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A PROTOTYPE AIRBAG SAFETY DEVICE TO PREVENT ACCIDENTAL INJURIES FOR BIKE RIDERS

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Received on 15-05-2016

Accepted on 18-06-2016

Abstract:

With increasing population and the density of vehicular traffic accidents are inseparable part of human life. Each year about 2 percent of motor vehicle crash deaths are motorcyclists. In a majority of motorcyclist deaths, the most serious injuries are to the head and spinal cord highlighting the importance of wearing a safety device. Airbag is a safety feature incorporated in many four wheelers. Two wheeler accidents prove fatal in most of the cases, hence an airbag has been designed for safety of the driver. This prototype model works with the combination of the sensors like Mems and Ultrasonic sensors which takes the fall detection signal with angular position of 45 degree or less and an obstruction as close as 3cm respectively will trigger to inflate the air bag that can be easily fitted into the riders jacket.

Key words: Airbag, Fall detection, Mems, Riders jacket

Introduction

Motorcycle injuries is the leading cause of deaths in India and about 40% of those killed and injured on Indian roads are motorcyclists. The majority of bike accident related injuries are to the head and spinal cord manifesting the importance of wearing a safety gadget. The World Health Organization has released a report stating that around 16.6 people/ lakh lose their lives in India due to road accidents. This results in a 3 % loss of the total domestic utility of the country. It has been pointed out by many Non profitable organizations that immediate and immense attention is required towards the protection of vehicle safety.

Roughly 1.3 million are lost annually on the world's roads and about 20 to 50 million people are subjected to severe injuries. Young people are more susceptible to motorcycle injuries, India is facing a massive increase in motor vehicle

density. The gush in motorization in addition with the expansion of road network has proved to be a challenge of addressing the increase in road accidents, its adverse reflection.

Apart from the lives lost, the motorcycle accidents envelops a greater share of hospitalization, lifelong disabilities and socio-economic losses in the young and middle-aged population. Motorcycle accident related injuries also consigns a colossal burden on the health sector in terms of acute care and rehabilitation. Stability and Speed do not hold a cordial relation thus sketching motorcycles to be dangerous. With speed motorcycle becomes tough to control, falls on the blind spot of other drivers and crashes placing the rider's life in serious threat. To sustain these common kind of accidents and related injuries, a rider should follow strict safety measures like wearing a helmet. But helmets will only protect the head from injuries. Similar to head, the spinal cord is also very critical. Talking about making riding a bit more safer that's where motorcycle airbags come into picture. To protect the chest, hip and back bone we can use safety airbag which will inflate under required conditions like over speed or an impact crash. Fitting an airbag inside a jacket is very, easy. Here a prototype of the design is only presented. This can further be miniaturized for compact fit into a jacket.

Materials and Methods

Human Airbag System Design

The proposed system can help the bike riders to prevent fall-related injuries. It can be used mainly for bike racing field as well as can be tailor made to suit regular motorcycle riders and also to prevent elders from getting hurt during a fall. Ultra sonic sensor is implemented here to detect an obstruction in terms of range of flight and MEMS is used for the angular detection in all 3 axis.

ArduinoUno Atmega 162 microcontroller is used as the brain of the system. The micro controller is programmed by using embedded c language.

The primary design considerations for a wearable airbag are as follows.

- 1) It must be stable and reliable, that is it must be able to detect falls promptly while the wearer is riding the bike.
- 2) It must protect the chest, stomach part, spine and back bones
- 3) It must be small, lightweight.
- 4) It must be activated on a true fall in accidents.
- 5) It should be cost effective.

Based on these considerations, a prototype of the proposed system consists of wearable Mems and ultrasonic sensor and an airbags. The design is composed of power supply, Microcontroller, mems sensor with interfacing circuit, ultrasonic sensor, air bag driving circuit, air pipe and airbags. The system collected the data of human body motion and posture by sensors, and the micro-controller was employed to analyze and process the data, the circuit was triggered once the micro controller had confirmed that the fall was inevitable.

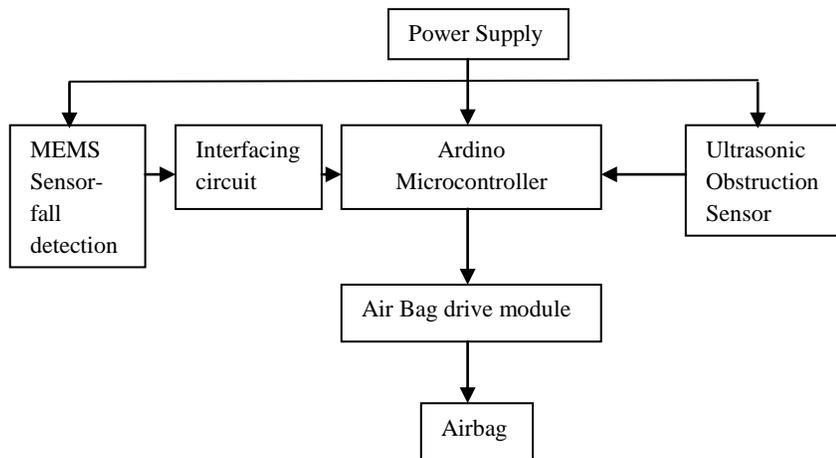


Fig. 1 Overall view of the system.

Protection from an impact during a fall can be prevented only if the fall is detected promptly. Many research work has been contributed in the area of fall detection. The General methods of fall detection are namely techniques based on audio-visual sensing and wearable sensing. The advantages of wearable sensing technique is its low cost and usability irrespective of time and place.

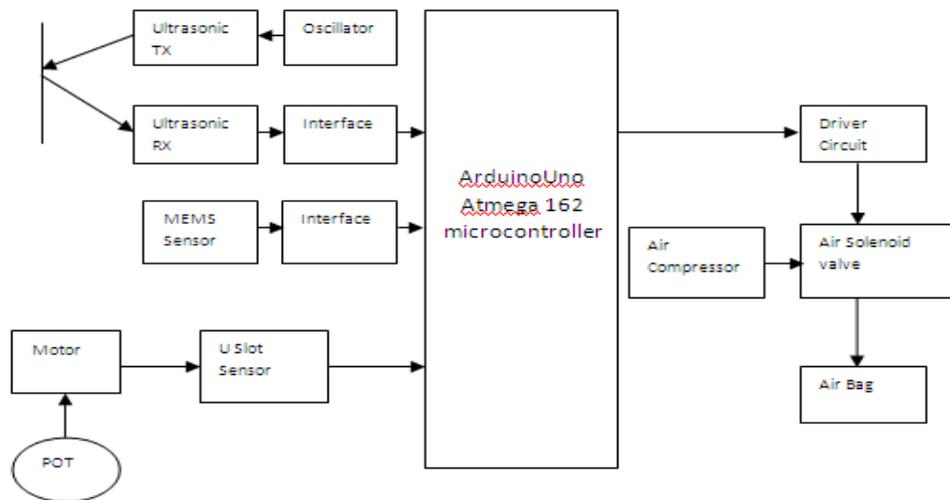


Fig 2: Block diagram of the wearable airbag system.

A potentiometer was used to mimic the speed of the motorcycle, which supplies speed respective input to the motor which in turn through the slotted Opto isolator module, with an IR transmitter(emitter) & a photodiode (receiver) mounted on either limbs detect objects that pass between the two arms provides the speed understandable to the microcontroller. MEMS sensor is used as an inclinometer measuring the tilt, this provides an indication of the angle of inclination between the rider and the ground, when the angle of inclination goes lower than 45 degrees it serves as a trigger signal. MEMS is used for the angular detection on all 3 axis. An ultrasonic transmitter and receiver setup is used to check the proximity of the obstacle. The presence of an obstacle as close as 3cm is detected and signaled to the microcontroller. A driver circuit is triggered to activate the air solenoid valve which fills the airbag using a 12v DC compressor. Thereby providing enough buffer for the impact. The micro controller is programmed by using embedded c language.

Results and Discussion

In this system, we are using an airbag to inflate and serve as a buffer when there is a fall .The system combines signals from acceleration, angle of inclination to the ground and obstacle proximity which acts as fall detection signal, a simple fall detection algorithm is developed and triggers to inflate the air bag .When the Mems detects angular position of 45 degree or less indicating that the rider would fall, the air compressor will turn on thereby inflating the airbag. The airbag will be fixed in the jacket that the rider wears thereby providing sufficient safety measure to protect the rider from the impact. Similarly when the ultrasonic sensor detects an obstruction as close as 3cm or less, the airbag is inflated. The combined effect of both the sensor ensuring angular position and obstruction proximity will ensure safety of the rider if an impact should occur.



Fig 3: Output when MEMS detects a fall (3 axis).

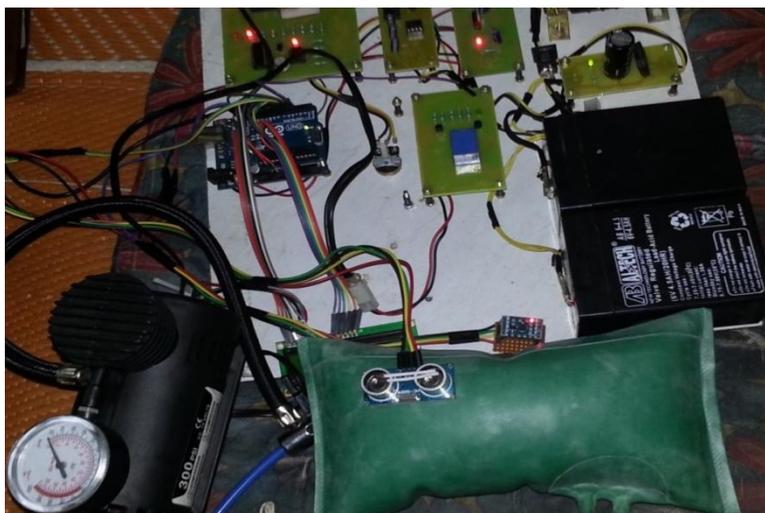


Fig 4: Output when the ultrasonic sensor detects an obstruction.

Future work:

Although the proposed system can help to prevent fall-related injuries many further developments are needed to miniaturize the airbag safety system. A light weight, compact version would serve the cause in reality. This pattern of protection can be extended to patients, elderly people to protect them from fall related injuries.

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