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Survey on Integrated Environment for Driver Safety Using ECG Electrodes

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Abstract - *Driver safety is an extremely important reason for concern in the present scenario. Currently according to many surveys carried out, the time spent by an individual in a vehicle is increasing year by year. Also the lifestyle of an individual right now is too stressful and hectic; together leading to a situation of drowsiness or arrhythmia while driving which could result to the ultimate loss of life, proving to be fatal. The situation demands integrated environment which could detect major abnormal conditions such as drowsiness and arrhythmia. This paper introduces various proposed ideas for driver's safety under above mentioned abnormal conditions.*

Key Words: **Driver safety, Finger ECG electrode, Capacitively Coupled ECG electrode, Drowsiness, Arrhythmia.**

1. INTRODUCTION

Integrated environment for a driver deals with the safety of the driver. There are two major abnormal conditions which are to be tackled to provide safety to a driver namely drowsiness and arrhythmia while driving. Firstly, drowsiness could occur due to a number of reasons such as driving at odd hours, driving continuously for day and night or it could be just that the driver is completely exhausted and is feeling sleepy leading to an accident, at times proving to be fatal. Secondly, arrhythmia (irregular heartbeat) occurs when the electrical signals to the heart that coordinate heartbeats are not working properly. The stressful and hectic lifestyle at present seems to be one of the critical reasons for both drowsiness and arrhythmia. For both the cases, the ECG electrodes are an excellent source to detect the abnormality in the heart rate of the driver. The ECG electrodes measure the heart beat of the driver. ECG electrodes along with some kind of external circuitry compare and monitor the heart beat with the reference to the normal heart rate already captured under normal conditions. This complete setup is used to determine if there is any abnormality in the heart rate of the driver at the time of the driving; if there is any abnormality, appropriate measures are taken for the safety of the driver and alert the driver about the same.

2. ECG MONITORING OF DRIVER

2.1 Finger ECG Based Abnormality Detection and Control System

The finger electrocardiogram (ECG) electrodes are used to measure the heart rate of the driver. The Finger ECG electrodes are placed on the right thumb and left index finger of the driver. These electrodes placed on the fingers effectively measure the heart beat of the driver at the time of driving. In case the situation of abnormality is detected the driver is given an alert to stop the vehicle to avoid any accident. Also, the supply of fuel to the engine is cut-down in case the driver is unable to stop the vehicle by himself the car will slow down and stop automatically.

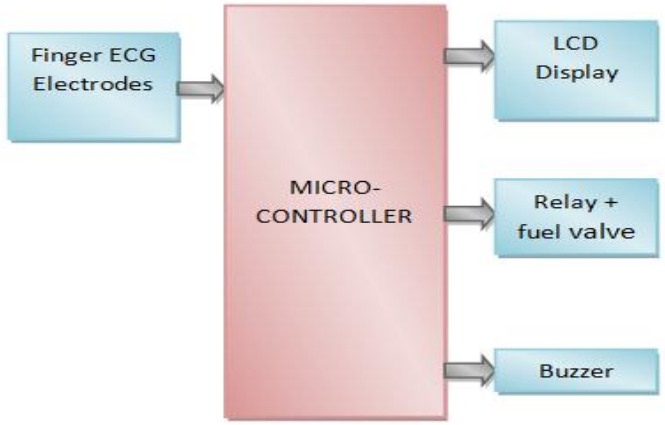

Fig -1: Block Diagram

The ECG electrodes play a vital role in the above system as the input value of the heart rate is sensed through these electrodes. The microcontroller will compare these values with the database of the normal heart rate captured under normal conditions. In case of any abnormality the buzzer is turned ON to make the driver alert about his abnormal condition and the LCD will also help to provide information about the present condition of heart beat to the driver. If driver is unable to stop the vehicle after he is alerted or ignores the alert; the supply of fuel is cut-down by making the relay open, to temporarily stop the vehicle and to successfully attain the safety of the driver.

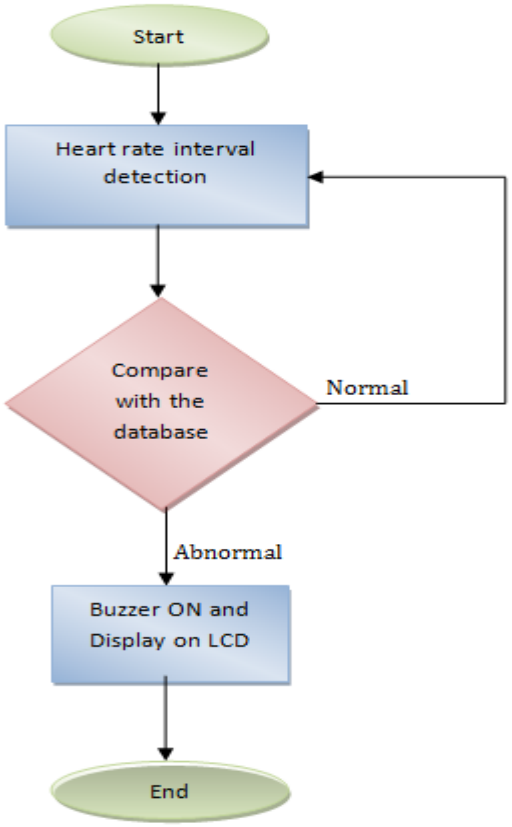

Fig -2: Flow Chart

2.1.1 Advantages:

1. Finger ECG electrodes are more reliable than blinking detector, yawning detector, etc.
2. Less time-consuming.
3. Better safety.
4. Prevention of an accident.

2.1.2 Disadvantages:

1. Less reliable than ECG electrodes that can be directly connected to the chest area, due to the continuous movement of hands.

2.2 Capacitively Coupled ECG Abnormality Detection System

The capacitively coupled ECG electrodes are used to measure the heart rate. These electrodes are non-contact capacitive, which form the capacitance between skin and electrode plates and through this capacitance ECG can be measured. In short, without direct contact and much co-operation from the driver, the abnormality in the ECG is detected with complete ease. These electrodes are suitably placed in the driver's seat to detect the abnormality at any point of time while driving.

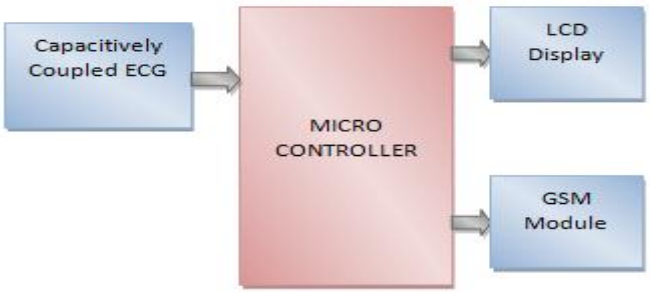

Fig -3: Block Diagram

The capacitively coupled ECG electrodes which are placed inside driver's seat play the vital role of sensing the heart rate of the driver without any direct contact. The microcontroller compares the sensed values with the database of already captured heart rate under normal conditions. If an abnormality in the ECG signals is detected then the LCD will display this information to alert the driver about the situation and a text message will go to an emergency contact to inform that the driver is facing some abnormality and needs help.

Advantages:

1. Comfortable and less Obstructive for the driver.
2. Stationary electrodes help to obtain highly accurate ECG signals.
3. Information could be sent to an emergency contact.

Disadvantages:

1. Expensive as the electrodes are to be mounted inside the seat itself.

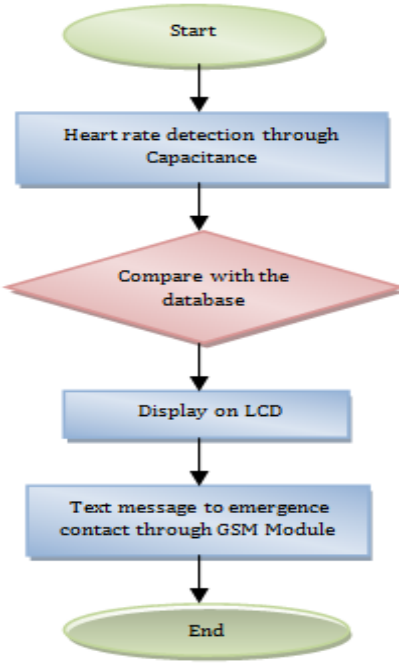

Fig -4: Flow Chart

3. CONCLUSIONS

The paper illustrates different approaches to develop an integrated environment for the safety of the driver. The electrocardiogram (ECG) electrodes prove to be an efficient and accurate way to measure the heart rate of the driver at the time of driving, to develop an integrated environment for driver safety in case of any abnormality such as drowsiness and arrhythmia.

Among the approaches discussed above, first is desirable for detecting drowsiness and arrhythmia both and controlling the vehicle. But the second approach is desirable only for detecting arrhythmia only as it will inform about the situation to an emergency contact which in case of drowsiness is not required.

The first approach alerts about abnormality as well as controls the vehicle in case of abnormality detection, whereas the second approach will only alert about the abnormality without any feedback mechanism to control the vehicle.

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