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# Dynamically Reconfigurable Smart Traffic System for Accident Rescue Opertaion

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**Abstract:** Road accidents are a major cause of death and injuries causing disability throughout the world in both the developed and developing countries. Prevention of accident is quiet impossible but it can be reduced by proper design and control. To improve the reliability of public transport, this study proposes a Smart Traffic Control System (STCS). The main concept of STCS is to control real time traffic flow by distinguishing the emergency vehicle from other vehicles (green signal) at remote accident location to reach in time to hospital with the help of Vibration Sense Message Alert System (VSMAS). In proposed system, each vehicle includes VSMAS located inside the vehicle which senses the vibrations beyond the threshold level. When the vehicle collides, the information of remote location is updated to Emergency Service Centre (ESC). ESC connected to city traffic database automatically sends emergency vehicle to accident spot. In the path of emergency vehicle from origin to hospital via remote accident location, green signal and emergency signal are updated to confined traffic route. Traffic signal delays of the junctions will be modelled based on emergency vehicle movement controlled by ESC. RFID is attached to each traffic junction for estimation of congestion for smooth movement of emergency vehicle. The prototype was examined with various sequences of inputs in laboratory which demonstrates experimental results on Spartan3E FPGA.

**Key words:** ESC, VSMAS, Spartan3E FPGA, emergency vehicle, RFID

## INTRODUCTION

The rate of road traffic is increasing day by day. Traffic rush is a hurdle to achieve our incentive targets. Transportation system is backbone of economic growth for developing countries like India. Transfer of goods, Industrial products and manpower are the important factors for industrial development which depends on transportation. Traffic congestion and inefficiency effects waste of money, fuel and time. The main cause of traffic accidents are tremendous increase in usage of vehicles in every year, improper driving, mismanagement, vehicle defects and whether conditions. Statistics of road accidents in the year 2014 is shown in Fig. 1. A new architecture of monitoring and controlling gives better results to reduce traffic accidents. With eternally increasing vehicles on road, authority should implement new methods to overcome such problems (Mao and Mao, 2013). Due to dynamic nature FPGA is more suitable for complex designs; traffic system can be implemented on FPGA, easily reconfigurable for design change in short span of time. The proposed STCS is designed in a way that the emergency vehicle clearance should pass automatically from accident location to hospital. The traffic light in sequence of Red, Yellow and green in particular direction is controlled by ESC. This system is efficiently designed using various peripherals like GPS, GSM and RFID Reader interface with FPGA to activate green signal and emergency input to confined traffic junctions from ESC for smooth movement of emergency vehicle (Chakole *et al*., 2013).

## MATERIALS AND METHODS

Proposed model represents real-time traffic conditions, when emergency vehicle is moving on a confined traffic path. Reconfigurable smart traffic system architecture consists of vibration sensor and MEMS sensor which are interfaced to FPGA. When a vehicle collision is enumerated the vibration sensors in the vehicle senses and sends the GPS location of vehicle to the ESC. Remote location information is communicated to ESC from VSMAS through GSM and GPS interface. Pre recorded message along with remote location details are communicated to ESC through FPGA. VSMAS Module is programmed in Xilinx Platform Studio-Embedded Development kit.

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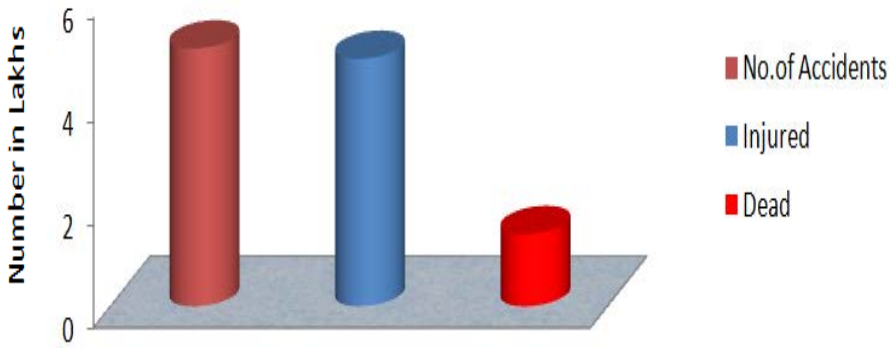


Fig. 1: India road accident statistics in the year 2014

Fig. 2: Vibration detecting module

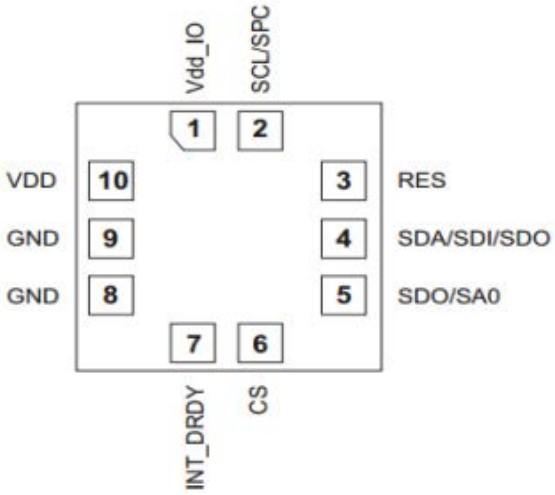


Fig. 3: MEMS nano pressure sensor

**Vibration detecting module:** Vibration Detecting Module detects vibration beyond the threshold level. Module outputs the threshold signal to FPGA. It can be used in various applications such as two/Four wheelers, earthquake detection, etc., contains VCC, digital output and GND signal. It is shown in Fig. 2 (Zappi *et al*., 2010).

**MEMS Sensor:** Micro electro mechanical system sensors can be used for various applications. It can be used for accident detection, when the pressure exceeds beyond certain level. MEMS Sensors is suitable for compact designs. Device communicates through $I^2C$ or SPI Interface for the application shown in Fig. 3 (Amin *et al*., 2013).

**GSM module:** GSM SIM900A module shown in Fig. 4 is used to send and receive sms. Module is interfaced with FPGA through RS232 serial communication. When VSMAS inputs to FPGA, GSM

Fig. 4: GSM sim900A

module automatically sends SMS to a phone numbers recorded in a program using Xilinx EDK (Lahade and Hirekhan, 2015).

**GPS module:** Global positioning system shown in Fig. 5 is used to track the position, latitude, longitude, date and


Fig. 5: GPS module

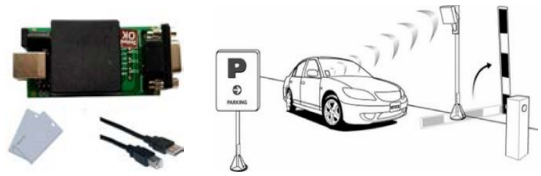

Fig. 6: RFID reader module

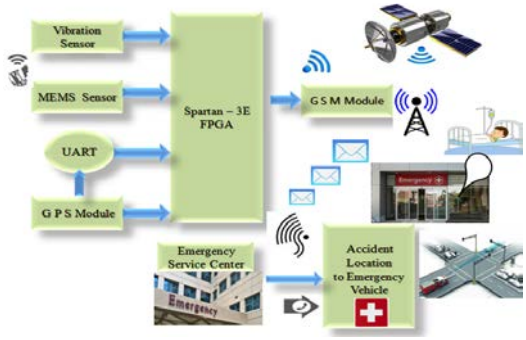


Fig. 7: Reconfigurable smart traffic system architecture

time. Module can be used in various applications. Module tracks the data in NMEA sequence format. GPS Module is communicated to FPGA through RS232 interface (He *et al*., 2009).

**RFID reader module:** Radio frequency identification is used to track the objects. RF tag is embedded in objects where security is prime constraint. Information stored in each tag can be tracked by using electromagnetic waves when object passes near to Radio ID Reader shown in Fig. 6. RF ID Reader is inserted at every traffic junction to serve three purposes:

- To know the traffic congestion that how many no. of vehicles passed at every junction stored in traffic database. Alternate precautions can be taken to avoid heavy congestion
- To identify stolen vehicle detection
- Emergency vehicle path can diverted to congestion free path based on traffic database (Jeevagan *et al*., 2014; Deng *et al*., 2010)

## RESULTS AND DISCUSSION

**Simulation:** The Accident occurrence at a time interval of 100.547 ns in North direction the green light pulses and red light in all directions. The delay pulses at 17 the emergency vehicle passes from North side yellow and red lights are displayed (Fig. 8).

The emergency vehicle passage and traffic clearance control can be represented at North-East zones. It can be represented in different time intervals and recorded value 1 at North and East directions display yellow and red lights.The way STCS guides the emergency vehicle to nearest hospital (Fig. 9).

Figure 10 shows the flow of traffic control in North East zone. The emergency vehicle travels from North to East. When emergency inputs are on automatically East zone with green signal is activated and red signal in North zone to block vehicles passage from North zone. Figure 11 presents the traffic control at multi junctions after emergency vehicle passage. Delay pulse shows the congestion in all directions in multi-junction view.

**Implementation results on FPGA:** Figure 12 shows the traffic route clearance for the emergency vehicle form North zone to emergency centre. When the emergency vehicle is North there is the green signal at the North zone and red signal at the South zone. As soon as the emergency vehicle passes the North zone green signal is activated in South zone and red signal in North zone.

Figure 13 shows the GSM module interfaced with the FPGA for message alert with Vibration sensor input. When accident occurs the VSMAS sends the information regarding the remote location of the accident to emergency service center.

Figure 14a shows green signal at North and red signal at south zones respectively. Figure 14b shows the response from North zone to South zone in a confined traffic route when ESC input is activated for smooth movement of emergency vehicle to hospital.

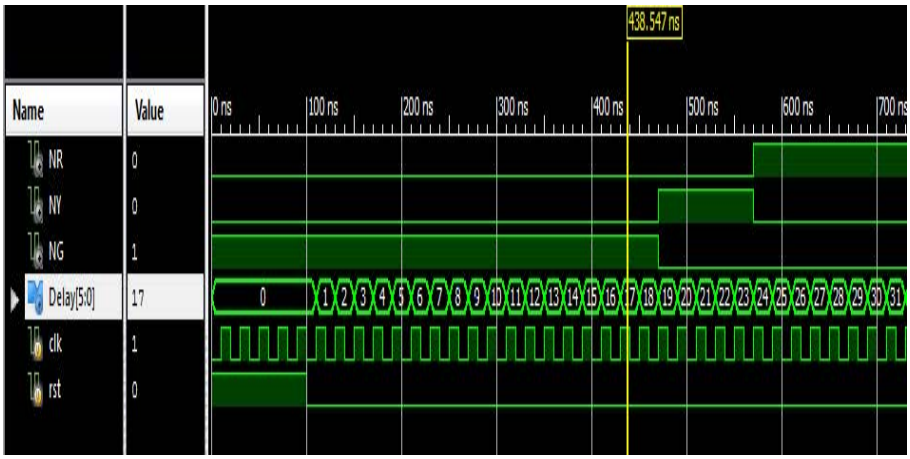


Fig. 8: North zone traffic clearance

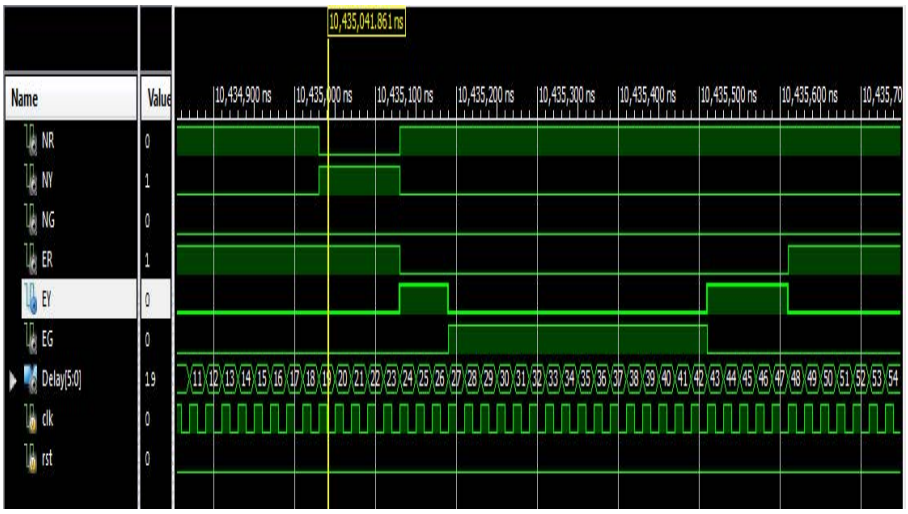


Fig. 9: North-East zones traffic clearance

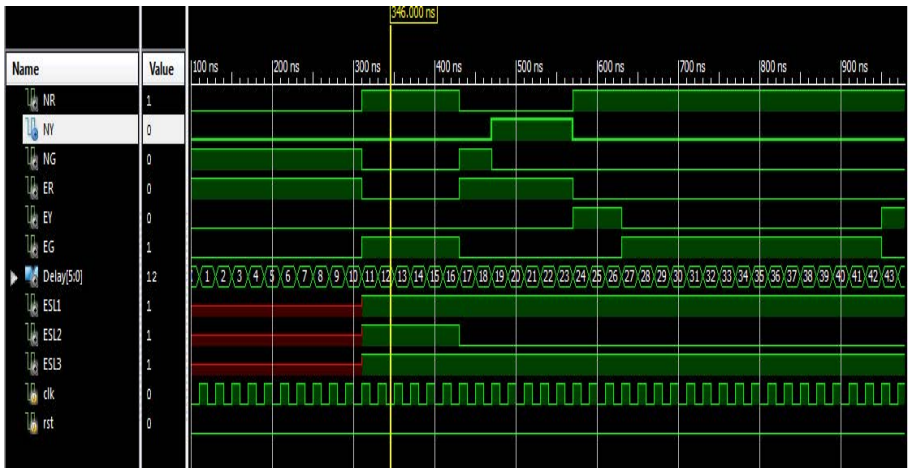


Fig. 10: North-East zones traffic clearance on emergency inputs

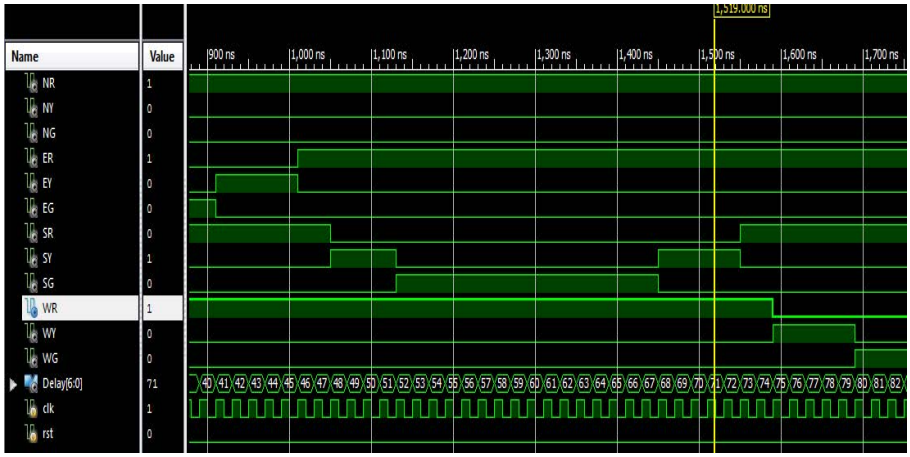


Fig. 11: Traffic clearance at multiple junctions

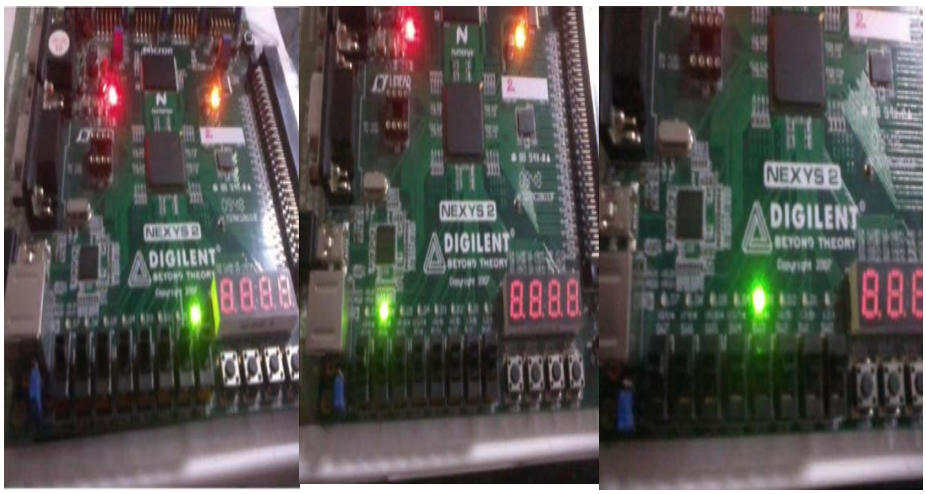


Fig 12: FPGA implementation of traffic control system: a) Green signal at North zone; b) green signal at South zone; c) red signal at North zone

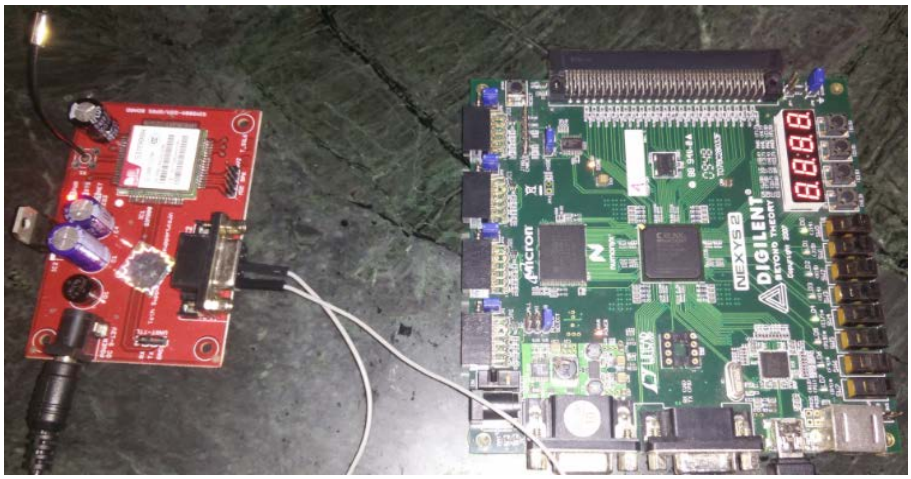


Fig. 13: GSM Module Interfaced with Nexys2 (Spartan-3E) FPGA for VSMAS

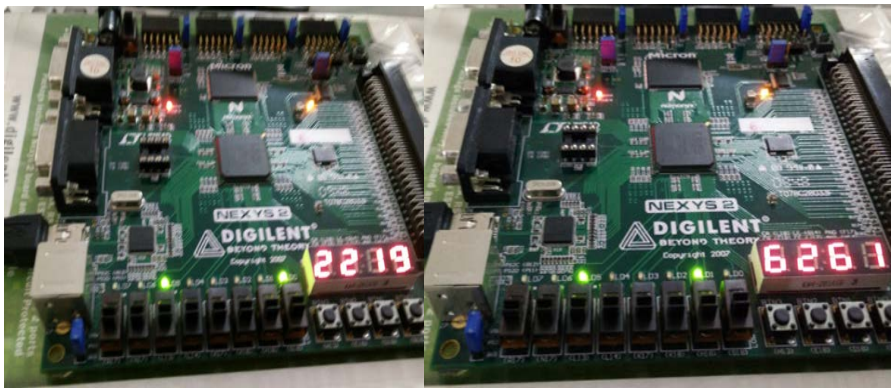


Fig. 14: ESC Controlling Traffic Path with delay view on seven segment display: a) North Zone with minimu delay; b) South Zone with maximum delay

## CONCLUSION

Prevention of road accidents is possible by redesigning the traffic control system with few modifications, limits the cause of death and injuries. This study proposes a Smart Traffic system for Accident Rescue Operation (STCFARO) to control real time traffic flow by activating green signal from emergency vehicle origin to remote accident location. Updating of hospital information and new traffic junctions in computer database is prime constraint to save human life. Implementation of STCFARO with software designing is a huge task which connects GPS for location tracking, traffic information to control traffic flow for smooth movement of emergency vehicle to accident location and information to hospital for emergency service. Accidents can be completely limited to maximum extent by designing a new gadget includes in steering. Gadget provides information to nearest emergency in case of health disorders; it also sends information to nearest control room if the level of alcohol is beyond limit. Gadget and VSMAS should communicate in wireless using Internet of Things (IOT) to control road accidents.

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