# Design of Severity Estimation Unit of Automotive Accidents

**Saroj S. Raut, Swapnili P. Karmore**

*Abstract*— **During the last decades, there have been remarkable growth in the total number of vehicles around the world, and hence results in increased traffic accidents rate. Several approaches have found in existing road safety vehicular system through the use of telecommunication technologies but, most of them is for improving traffic safety and focused on vehicle to vehicle communication. Currently available intelligent transportation system gives the pre collision alert to avoid the accidents and may help to reduce accident rate but this systems does not have any facility to provide post collision assistance. We know it is not possible to achieve the zero accident objectives. So we developed the framework in which an advanced communication technology is supported by fuzzy GUI Graphical User Interface to provide accurate notification and severity estimation of the accident for better assistance in traffic accidents .System consists of two main subparts that is on board unit equipped inside car and another unit is located at control station which is supported by fuzzy system to provide the specific features of available data sets required to determine the severity of accidents. This system managed to reduce the response time to give alert about accident and hence will improve the overall rescue process after an accident takes place. It's an intelligent robust, cost effective system which is able to detect road accidents, notify them, and estimate their severity.**

*Index Terms*—**Graphical User Interface; Intelligent Transportation System; Severity of accident; Vehicle to control unit communication.**

## I. INTRODUCTION

During the last decades, the world has experienced a remarkable growth in the total number of vehicles. Road traffic has also been increasing day by day, as there is a demand for cars and vehicles, for transportation and increased business activities. Thus, increasing traffic density and causing more and more traffic accidents. Currently, many vehicular traffic safety systems have been developed and implemented, which may also reduce the accidents. But completely avoid the accident is impossible in today high traffic network. In most of the accidents, it was observed that many of the deaths occurred only due to late arrival of the medical assistance. In a traffic accident, while the assistance of the seriously injured passengers, it is crucial to minimize the negative effects on the health of the occupants. Therefore, after a traffic accident a fast and efficient rescue operation is require, that increases the chances of survival of the injured and reduces the injury severity.

This proposed framework includes the merging of computing and telecommunications which allow better communication and hence increased quality of system. The proposed intelligent system is with advanced materials and sensors also with the advent of wireless communication technology. It has the ability to convey severity of accident information to the control unit so that they can immediately inform to required emergency services in order to provide rescue operation after accident. The survival chance of accident victim fall sharply, if typical arrival of medical help takes more time. So, immediate transportation of the injured to the hospital is critically important to the survival of the injured in severe accident. Thus, the purpose of this framework is to determine the real time estimation of severity of accident which can be helpful to provide immediate emergency and rescue services after accidents.

The paper is arranged as follows. Section 2gives the details about the previously done related work. Section 3 describes architecture of the proposed system, Section 4 gives overall working flow of the framework, Section 5 gives tools with implementation and section 6 gives result and finally, we conclude the paper in Section 7.

## II. RELATED WORK

There are various intelligent transportation system designed ,based on vehicular network and telecommunication technologies focusing in reducing number of road accidents. Different technique discussed below in details. This technique has its merits & demerits.

Recently in the modern society effective traffic management is of great importance. This paper [1] proposed mobile health monitoring system which runs in Android based smart phones. Such system mostly focused on driver's health conditions which are one of the main causes of severe accidents. In this framework author focused on two vital parameters related to health such as Heart Rate and Respiration Rate. In this framework, the driver's health condition were continuously monitored using various wireless body sensors by collecting vital signs(heart rate and respiration rate)in mobile node through Bluetooth communication. If any abnormalities were found then system gives an alert about abnormalities and hence this can be useful to avoid the accident [1].

Intelligent traffic surveillance system with computer vision and image processing for traffic incident detection has

***Manuscript received May, 2015***.

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attracted much attention recently. Author in [2] represents a probabilistic model using three dimensional model-based vehicles tracking for predicting traffic accidents. This 3D model acquired a series of moving trajectories from which vehicle activity pattern are learned. In this method a fuzzy self organizing neural network was considered for leaning vehicle activity pattern. It takes whole trajectory as an input and gives directly output neurons which present the distribution pattern of the trajectories. Following are vehicle tracking algorithms used in intelligent visual surveillance of road traffic: feature-based tracking algorithms, model-based tracking algorithms, active contour-based tracking algorithms, region-based tracking algorithms. Vehicle activities are analyses from vehicle motion pattern and the production of conceptual description of vehicle action [2].

To minimize the negative effect on the health of the occupant, rescue services and medical assistance should provide immediately after accident. Manuel Fogue et .al. [3] designed a system for automatic detection ,reporting and assistance of road traffic accidents which helps in reducing the time needed to deploy the emergency services after an accidents takes place. This system combines both vehicle to vehicle communication and vehicle to roadside infrastructure communications. In vehicle to vehicle communication, the vehicles which involve in accident are direct communicate with each other and also with other approaching vehicles that may face this situation. Knowledge inference and data mining are two main concepts considered here for severity estimation which considers most relevant variables that can efficiently specify the accidents and considered relevant information. [3].

Recently, an inter vehicular accident warning system is of great importance which give the time to other approaching vehicles so that they can stop and hence avoid crashing on any unexpected obstacle. This framework proposed the strategy which gives the alert about the occurrence of accident to the other approaching vehicles. Here wireless module equipped in the vehicles and through which they communicate with each other. Between the front and the back vehicles alert messages travelled back and forth. Hence it allowed the alert messages to travel the last vehicle in given situation through intermediate ones and immediately bounce back. The front vehicle sent an alert message and this triggered testing mechanism. In this a farthest spanning relays were used to manage the alert propagation activity [4].

For accident severity classification most important selected attributes are required. Tibebe Beshah et al. [5] present an application of evolutionary fuzzy classifier design data analysis of road accidents. The classification method with the records of real traffic accidents is used to learn the severity of traffic accidents .The goal of this research was to develop a fuzzy classifier that would label data in the data set. According to the severity, the accidents are classified into four classes: minor accidents with no injury, moderate accidents resulting in an injury, severe accidents, and accidents with an unknown severity .Genetic programming used to mine fuzzy rules approximating classes of selected attributes of traffic accident data [5] [6].

In general any road safety strategy involves collection and analysis of accident data. According to author [8] in order to explain and manage road safety enterprise information architecture, it is necessary to identify factors which are mostly get affected by the collision. This framework developed the road safety information architecture and also developed classification techniques using decision tree and rule induction approach. Design science research approach is adopted for the design and evaluation of proposed architecture guided by Zachman Framework. For detail explanations of safety road situation the J48 Decision tree algorithm and PART rule induction algorithm was preferred. To architect the road safety data collection analysis, the second defines requirements, constraints and operations [7].

## III. SYSTEM ARCHITECTURE

Proposed system aims to estimate the accident severity, so different vehicular sensors were used in this system to consider the real cases that are mostly affected in accident and hence useful to indicate the severity of impacts. The parameters which are mostly affected by accidents are considered here they are: speed, location of the vehicle, seat position, light status, airbag status, and vehicle characteristics. Each vehicle is equipped with an on board unit as shown in Fig.1, which acts as data acquisition unit. This on board unit continuously senses all the input signals from various sensors (IR sensors) and other devices (GPS) in the vehicle. After detecting the signal it reports the situation to the control unit. The on board unit is economically feasible and include enough interfaces to allow connection with communication system. The position and speed of the vehicle is easily determined by GPS (Global Positioning System) and IR sensors. In this various sensors used are analog; in order to properly handle the input data, prior analog to digital transformation is necessary. This can done using AVR microcontroller which has inbuilt analog to digital converter.

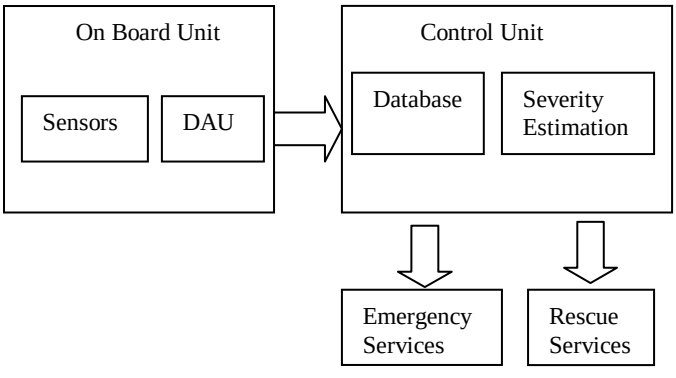


**Fig.1 System Architecture**

There is a control unit that estimates the severity of the accidents .This control unit works on an artificial intelligent neural network algorithm along with fuzzy system which determine the severity based on input parameters and previously stored database. Here, Severity is classified into three way based on damage in vehicles and passenger's

  

injuries: 1minor (vehicle can be driven safely after accident and an harmed passengers) 2 moderate (Vehicle shows defects and occupants has minor injuries) 3 severe (vehicle needs to be towed and fatal injury to the passenger).This severity automates many of the decision to be taken by emergency services and hence reducing the assistance time.

## IV. METHODOLOGY

The flowchart given in the following Figure 3.2 describes the working principle of the how the severity estimation of the accident is done. The overall working of this framework is understand briefly from flow chart .In the normal condition means in no accident case the different sensors that are equipped inside the vehicle along with on board unit, is continuously check the various decided parameters of the vehicle. All these sensors output are collected by data acquisition unit (AVR microcontroller).Then we need to communicate all these information to the control station which are located in that area. In order to obtained the real time severity estimation of accident the RF transmitter receiver module was used for wireless transmission of data. At the control station there is RF receiver module which collects all the information transmitted by transmitter. The important unit of the control station is estimation module which was based on MATLAB software.

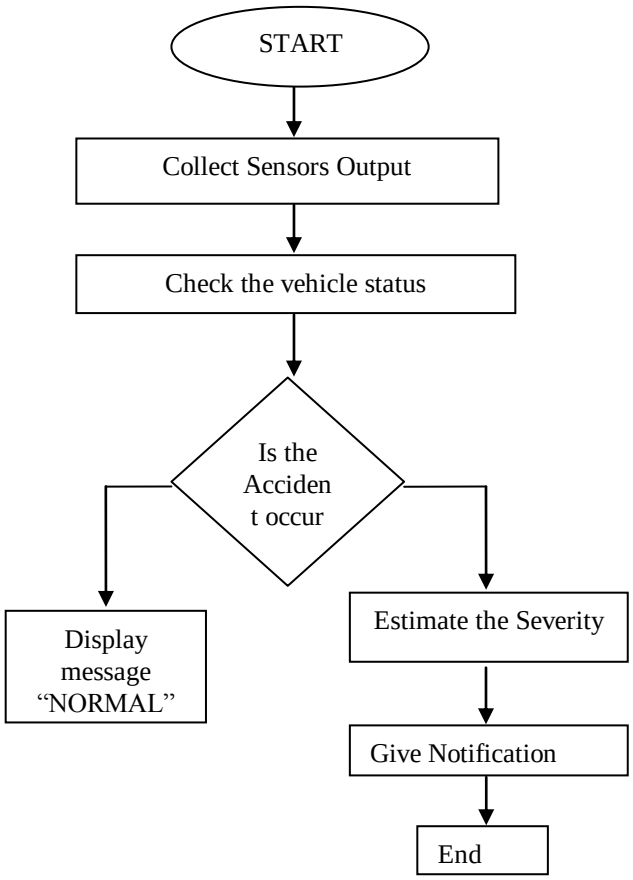


**Fig.2. Flow Chart of Severity Estimation Unit**

Severity estimation of the accident takes place at the control station module and corresponding severity status was represented using developed fuzzy GUI. All the predefined range of the parameter has already been defined at on board units of the vehicle and after getting all data from on board unit, control station display the status. In this way real time severity estimation of accident was takes place by collecting required data and transmitting this to control unit which has inbuilt software for severity estimation.

## V. IMPLEMENTATION PLATFORM

5.1] Hardware requirements:

- ☐ AVR Atmega 16 microcontroller
- ☐ RF transmitter receiver module
- ☐ 7805 Voltage regulator
- ☐ IR Sensor
- ☐ Potentiometer
- ☐ Global Positioning System (GPS)
- ☐ 16*2 LCD
- ☐ DC motor
- ☐ L293D H bridge IC
- ☐ IC 40106

5.2] Software Requirements:

- ☐ MATLAB
- ☐ Code Vision AVR
- ☐ Proteus 7

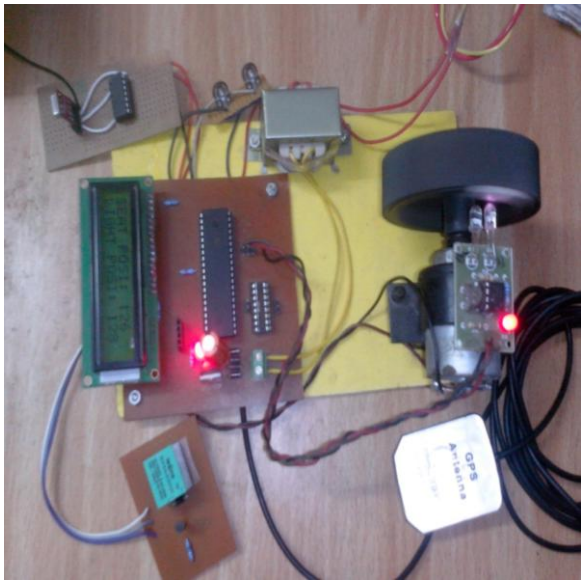

**Fig. 3 On board Unit**

The transmitter side on board unit is shown in fig.3, on which the AVR Atmega 16 microcontroller was interfaced with different sensors including IR sensor, DC motor, potentiometer and RF transmitter module. The reason of using AVR microcontroller is that it has inbuilt analog to digital converter and system uses analog sensors, so prior transmission of analog to digital data is done by

  

microcontroller itself. The acquisition unit continuously senses all the sensors output and transmit it to the control station through RF transmitter and receiver. Here relay was used to check the airbag status which is the most important parameter for estimation of damage. Designed on board unit is feasible to designed and cost effective.

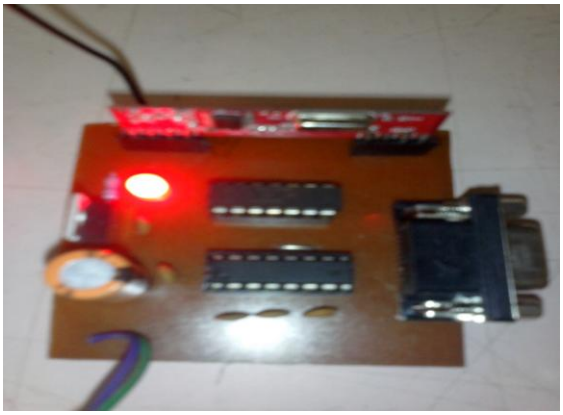

**Fig 4. Control unit Module**

The control consists of hardware as well as software components to estimate damage. In the fig.4 we see that there are RF receiver module at the control unit which receives the real time data from the vehicle. These data are necessary to estimate the accident severity. GPS that is global positioning system is also integrated into the system. To provide the geographical location of crashed vehicles GPS was used .So that we get the immediate location of the vehicle hence can provide the required rescue services at the accident location to save the person trap inside the vehicle .This all about the hardware implementation on transmitter and receiver side. But the main component of control station was software unit which estimates the accident severity. Severity was estimated and display using fuzzy GUI in MATLAB. After training of the neuron we will get the required results.

## VI. Result Analysis

In the implementation part we have seen that the final required results were obtained at the control station after getting the real time data from on board unit equipped inside the vehicle. Severity to be estimated is a predictable phenomenon so here fuzzy system was used to estimate the result on real time. We will get the severity of the accident in terms of three four cases: No accident case, minor accident, major accident and severe accident. Under No accident case system displays "No Accident" as the output message as shown in fig.5.

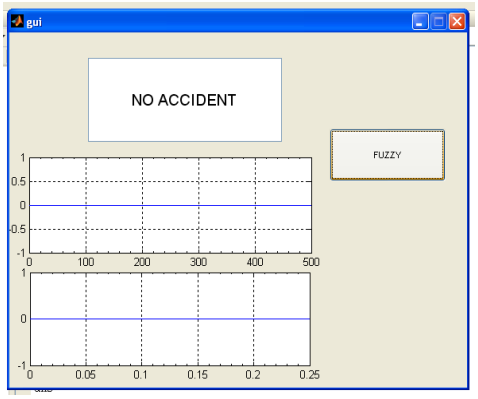


**Fig.5 Result shows no Accident case**

Under No accident case system displays "No Accident " as the output message as shown in fig.6.2.1.After comparing and training it observed a minor accident case hence system display "Minor". This severity is first classified into different cases as shown, the classification of severity in which indicate minor accident, major accident and last shows severe accidents case. This classification is helpful for predicting the severity. These are the predefined level used in network training to get the desired result.

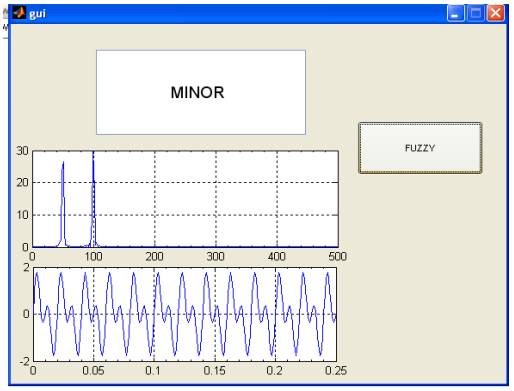


**Fig.6 Minor Accident Case**

If the accident occurred then its severity will be estimate and display using GUI the here the severity shown in fig.6 is "minor" accident case. The pulse obtained are also scattered in the given range for minor accident. In figure 7 we observed that the obtained pulses are not much scattered as that of in minor accident case. In third case the system will shows the severe accident case as shown in fig.7. For displaying the final results system used the fuzzy GUI which is flexible with any system and can model any function of arbitrary complexity.

  

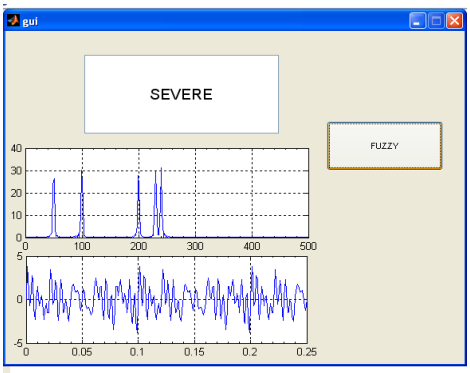


**Fig.7 Severe Accident Case**

Experimental results are presented, where from received real time data system shown specific severity using the GUI, with the intelligent control module. Initial experiments have confirmed that the novel technique is a feasible approach for determining an accident severity effectively using efficient intelligent GUI, as it reduces the amount of work required from the human user who is interacting with the computer.

## VII. CONCLUSION

This study compared various road safety systems which reduced the traffic accident rate and some system also provides post collision assistance after the accident. Thus, here certain technique has been reviewed and comparative analysis between different algorithms is discussed. Hence the proposed system developed fuzzy GUI for determine the severity of accident which can be helpful to provide the immediate rescue services and medical facilities to the victims. This system considered the real cases affected in the accident so it is a reliable and portable system. We developed a system which managed to reduce the response time to give alert about accident and hence will improve the overall rescue process after an accident takes place. It's an intelligent robust, cost effective system which is able to detect road accidents, notify them, and estimate their severity. This is reliable and promising way for saves the person life after accident.

## REFERENCES

[1] K. Bharathwajan, S. Janani, K. Rguram, C.Sweetlin Hemalatha, V. Vaidehi," Intelligent accident mitigation system by mining vital signs using wireless body sensor,"2013 International Conference on Recent Trend in Information Technology.

[2] Weiming Hu,Xuejuan Xiao,Dan Xie, Tieniu Tan, Steve Maybank,"Traffic accident prediction using 3-D model-based vehicle tracking", IEEE transaction on vehicular technology, Vol.53, no.3,May 2004.

[3] Manuel Fogue, Piedad Garrido, Francisco J. Martinez, Juan-Carlos Cano, Carlos T. Calafate, and Pietro Manzoni,"A system for automatic notification and severity estimation of automotive accidents"IEEE Transaction on Mobile Computing, vol.13, no., May 2014.

[4] Alessandro Amoroso,Gustavo Marfia, Marco Roccetti, Giovanni Pau,"To live and driven in L.A.:measurement from a real intervehicular accident alert test,"WCNC 2012 Workshop on Wireless Vehicular Communicatin and Network.

[5] Tibebe Beshah, Dejene Ejigu, Pavel Kromer, Vaclav Snasel, Jan Platos, ajith Abraham,"Learning the classification of traffic accident types",2012 fourth International Conference on Intelligent Networking and Collaborative System.

[6] Pavel Kromer,Tibebe Beshah, Dejene Ejigu, Vaclav Snasel, Jan Platos, Ajith Abraham,"Mining traffic accident features by evolutionary fuzzy rules,"2013 IEEE Symposium on Computational Intelligence in Vehicles and Transportation System.

[7] Tibebe Beshah,Dejene Ejigu,Ajith Abraham," A novel road safety information architecture(RSIA):an enterprise view,"2012 World Congress on Information and Communication Technology.

[8] Mohamed M.Ahmed and Mohamed A. Abdel-Aty," The viability of using automatic vehicle identification data for real-time crash prediction,"IEEE Transactin on Intelligent Transportation System,vol.13,no.2,June 2012.

[9] S.J.Jung, H.S.Shin,J.H.Yoo and W.Y.Chung,"Highway sensitive driver condition monitoring system using nonintrusive active electrodes,"2012 IEEE International Conference on Consumer Electronics.

[10] A.Pande and M.Abdel-Aty," Identification of rear-end crash pattern on instrumented freeways: a data mining approach,"Proceedings of the 8th International Conference on Intelligent Transportation Systems Vienna,Austria,September 13-16,2005.

[11] H.S. Shin,S.J.Jung ,J.J. Kim and W.Y.Chung,"Real time car drivers condition monitoring system,"proceedings of IEEE Sensors 2010 Conference,Waikoloa,Hawaii,USA,pp.951-954,Nov.2010.

[12] Ching-Yao Chan "On the detection of vehicular crashes-system characteristics and architecture", IEEE Transaction on Vehicular Technology,vol.51,no.1,Jan.2002.

  