

Before a driver handles the wheel, his pulse, systolic and diastolic data will be taken and logged in. The device is in the form of wrist band. Once the diver gets into the vehicle he is going to connect it to an interface of the dash board, or it will be connected wirelessly, if not done and engine is starts there will be beeping alarm telling the driver that he has not attached his SABCCA wrist band to his vehicle. The logged in data becomes the reference value for the device, while on motion should the driver starts feeling sleepy the new data of the device deviates from the logged in data thereby cutting down fuel from the throttle line or automatic graduated brake application, at the same time sound alarm in the vehicle for passengers to hear, flash a special or hazard light for oncoming vehicle to take precaution, send signal to nearby vehicle through Vehicular ad hoc networks (VANETs) [3] and send call out or sms to transport control centers (TCC) of transport company, all these happens within microseconds. Once the driver comes back to normal all these signal stops, but a logging is captured. Once it exceeds the predefine occurrence the driver will not have any option than to park the vehicle for some minutes as determined by TCC. There is time interval for which the driver should recover from fallen asleep, if exceeded the vehicle can only be started for proper parking; the waiting time is factory set according to preference, but it is reconfigurable.

There are many blood pressure measurement devices on the market that shows heart rate data, the output of the heart rate can be interfaced to a microcontroller which will transmitted to the GSM module via the Tx and Rx pins, alternatively a heart rate monitor can be built by using optical sensor to measure the alteration in blood volume at the finger tip of humans. The sensor unit comprises of both IRTx and IRRx. The IRTx sends infrared light into the fingertip and the IRRx receives the portion of the light that is reflected back. The blood volume is dependent of the intensity of the reflected light. A low pass filter can take care of the slight change in reflected infrared light detected by IRRx caused by each heart bit [7] as shown in figure 2.

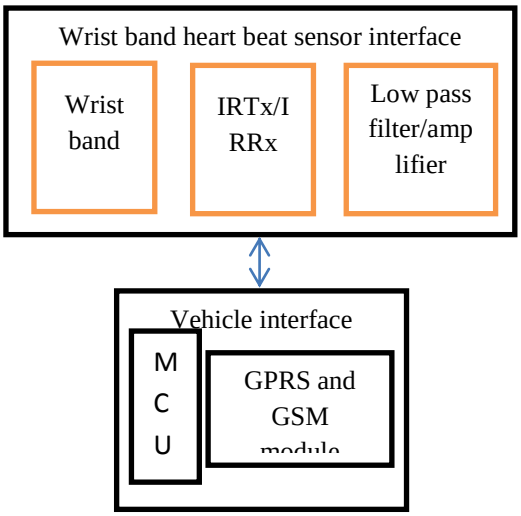


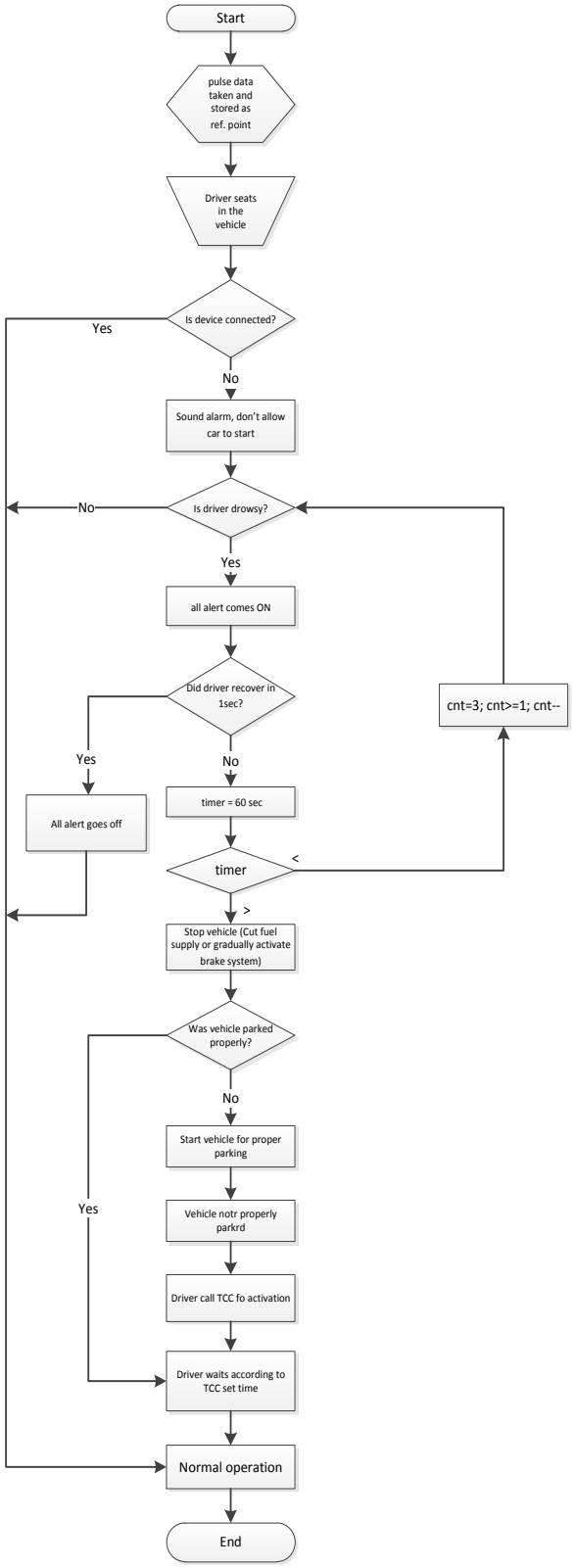
Fig -2: SABCCA Device

3.2 Pseudo Code

1. Heart rate data taken and stored as reference point from diver
2. Driver seats in the vehicle, device connected
3. Is device connected to vehicle?
4. Then device beeps to remind driver when ignition is initiated
5. Then vehicle should not start
6. If driver is feeling sleepy for 1s
    a. Then all signal comes ON
    b. if driver recovers after 1s?
        i. All signals goes off
        ii. Goto line 14 normal operation
7. Time interval for condition 6 to re-occur 60s
8. If condition 6 occurs 3 times
    a. Stop vehicle (Then cut fuel supply or apply graduated brake)

    Otherwise
    b. Goto line 14 normal operation
9. If vehicle stops and was not properly parked
10. Start car for proper parking only
11. If car fails to be parked properly
12. Then driver should call TCC for activation of condition 15
13. Then driver should park properly and rest for some time determined by TCC
14. Normal operation

3.3 Flow Chart



The MCU PIC16F628A has UART functionality with TTL signal output that can directly interface with the GSM/GPRS module via Tx(RB1) & RX (RB2) and Tx & Rx respectively. The output of the hart bit sensor is connected to pin 3 of PIC16F628A. With AT command the GSM/GPRS module can be programmed to function accordingly.

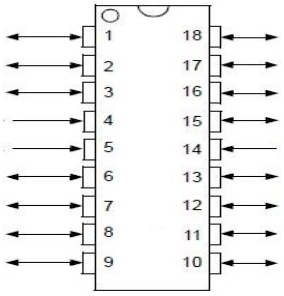


Fig -3: PIC16F628A pin layout

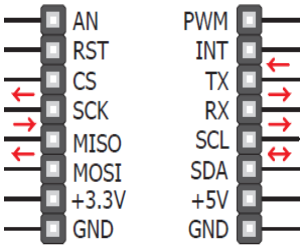


Fig -4: GSM/GPRS module pin layout

3.4 Some AT Command of GSM Module from Telit Modules Software User Guide [8]

Module Identification This verifies if the DTE/DCE connection is working **AT** OK Select 3GPP System (both GERAN and UTRAN) **AT+WS46=25** OK This allow automatic for band selection: **AT#AUTOBND=2** OK **SIM/USIM Access File** AT**#ENAUSIM=1** **OK** **Automatic Data/Time updating** Enable full data/time updating **AT#NITZ=153,1** **Ok** **Network Status** **AT+CREG=2** OK Collect only the Serving Cell Network Information: **AT#SERVINFO**	Set up Text Mode for the SMS: **AT+CMGF=1** OK Check the stored SMSC number: **AT+CSCA?** +CSCA: "+234X20XX58XX0",145 OK **Set SMSC Number** **AT+CSCA=<number>,<type>** Set up the desired SMSC number in international format: **AT+CSCA=+234X20XX58XX0,145** OK **AT+CPMS=?** Check the supported SMS storage types +CPMS: ("SM"),("SM"),("SM") Only "SM" storage type is supported OK **Write a new SMS** Send the stored SMS to the module itself: **AT+CMGF=1** □ Select Text Mode OK

Enable DTMF decoder **AT#DTMF=1** OK **Select SMS Format Type** Follow the AT command used to select the mode. **AT+CMGF=<mode>** Check the supported range of values: **AT+CMGF=?** +CMGF: (0,1) OK	**AT+CPMS="SM"** Select "SM" storage to read SMS +CPMS: 1,50,1,50,1,50 OK Read the SMS stored on position 1. **AT+CMGR=1** +CMGR: "STO SENT","+39329X569YYY","WIND SIM" SEND THE STORED SMS # 1 TO MODULE ITSELF OK Select how the new received message event is indicated by the DCE to the DTE. **AT+CNMI=1,1,0,0,0** OK Send the stored SMS # 1 message to module itself. **AT+CMSS=1** +CMSS: 79 OK The SMS #1 is received by the module itself, the following unsolicited indication is shown on DTE: +CMTI: "SM",2

4. CONCLUSIONS

This article proffers solution to reduce the rate of accident due to drowsiness while driving. With the deployment of this device in every vehicle, the reduction of accident will be colossus in the society and it will help to call for help automatically in the event of accident. It will also help drivers to know their health status before seating on the wheel.

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BIOGRAPHIE

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I attended my primary and secondary school in Port Harcourt, Rivers State, Nigeria.

I graduated and obtained a B.Tech degree in Electronics Engineering in Rivers State University of Science & Technology where I presently work, after my first degree I worked for some years before proceeding for further studies.

In 2008, I obtained MSc. in mobile personal and satellite communication in the University of Westminster, UK. Within this period I also attended the Institute of Engineering and Technology and obtained a level 3 certificate in the requirement for electrical installations (BS7671 2008).