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Firefighters Safety Suit

Ms. R. Valarmathi[1], KR Anusha[2], M. P. Sumathi[2]

[1]Associate Professor, Department of ECE, St.Peter's College of Engineering and Technology, Ch-54
[2]Student, Department of ECE, St.Peter's College of Engineering and Technology, Ch-54

Abstract: A fire-fighter is usually the first official on the scene of fires, major car accident, building collapse and other emergencies. We have designed an inflated air bag suit with impact and pressure sensor. When a concrete or weighted object falls on the human body, the suit will inflate the moment it touches the body, thus saving the Fire-fighters from injuries. Fire-fighters are also more prone to heart attack. With the help of IoT, the heart rate will be constantly monitored in order to take necessary measures.
Keywords: Fire-fighter, Inflated air bag suit, Impact sensor, Pressure sensor, Heart monitor- IoT, Rescue in accidents.

I. INTRODUCTION

Injury due to falling debris is common for Fire-fighters. Falling concrete on human body can mostly lead to internal injury and there is always a possibility of future disability. We are developing a means to prevent or reduce the impact of falling object on crucial parts of human body. The second the falling debris comes in contact with human body, the air bag inflates because of the sensors that senses the external pressure above assigned threshold value and triggers the mechanism. The Air bag will remain inflated for several minutes depending on the quality of material used. Within those minutes, a message will be sent to the person monitoring on-site and can be helped. Inhaling toxic gases in case of fires is common sometimes leading to heart diseases and though many preventive measures exist, we are monitoring the heart rate continuously using IoT as a safety measure.

II. RELATED WORKS

This part shows the previous work for fall related safety. A hip-protecting jacket is designed to absorb the shock of fall and reduce the impact on human body by automatically inflating an air bag when the person falls. This system consists of the telemetry acceleration monitoring and air bag inflating parts. The air bag inflating system consists of an air bag, a battery, a gas cartridge, sensors, a triggering system to release the gas, and a relief valve. When the user experiences a fall, the sensors detect and this causes the triggering signal to automatically release gas from the cartridge inflating the air bag and protect the user. After its use, the relief valve is opened to release air from the air bag; this system is ready for reuse after the used cartridge is replaced.

A fall detection algorithm is developed in which zero acceleration condition is considered as a sign of user falling. When the acceleration changes to zero, the pressure in the air bag gradually increases before the large impact acceleration occurs.
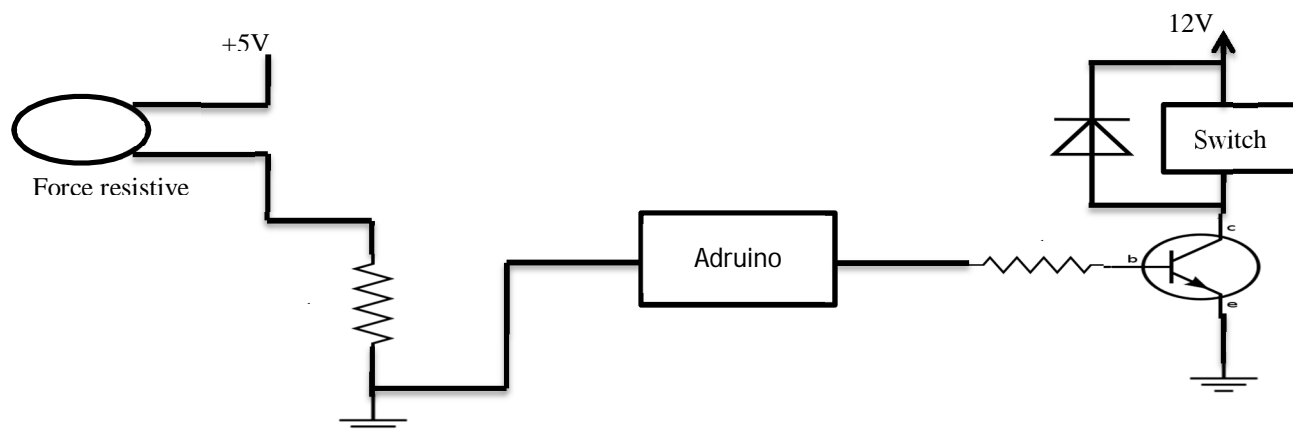
A. Proposed System

Figure 1: Block Diagram of Proposed System

Figure 1 explains the working principle of proposed system for Air bag inflated safety suit. In this methodology, air-bag inflated suit is used for upper body protection especially the sensitive parts. When the falling debris comes in contact with the user, the force sensing resistor senses the impact and pressure within seconds.

It creates a trigger and sends signal to automatically release CO2 gas from the cartridge, thereby inflating the air bag and protect the user. The solenoid acting as switch is opened to release air from the air bag. This requires replacement of cartridge for using another time.

B. Force-Sensing Resistor

FSR is a material whose resistance changes when force, pressure or mechanical stress is applied. They are also known as Force resistive sensor or just FSR. It consists of a conductive polymer that changes resistance in a predictable manner following application of force to its surface. They are supplied as a polymer sheet or ink that can be applied by screen printing. The sensing film consists of both the electrically conducting and non-conducting particles in matrix. The particles are sub-micrometer sizes, and they are formulated to reduce the temperature dependencies, improve mechanical properties and increase surface durability. Force applied to the surface of the sensing film leads the particles to touch the conducting electrodes, changing the resistance of the film.

Compared to other force sensors, the advantages of FSRs are their size, low cost and good shock resistance. One of the disadvantages is that their low precision: measurement results might differ. It requires long term stability and more complicated drive electronics.

C. Algorithm For Impact And Pressure Sensor

Using Arduino, an algorithm is created that will send a trigger like signal when the impact and pressure value is above the assigned threshold value, thus causing the release of CO2 gas from cartridge and inflating the airbag.

A pulse sensing mechanism is also included for the constant monitoring of heart and the details will be sent to cloud and from cloud, software processes and the alert is sent to the mobile app of user.

D. Heart Rate Monitoring Using IoT

From fig2, Mobile app is designed such a way that it is compatible for all the devices. The pulse sensor waveform is stored as data in the cloud. With Internet, the software processes the data and if the pulse wave is above the assigned threshold value, then the mobile app receives an alert listing the details of user's heart rate. Thus, the user can be under proper care throughout. The alert can also be sent to two or more people simultaneously.
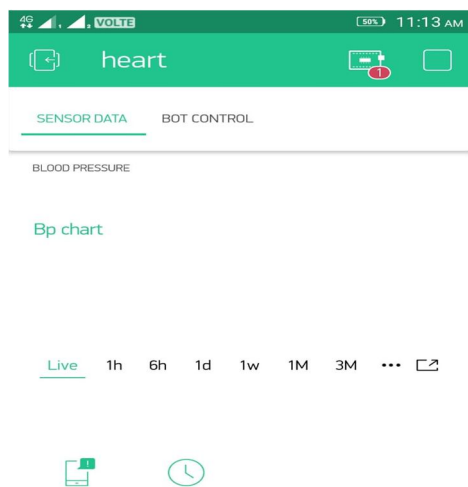

Fig 2: Mobile app development for alerts

E. Verification and Result

The prototype system is being tested and the results are positive. The pressure and impact value increases and when it reaches threshold, air bag inflation process occurs.

The heart rate details are recorded simultaneously since it was experimental, the heart rate was found to be normal and thus, it didn't alert.

III. CONCLUSION

Upper body part-protector is developed to save the user from falling debris, concrete or building blocks and collision using an airbag that inflates extremely rapidly and then deflate. Hence, it prevents the user from external or internal injuries and from any possibility of future disability. This prototype is cost efficient. It can be further developed by also monitoring the respiratory rate or adding GPS in the system.

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