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Vehicle and Patient Monitoring Using Wireless Black Box

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Abstract—

In this project, wireless black box using MEMS accelerometer and GPS tracking system is developed for accidental monitoring. The system consists of cooperative components of an accelerometer, microcontroller unit, GPS device and GSM module. In the event of accident, this wireless device will send mobile phone short message indicating the position of vehicle by GPS system to family member, Emergency medical service (EMS) and nearest hospital. And heartbeat sensor is detecting the heartbeat of the patient and report send to the doctor. The threshold algorithm and speed of motorcycle are used to determine fall or accident in real-time. The system is compact and easy to install under rider seat. The system has been tested in real world application using bicycles. The test results show that it can detect linear fall, non-linear and normal ride with high accuracy.

Keywords—ARM Processor; XBEE; GPS/GSM and MEMS

I. INTRODUCTION

The motor cycle accident is a major public problem in many countries, particularly in India. Despite awareness campaign this problem is still increasing due to rider's poor behaviour such as speed driving, drunk driving, riding with no helmet protection, riding without sufficient sleep, etc. the numbers of death and disability are very high because of late assistance to people who got the accident. These cause huge social and economic burden to people involved. Therefore several research group and major motorcycle manufacturers have developed safety devices to protect riders from accidents injuries. However, good safety device for motorcycle is difficult to implement and very expensive.

Alternatively, intelligence schemes such as fall or incident detection with tracking system have also recently been devised to notify the accident to related people so that quickest assistance can reach people who got the accident. Thus fall detection and accident alarm system is developed for motorcycle has recently gained attention because these systems are expected to save life by helping riders to get medical treatment on time. In this work, wireless

Black box using MEMS accelerometer and GPS tracking system is developed for accidental monitoring. In this event of accident, this wireless device will send mobile phone short message indicating the position of vehicle by GPS system to family member, emergency medical service and nearest hospital so that can provide ambulance and prepare treatment for the patients.

The system consists of cooperative components of an accelerometer, microcontroller unit, GPS device and GSM module for sending a short message. An accelerometer is applied for awareness and fall detection indicating an accident. The speed of motorcycle and threshold algorithm are used to decide a fall or accident in real-time. Mobile short message containing position from GPS will be sent when motorcycle accident is detected. The robust package design is implemented so that it is safe from waters spray and dust in environment. The module is aimed to be installed under the motorcycle se

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A high performance 32 bits MCU is used to process and store real-time signal from the accelerometer.

The Central Processing Unit (processor, in short) can be any of the following: microcontroller, microprocessor or Digital Signal Processor (DSP). A micro-controller is a low-cost processor. Its main attraction is that on the chip itself, there will be many other components such as memory, serial communication interface, analog-to digital converter etc. So, for small applications, a micro-controller is the best choice as the number of external components required will be very less. On the other hand, microprocessors are more powerful, but you need to use many external components with them. D5P is used mainly for applications in which signal processing is involved such as audio and video processing.

In this proposed solution, mainly three sensors are the key elements which collect the data from surrounding and give alert to the owner.

II. SYSTEM ARCHITECTURE

The system architecture of this proposed system is divided into two different blocks.

8051 END: Hardware implementation for this proposed system is shown below with the simple blocks. Power supply block is designed and developed to generate power source for the 8051 controller and its relevant components. Reset circuit is designed and developed to reset the program whenever necessary and interfaced to the 8051 controller for greater stable response. Clock circuit is designed and developed to generate oscillations and interfaced to the 8051 controller for needy response. A simple block diagram shown below:

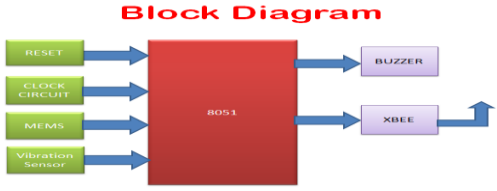

Figure – 1: 8051Block Diagram

ARM7 END: Hardware implementation for this proposed system is shown below with the simple blocks. Power Supply block is designed and developed to generate power source for the ARM processor and its relevant components. Reset Circuit is designed and developed to reset the program whenever necessary and interfaced to the ARM processor for greater stable response. Clock Circuit is designed and developed to generate oscillations and interfaced to the ARM processor for needy response. LCD Display can also interface to the ARM processor for displaying the status of the system for better understanding. A simple block diagram shown below:

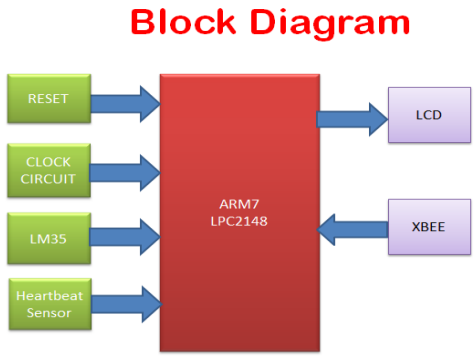

Fig – 2: ARM7 Block Diagram

III. IMPLEMENTATION

HARDWARE:

8051 END:

In hardware implementation, Vehicle Motors are interfaced with 8051 micro controller.

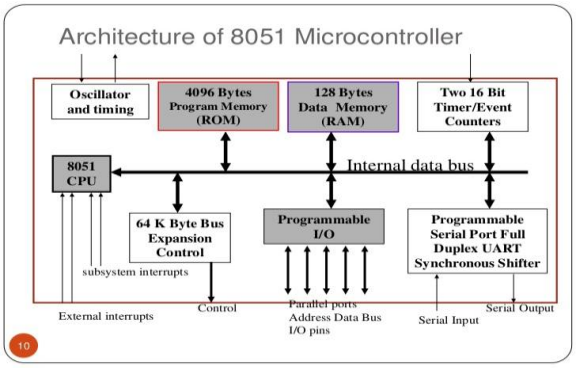

Fig – 3: 8051 Architecture

*MEMS:*A Micro electro mechanical system (MEMS) is the technology of very small mechanical devices driven by electricity; it merges at the nano-scale into nano-electro mechanical systems and nano technology

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Recent a dvances in microelectronic mechanical systems have made high-performance, high-accuracy, low-cost accelerometers available on a sigle monolithic IC. Accelerometers are used for an acceleration and tilt measurements, vibration control, and cutoff switches for specific vibration conditions. Module of MEMS has shown below:

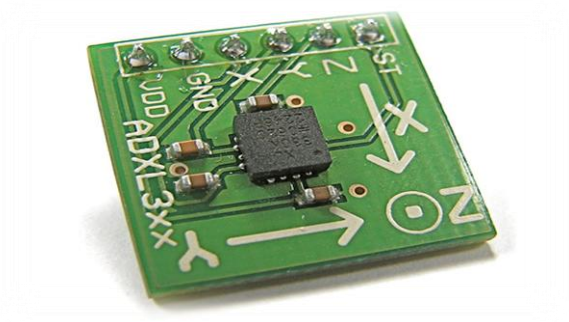

Fig – 4: MEMS

An accelerometer output always has two components: an output signal proportional to the tilt and another output signal proportional to the acceleration or vibration. Depending on the application, a signal-conditioning circuit may be required. Applications that are based purely upon vibration or acceleration measurements require that the tilt signal be filtered out.

In our particular application, the design goal was the activation of an alarm circuit when an object was subjected to a jerk of higher intensity than a reference value. The frequency of the applied jerk was expected to be in the range of 1 to 5 Hz.

Vibration Sensor:

Shown is the implementation of the alarm circuit using an ADXL105 (Analog Devices Inc.) accelerometer. The ADXL105 is a single-axis accelerometer with an uncommitted on-board amplifier.

ARM7 END:

In hardware implementation, ARM processor plays a key role in monitoring and controlling the security system. Low-power consumption ARM processor (LPC2148) operating at 3.3V, 50uA is designed and mounted on a PCB along with Reset Circuit and a Clock Circuit. LPC2148, a 32-bit microcontroller with advanced RISC architecture and having 48 GPIO lines with a program memory of 32KB and a data memory of 512Bytes.

And we have 2 UART ports i.e. UART0 and UART1. In this project XBEE connected to the UART0 port of ARM7 (LPC 2148). And 3 Analog to Digital channels, though I connected three Analog sensors to ADC channels of ARM7, so that it converts Analog Values to Digital Values. Those values i have uploaded into ThingSpeak.

Each Sensors and its behaviour explained in below. And ARM7 (LPC 2148) internal architecture overview has shown below as well ARM7 (LPC 2148) with LCD has shown below.

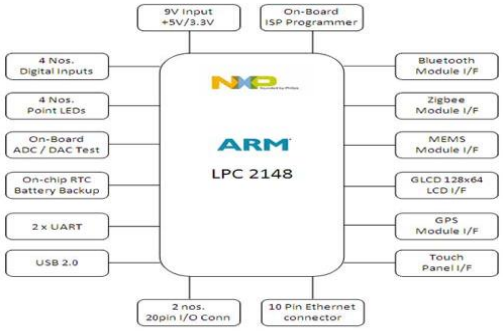

Figure – 5: ARM Overview [LPC2148]

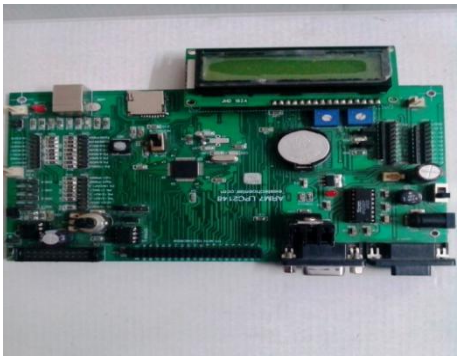

Figure – 6: LPC2148 Development Board

*LM35:*LM35 series sensors are precision integrated-circuit temperature sensors whose output voltage is linearly proportional to the Celsius temperature. The LM35 requires no external calibration since it is internally calibrated. . The LM35 does not require any external calibration or trimming to provide typical accuracies of ±1⁄4°C at room temperature and ±3⁄4°C over a full −55 to +150°C temperature range.
The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies. As it draws only 60 µA from its supply, it has very low self-heating, less than 0.1°C in still air.
The characteristics of LM35 have shown below:

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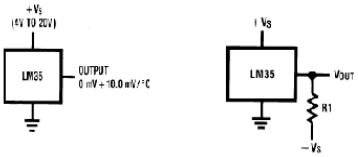

Figure – 7: LM35 Schematic

XBEE: XBEE is an IEEE 802.15.4 standard for data communications with business and consumer devices. It is designed around low-power consumption allowing batteries to essentially last forever. The XBEE standard provides network, security and application support services operating on top of the IEEE 802.15.4 Medium Access Control (MAC) and Physical Layer (PHY) wireless standard. It employs a suite of technologies to enable scalable, self-organizing, self-healing networks that can manage various data traffic patterns.

XBEE is a low-cost, low-power, wireless mesh networking standard. The low cost allows the technology to be widely deployed in wireless control and monitoring applications, the low power-usage allows longer life with smaller batteries and the mesh networking provides high reliability and larger range. XBEE has been developed to meet the growing demand for capable wireless networking between numerous low power devices. In industry, XBEE is being used for next generation automated manufacturing, with small transmitters in every device on the floor, allowing for communication between devices to a central computer. This new level of communication permits finely tuned remote monitoring and manipulation.
Schematic Diagram of 8051 has shown below:

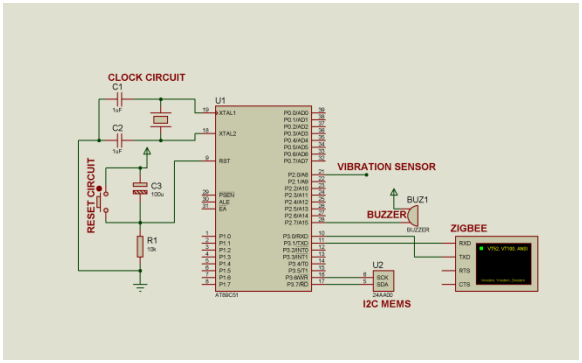

Figure – 8: Schematic Diagram

Schematic diagram of ARM7 (LPC2148) has shown below:

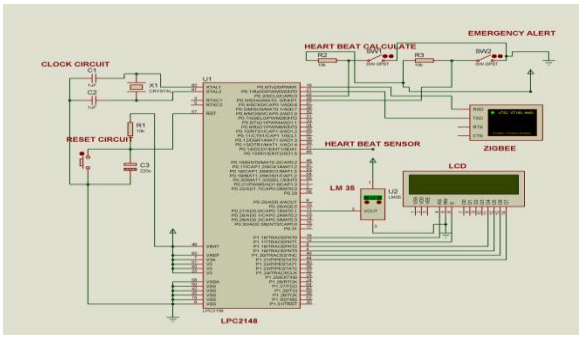

Figure – 9: Schematic Diagram

Ultrasonic sensor (LM 393) connected at P0.3 of ARM7 (LPC 2148), AMG sensor has connected at P0.2 of ARM7 (LPC 2148) and L293D connected at P0.5, P0.6 and P0.7.

SOFTWARE:

Here, to program ARM processor KeiluVision 4 was used as a cross-compiler and Flash Magic was used as a programmer.

ALGORITHM&FLOWCHART

ALGORITHM:

Step – 1: At the 8051 end, InitializeMEMS and vibration sensor.

Step – 2: If the accident detected send the data to the ambulance unit through XBEE

Step – 3: At the ambulance end, Initialize the XBEE and wait for the alert message.

Step – 4: If received move to accident zone and load the patient connect sensor unit.

Step – 5: At the hospital end, Initialize the XBEE and wait for the message.

Step – 6: If received track the ambulance using google maps.

FLOWCHART:

The flowchart of this paper is shown below.

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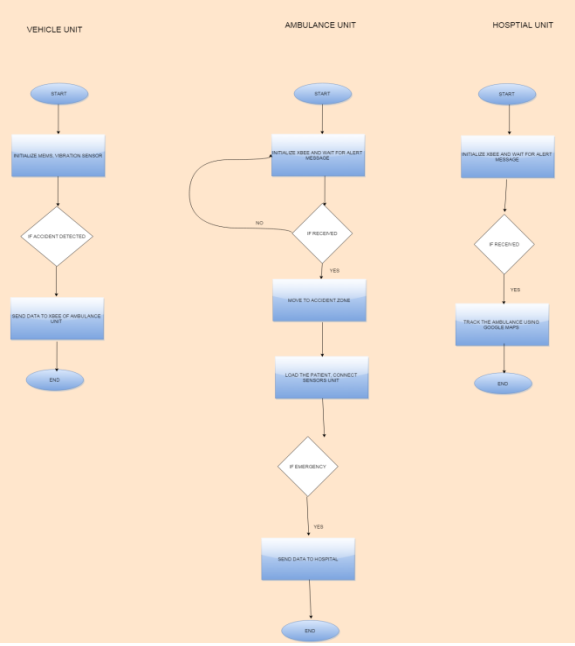

Figure – 10: Schematic Diagram

IV. RESULTS

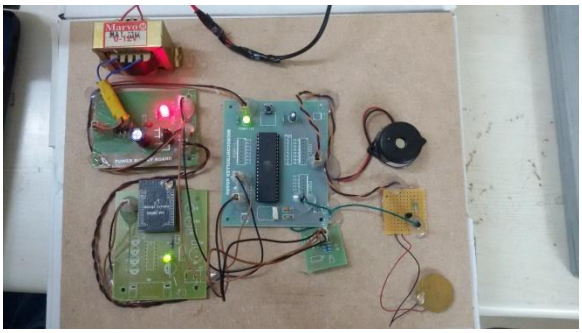

Fig – 11: Final Prototype 1

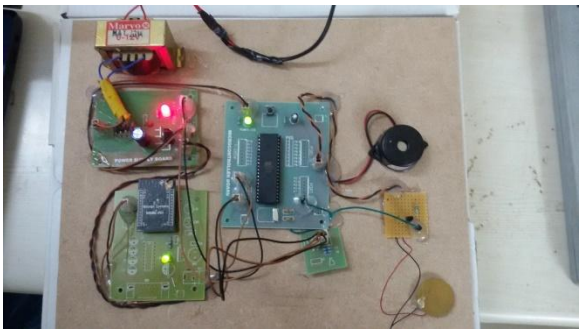

Fig – 12: Final Prototype 2

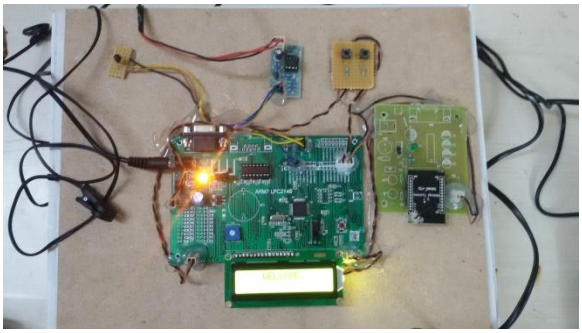

Fig – 13: Final Prototype 3

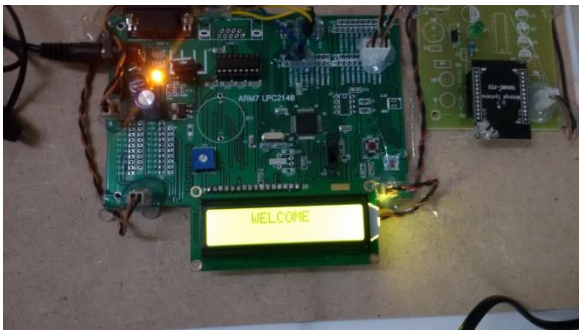

Fig – 14: Final Prototype 4

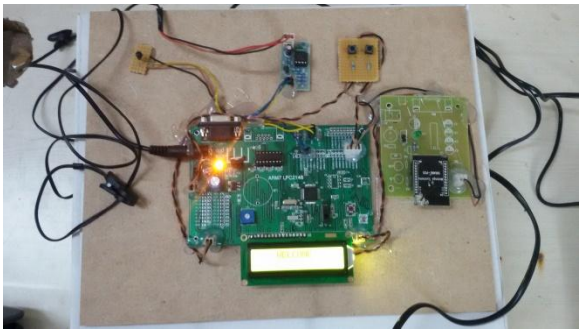

Fig – 15: Final Prototype 5

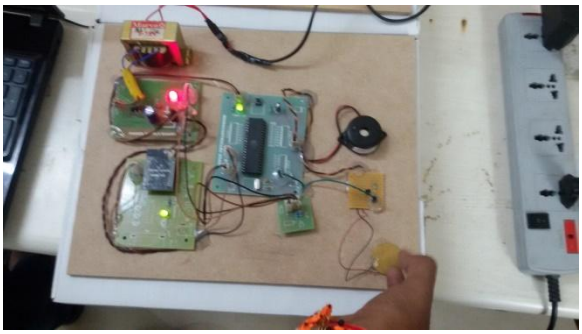

Fig – 16: Final Prototype 6

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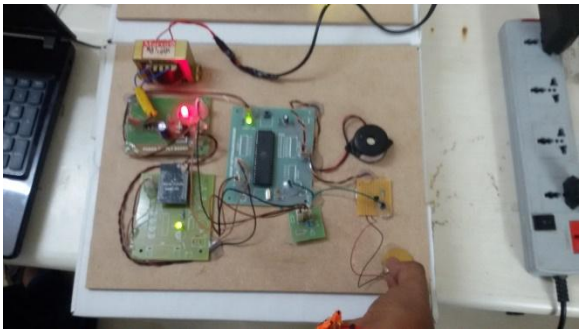

Fig – 17: Final Prototype 7

Fig – 18: Final Prototype 8

Fig – 19: Final Prototype 9

Fig – 20: Final Prototype 10

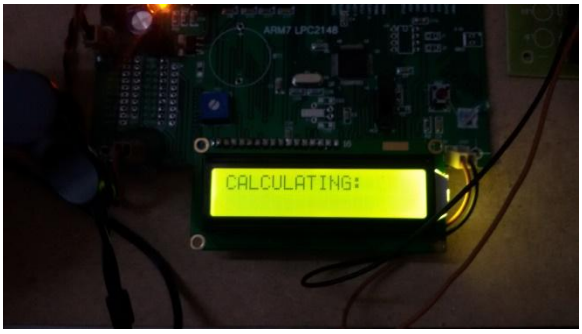

Fig – 21: Final Prototype 11

Fig – 22: Final Prototype 12

V. CONCLUSION

Here, in this paper we proposed a wireless black box a simple alert system for tracking ambulance and moving it to the accident zone and from accident zone to nearby hospital.

ACKNOWLEDGEMENT

I would like to express my special thanks and gratitude to Assot Prof I.Adambabu,K. N. BHUSHAN, Assoc. Prof & HOD ECE, Marri Laxman Reddy Institute of Technology& Management as well as our Principal Dr. K Venkateswara Reddy, M. Tech., Ph.D., MISTE, who gave me the golden opportunity to do this wonderful project on the topic (Development of Intelligent Vehicle Network for safety Applications), which also helped me in doing a lot of Research and I came to know about so many new things. Secondly I would like to thank my parents and friends who helped me a lot in finalizing this project within the limited time frame

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BIOGRAPHY:

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