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Research paper

Automobile Driver Stress Detection By Wearable Glove System

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Abstract

This paper focuses on predicting the driver's stress depending on the change in skin conductance. The Galvanic Skin Response (GSR) sensor is used for measuring the skin conductance. The electrical conductance varies with respect to the moisture of the skin produced by the sweat glands. The emotions of the driver such as normal state and stressed state are considered for monitoring. The electrical conductance of the skin helps to monitor the stress of the driver when driving the vehicle. Compared to other physiological signals such as ECG, EMG, EEG, EOG, Respiration Rate, this method is a simple and reliable method. Twenty subjects were exposed to the simulation driving environment under different scenarios such as normal roads, highways and heavy traffic roads. The readings obtained from this study helps in detecting the driver's stress level.

Keywords: *GSR, Skin conductance, Stress Detection , Automobile, Accidents.*

1. Introduction

Driving is a part of day-to day activity that requires presence of mind and concentration [6]. Due to stress drivers suffer from various problems such as high blood pressure, cardiac arrest, back pain etc. The electronics and the information system present in the automobile system helps in safe driving[1].
The major reason behind road accident and death is due to the increased driver stress. The stress while driving occurs due to different scenarios such as long time driving, traffic, obstacles in the road, varying road conditions, driving in bad weather conditions[6]. All these scenarios should be considered to avoid accidents. Most of the accidents happens due to increased stress of the driver. To increase the safety and protection of the driver, newer technologies are implemented in the automobile industry. Stress causes changes in the physiological parameters of the body such as breathing rate, muscle contraction, heart rate and sweating etc.
Physiological signals such as Electrocardiogram (ECG), Electroencephalogram (EEG), Electro-oculogram (EOG), Electromyogram (EMG), Galvanic Skin Response (GSR) makes it possible to detect driver exhaustion and stress[6]. The utilization of physiological signals for determining the driver stress requires sensors that are costly and unique, to produce real time data for analysis.
This work presents the stress detection based on Galvanic skin response of the skin. The change in electrical conductivity of the skin occurs due to the sweating. The studies are carried out in a simulated driving environment to study the subject's behaviours that correlate with stress[4].

2. System Overview

2.1. GSR Sensor

The characteristic of the human body that makes continuous change in the electrical conductivity of the skin is called as Electro dermal activity (EDA). EDA is caused due to electro dermal response (EDR), galvanic skin response (GSR), psycho galvanic reflex (PGR), skin conductance level (SCL), and skin conductance response (SCR).
GSR sensor helps to determine the sweat gland activity thus increasing the skin conductance.

2.2. PIC16F877A

The PIC16F877A is an 8-bit microcontroller used for programming to detect the stress depending on the readings from the GSR sensor. Based on the signal from the GSR sensor the microcontroller programming is done to detect the status of the driver. The Bluetooth module is interfaced with the microcontroller to transmit the data to the mobile phone.

2.3. Bluetooth

Bluetooth is a low-cost transceiver chip interfaced with the device. This telecommunication technology is used for transmitting the status information of the driver such as normal state and stressed state to the predefined mobile phone.

2.4. LCD Display

The LCD display helps in displaying the status of the driver's stress information present in the prototype. If the driver is out of stress, it gives the display as normal state and if the driver is stressed it shows the display as stressed state.

2.5. Buzzer

A buzzer is an alarming device which is connected to the system so that the it gives an indication that the stress level of the driver is high and it is not advisable for the driver to continue driving.

3. System Overview

The driver stress detection system is shown in Fig. 1. Here the GSR sensor placed in the glove is connected to the driver finger. The skin conductance is measured by the GSR sensor continuously and the readings of the skin conductance is given to the microcontroller for further processing. Based on the readings obtained from the GSR sensor programming is done in PIC controller to display the status of the driver stress level in the LCD display and to initiate the alarm in the buzzer. The Bluetooth telecommunication technology is utilized in the system for transmitting the information to the mobile phone.

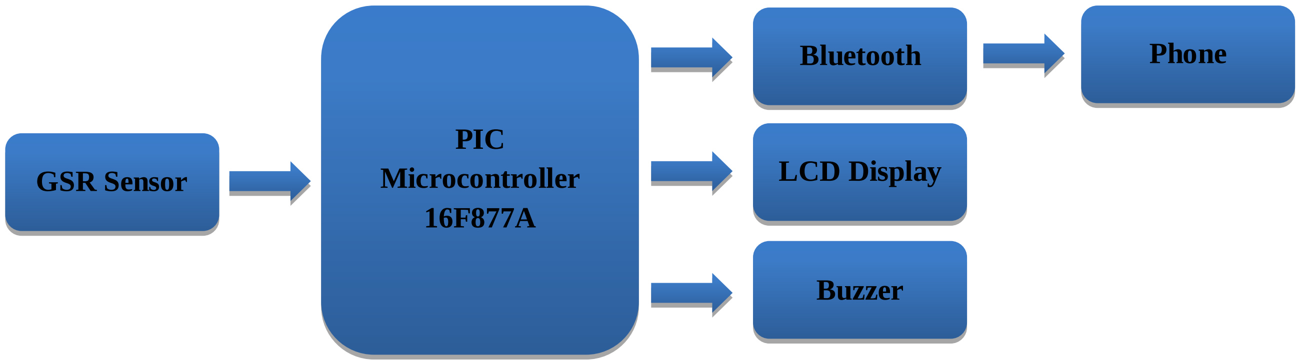

Fig. 1: Block Diagram of the Driver Stress Detection System

4. Results & Discussions

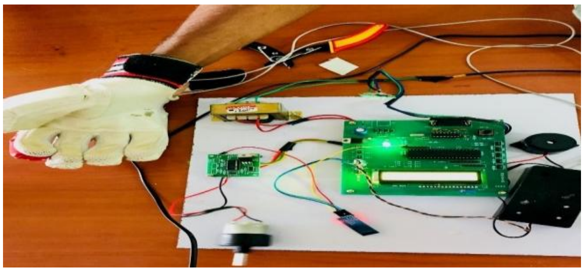

Fig. 2: Driver Stress Detection System

The driver stress detection system is shown in Fig. 2. Here the GSR sensor is placed inside the gloves and attached to the driver finger. The skin conductance is measured by the GSR sensor and Programming is done in the PIC microcontroller to detect the stress.

The skin conductance readings from GSR sensor for normal state and stressed state is displayed in Table 1. The readings were taken for 20 persons with varying emotions in a simulated driving environment. The changes in the skin conductance is observed for every person. From the readings of skin conductance the mental state of the driver is very clearly observed such as the normal state and the stressed state. The stressed state shows a higher value of skin conductance when compared with the normal state values.

Table 1: Readings of GSR sensor for various states

S. No	Test Inputs	Normal State		Stressed State	
		Skin Conductance (μs)	Voltage (mv)	Skin Conductance (μs)	Voltage (mv)
1.	Input 1	162	0.31	958	2.10
2.	Input 2	60	0.19	110	0.59
3.	Input 3	158	0.41	565	1.32
4.	Input 4	35	0.13	195	0.59
5.	Input 5	141	0.2	428	1.28
6.	Input 6	84	0.21	245	0.62
7.	Input 7	121	0.33	342	0.98
8.	Input 8	45	0.17	187	0.47
9.	Input 9	105	0.117	765	1.18
10.	Input 10	203	0.29	634	1.03
11.	Input 11	81	0.19	187	0.68
12.	Input 12	220	0.013	432	1.22
13.	Input 13	55	0.2	512	0.85
14.	Input 14	69	0.01	237	0.752
15.	Input 15	91	0.3	352	0.58
16.	Input 16	111	0.2	595	0.67
17.	Input 17	71	0.4	211	0.9
18.	Input 18	110	0.2	412	0.61
19.	Input 19	93	0.11	321	0.52
20.	Input 20	75	0.01	532	0.6

5. Conclusion

The electrical conductance helps to monitor the stress of the driver while driving the vehicle. The stress of the automobile drivers can be detected by the stress detection system for the protection and safety of the individuals travelling in the vehicle. From Table 1 it is inferred clearly that the skin conductance in the stressed state is much higher than the skin conductance in the normal state. This paper presents the prototype of the stress detection system with the help of gloves. Then to highlight the stress levels of the drivers and to understand their changes the following elements are connected in this work. The buzzer to alarm the customer and the short-message-service sent to the phone. In future, the detected stress can be communicated to the call center of the taxicab service and the stress-free driver can be shifted instead of the stressed driver. By these changes, the chances of accidents on the roads can be reduced to an extent.

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