



## Emergency Call for Nearest Ambulance during Airbag Inflation using Wireless Sensor Networks

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**Abstract**— *An airbag is a vehicle safety device. It is an occupant restraint system consisting of a flexible fabric envelope or cushion designed to inflate rapidly during an automobile collision. Its purpose is to cushion occupants during a crash and provide protection to their bodies when they strike interior objects such as the steering wheel or a window. Even though deaths related to airbags had declined, major injuries remain fairly common in accidents with an airbag deployment. This paper proposes a method where wireless sensor networks are used to sense an airbag inflation and contact the nearby ambulance with the help of control messages. This avoids more harm that could be caused to the victims while waiting for ambulance to reach from a far distance.*

**Keywords** — *Collision, Airbag, Ambulance, WSN, FAC protocol.*

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### I. INTRODUCTION

According to World Health Organization as in [2],[3], nearly 1.3 million people die in road crashes each year, on average 3,287 deaths a day. An additional 20-50 million are injured or disabled. Road traffic crashes rank as the 9th leading cause of death and account for 2.2% of all deaths globally. Each year nearly 400,000 people under 25 die on the world's roads, on average over 1,000 a day. Over 90% of all road fatalities occur in low and middle-income countries, which have less than half of the world's vehicles. Road crashes cost USD \$518 billion globally, costing individual countries from 1-2% of their annual GDP. Road crashes cost low and middle-income countries USD \$65 billion annually, exceeding the total amount received in developmental assistance. Unless action is taken, road traffic injuries are predicted to become the fifth leading cause of death by 2030. Road accidents have earned India a dubious distinction. With over 130,000 deaths annually, the country has overtaken China and now has the worst road traffic accident rate worldwide. Airbag deployed in every vehicle could reduce this statistics.

An airbag is a vehicle safety device. It is an occupant restraint system consisting of a flexible fabric envelope or cushion designed to inflate rapidly during an automobile collision. Its purpose is to cushion occupants during a crash and provide protection to their bodies when they strike interior objects such as the steering wheel or a window. Modern vehicles may contain multiple airbag modules in various side and frontal locations of the passenger seating positions, and sensors may deploy one or more airbags in an impact zone at variable rates based on the type, angle and severity of impact; the airbag is designed to only inflate in moderate to severe frontal crashes. Airbags are normally designed with the intention of supplementing the protection of an occupant who is correctly restrained with a seat belt. The first commercial designs were introduced in passenger automobiles during the 1970s with limited success. Broad commercial adoption of airbags occurred in many markets during the late 1980s and early 1990s with a driver airbag, and a front passenger airbag as well on some cars; and many modern vehicles now include four or more units as said in [2]. A wireless sensor network (WSN) of spatially distributed autonomous sensors is to monitor physical or environmental conditions, such as temperature, sound, pressure, etc. and to cooperatively pass their data through the network to a main location as in [1]. The more modern networks are bi-directional, also enabling control of sensor activity. The development of wireless sensor networks was motivated by military applications such as battlefield surveillance; today such networks are used in many industrial and consumer applications, such as industrial process monitoring and control, machine health monitoring, and so on. Wireless sensor networking is one of the hot topics in computer science research. It is an emerging technology that have revolutionized the design of embedded systems and triggered a new set of potential applications including environment monitoring, smart spaces, medical systems and new domestic solutions. Such a network normally consists of a large number of distributed nodes that organize themselves in a multi-hop wireless network. Each node has one or more sensors, embedded processors and low-power radios, and is normally battery operated. Typically, these nodes coordinate to perform a common task. The delivery of sensory data for process and analysis, usually to a control station (also referred as sink), is based on the collaborative routing work of the WSN nodes.

In this paper wireless sensor networks are used to detect the airbag inflation during collision between vehicles and contact the ambulances in its network and confirm for help to the nearest available ambulance. The organization of the paper is as follows: Working of the airbags is explained in section 2. FAC protocol exclusively designed for this project is described in section 3. Then, there is a brief overview of the proposed system in section 4. Finally, its summarized by the conclusions and the future work in section 5.

## II. How AIRBAGS WORK?

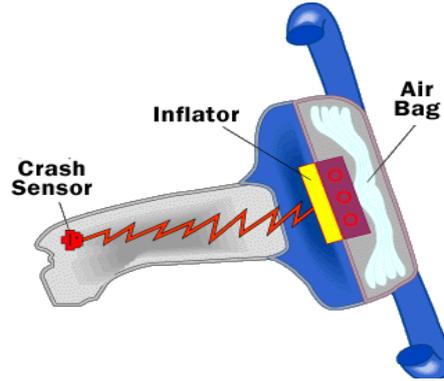


Fig. 1 The airbag inflator.

### A. Airbag Inflation

Fig. 1 shows an airbag inflator as in [2],[4]. The goal of an airbag is to slow the passenger's forward motion as evenly as possible in a fraction of a second. There are three parts to an airbag that help to accomplish this feat:

- The bag itself is made of a thin, nylon fabric, which is folded into the steering wheel or dashboard or, more recently, the seat or door.
- The sensor is the device that tells the bag to inflate. Inflation happens when there is a collision force equal to running into a brick wall at 10 to 15 miles per hour (16 to 24 km per hour). A mechanical switch is flipped when there is a mass shift that closes an electrical contact, telling the sensors that a crash has occurred. The sensors receive information from an accelerometer built into a microchip.
- The airbag's inflation system reacts sodium azide ( $\text{NaN}_3$ ) with potassium nitrate ( $\text{KNO}_3$ ) to produce nitrogen gas. Hot blasts of the nitrogen inflate the airbag.

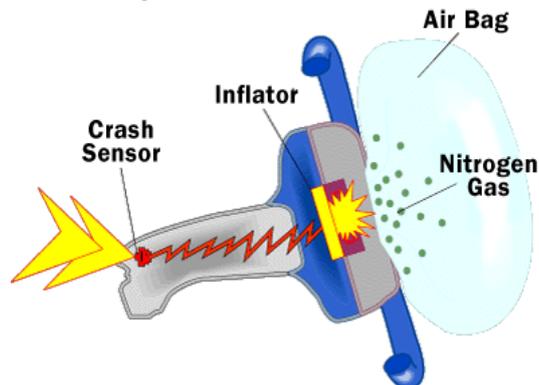


Fig. 2 The airbag and inflation system stored in the steering wheel.

Fig. 2 and 3 show an airbag inflation system. Early efforts to adapt the airbag for use in cars bumped up against prohibitive prices and technical hurdles involving the storage and release of compressed gas. Researchers wondered:

- If there was enough room in a car for a gas canister
- Whether the gas would remain contained at high pressure for the life of the car
- How the bag could be made to expand quickly and reliably at a variety of operating temperatures and without emitting an ear-splitting bang.

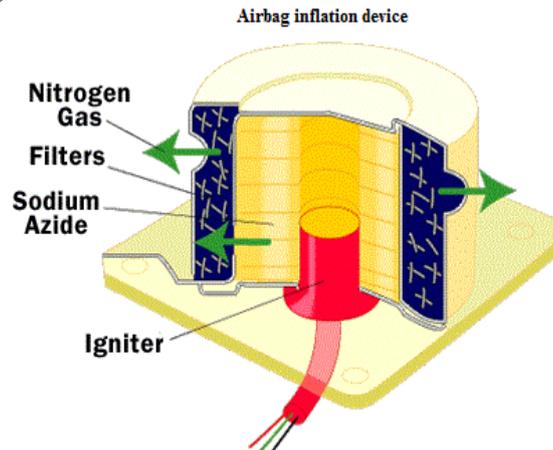


Fig. 3 The inflation system uses a solid propellant and an igniter.

- They needed a way to set off a chemical reaction that would produce the nitrogen that would inflate the bag. Small solid-propellant inflators came to the rescue in the 1970s.
- The inflation system is not unlike a solid rocket booster. The airbag system ignites a solid propellant, which burns extremely rapidly to create a large volume of gas to inflate the bag. The bag then literally bursts from its storage site at up to 200 mph (322 kph) -- faster than the blink of an eye! A second later, the gas quickly dissipates through tiny holes in the bag, thus deflating the bag so you can move.
- Even though the whole process happens in only one-twenty-fifth of a second, the additional time is enough to help prevent serious injury. The powdery substance released from the airbag, by the way, is regular cornstarch or talcum powder, which is used by the airbag manufacturers to keep the bags pliable and lubricated while they're in storage.

### III. FAC PROTOCOL

The working of a new protocol named FAC ( Flood Acknowledgement Confirmation ) protocol exclusively proposed for this system is as shown in Fig.4. There is a single sender which may have many number of receivers in its reachable area. There are three type of control signals involved in this protocol, namely flood message, acknowledgement and confirmation signal. At first, the sender floods the message for connection which reaches all its neighbouring nodes. The receivers reply with an acknowledgement to sender only if they are free and are ready to connect. As shown in the Fig.4 , the receiver 2 does not reply with an acknowledgement as it is not ready for this connection. The sender then confirms the connection only to that node whose acknowledgement reaches the sender first. This action confirms that the sender is connected to the nearest node to it. In case the flood message or the acknowledgement is lost in the middle, it is not resent, instead the connection is made between the node whose acknowledgement reaches the sender first.

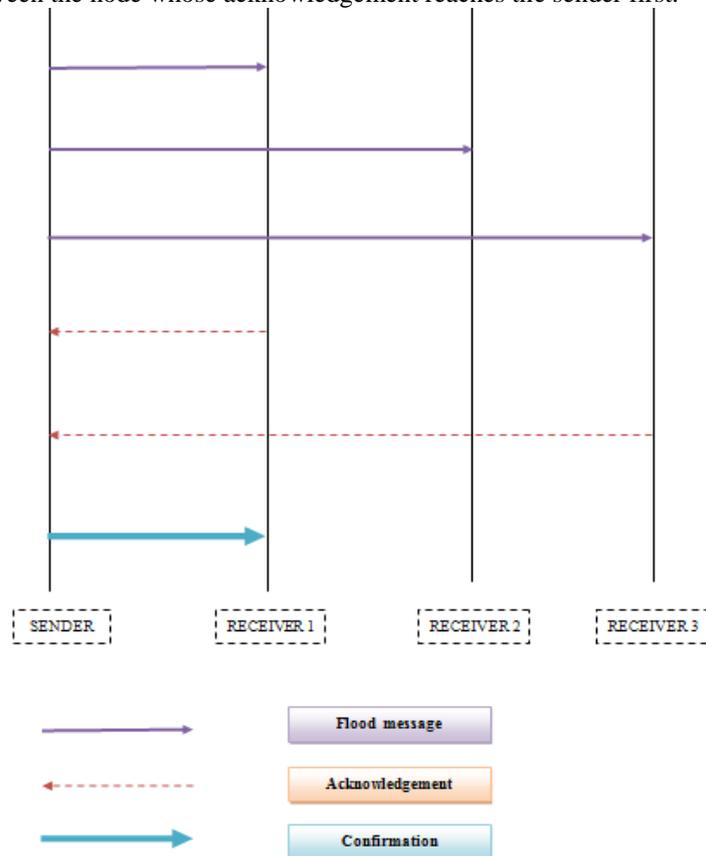


Fig. 4 Working of FAC protocol

### IV. PROPOSED SYSTEM

The Fig.5 shows the working of the proposed system. When two vehicles collide with each other, airbag inflates and tries to save the passenger from death. But the accident might have caused major injuries which could lead to death of the victim if no medical assistance is provided in time. The wireless sensor installed in the vehicle senses that the airbag inflation has taken place. This wireless sensor node now contacts the nodes installed in ambulances for help as shown in the figure as flood message. The WSN floods the message to all the neighbouring nodes it can reach. In a network, flooding is the forwarding by a router of a packet from any node to every other node attached to the router except the node from which the packet arrived.

The ambulances which are available for transporting the victims reply back with an acknowledgement stating that they are free to help. The victim node now chooses the node whose acknowledgement reaches it first and then sends a confirmation message to it asking for help. The ambulance which has recieved the confirmation now reaches to the spot by knowing the address present in the header of the control messages.

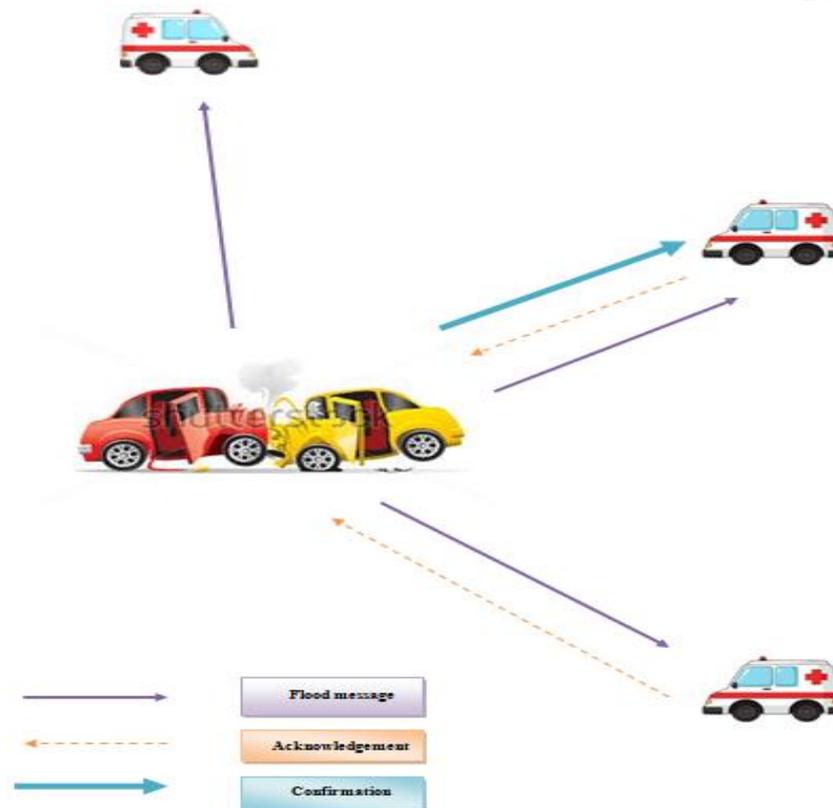


Fig. 5 Proposed system

## V. CONCLUSION AND FUTURE WORK

While airbags can offer a high degree of security, they are far from perfect solution. Sound principles of system engineering are still required to ensure a high level of security rather than the assurance of security coming simply from the inclusion of airbags.

In this paper wireless sensor networks are used to detect the airbag inflation during collision between vehicles and contact the ambulances in its network and confirm for help to the nearest available ambulance. The proposed FAC protocol framework not only satisfies the need for help from the accident spot but also saves the life of the victim that is in danger by providing the timely medical assistance needed.

As a future work, this protocol can be used for many applications like traffic and police department by exchanging messages of the thieves, etc. The protocol can be changed according to the application needs in the future.

## ACKNOWLEDGEMENT

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## REFERENCES

- [1] [http://en.wikipedia.org/wiki/Wireless\\_sensor\\_network](http://en.wikipedia.org/wiki/Wireless_sensor_network).
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