International Journal of Research (IJR)
e-ISSN: 2348-6848, p- ISSN: 2348-795X Volume 2, Issue 09, September 2015
Available at http://internationaljournalofresearch.org

Development of Intelligent Vehicle Network for safety Applications

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Abstract—

Connected vehicle technology aim to solve some of the biggest challenges in the transportation in the areas of safety, mobility and environment. The safety application for Intelligent Transport System (ITS) is one of the main objectives in this project. Safety application is research and industrial initiative which aim to contribute to the global advancement of automobile industry. In this project we focus on V2V communication, once cars are connected which is able to share data with other cars on the road and which help to reduce Highway accidents. Ultimately, vehicles are connecting via multiple complementary technologies of vehicle to-vehicle (V2V) and vehicle to vehicle communication has done in this project mainly. Here I've used ARM7 (LPC 2148) and 8051 Controller, the communication between these two has done through UART (XBEE). When the vehicle 1 comes beyond another vehicle 2 when there is information to transmit then it triggers through XBEE and the vehicle 2 will transmit the vehicle 1's data according to the received emergency message.

Keywords—ARM7; AMG Sensor; Motor Driver; XBEE; GSM.

I. INTRODUCTION

The main motivation for vehicular communication systems is safety and eliminating the excessive cost of traffic collisions. According to World Health Organizations (WHO), road accidents Annually cause approximately 1.2 million deaths worldwide; one fourth of all deaths caused by injury. Also about 50 million persons are injured in traffic accidents. If preventive measures are not taken road death is likely to become the third-leading cause of death in 2020 from ninth place in 1990. A study from the American Automobile Association (AAA) concluded that car crashes cost the United States 300$ billion per year.

However the deaths caused by car crashes are in principle avoidable. US Department of Transport states that 21,000 of the annual 43,000 road accident deaths in the US are caused by roadway departures and inter-vehicular communications. This number can be significantly lowered by deploying local warning systems through vehicular traversing that intersection. Studies show that in Western Europe a mere 5km/h decrease in average vehicle speeds could result in 25% decrease in deaths.

Policing speed limits will be notably easier and more efficient using communication between vehicles.

II. SYSTEM ARCHITECTURE

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

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

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e-ISSN: 2348-6848, p- ISSN: 2348-795X Volume 2, Issue 09, September 2015
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Circuit is designed and developed to generate oscillations and interfaced to the ARM processor for needy response. LCD Display is interfaced to the ARM processor for displaying the status of the system for better understanding. XBEE Module is used as inter vehicular communication. Buzzer is used to produce a beep sound to find out the occurrence of vehicle when detected by AMG Sensor (Mine). GSM module is used to communicate with the end user. Motor Driver is used to drive the vehicle.

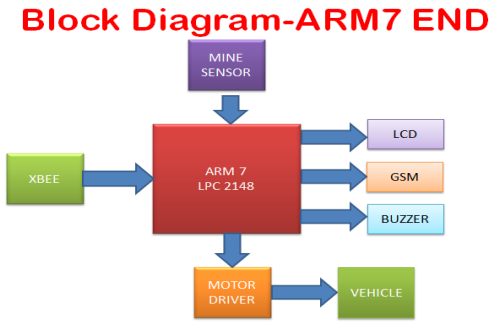

Figure – 1: Block Diagram of ARM7 END

8051 END: This is fixed with another vehicle for connectivity. XBEE Module is also interfaced with the controller for inter vehicular communication. Motor Driver is used here to drive the vehicle. The switch is interfaced with the controller for initiating the communication.

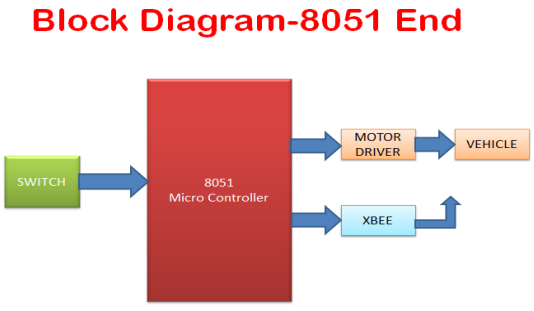

Figure – 2: Block Diagram of 8051 END

III. IMPLEMENTATION

HARDWARE:

In this project Hardware implementation has divided into two different parts, one was at ARM7 end and other was 8051. Let's see individual hardware implementation.

At ARM7 End 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.

For critical code size applications, the alternative 16-bit Thumb mode reduces code by more than 30 % with minimal performance penalty. Due to their tiny size and low power consumption, LPC2141/42/44/46/48 are ideal for applications where miniaturization is a key requirement, such as access control and point-of-sale. Serial communications interfaces ranging from a USB 2.0 Full-speed device, multiple UARTs, SPI, SSP to I2C-bus and on-chip SRAM of 8kB up to 40kB, make these devices very well suited for communication gateways and protocol converters, soft modems, voice recognition and low end imaging, providing both large buffer size and high processing power. Various 32-bit timers, single or dual 10-bit ADC(s), 10-bit DAC, PWM channels and 45 fast GPIO lines with up to nine edge or level sensitive external interrupt pins make these microcontrollers suitable for industrial control and medical systems.

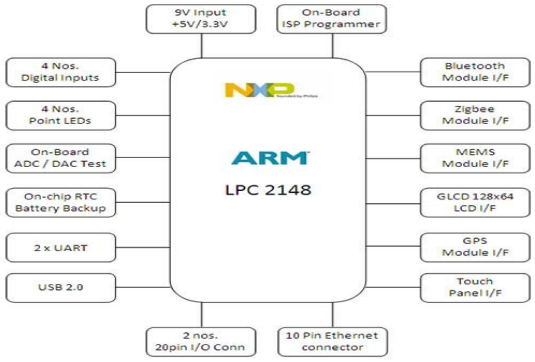

Figure – 3: ARM Overview [LPC2148]

International Journal of Research
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e-ISSN: 2348-6848, p- ISSN: 2348-795X Volume 2, Issue 09, September 2015
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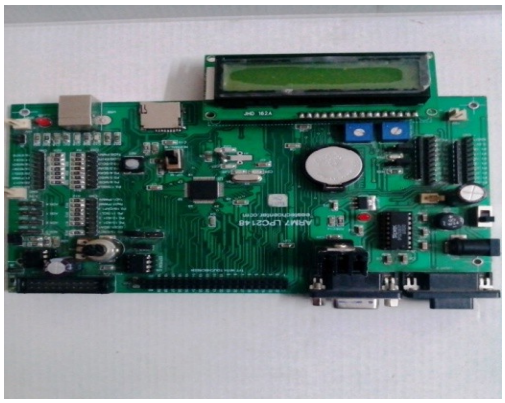

Figure – 4: LPC2148 Development Board

Here, in the above figure the clock circuit and reset circuits were assembled along with the LCD display circuit. A 16 X 2 LCD display is used for displaying the status of the system.

LCD: LCD has used in this project for display status of the system. Interfacing LCD to LPC 2148 has shown below:

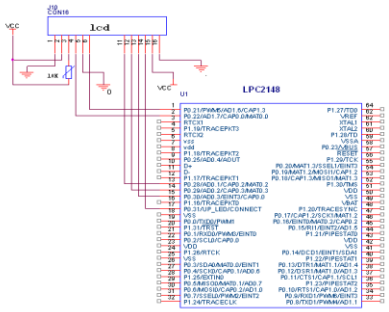

Figure – 5: LCD Display Interfacing

XBEE: ZigBee 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 ZigBee 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. Architecture of XBEE module has shown below:

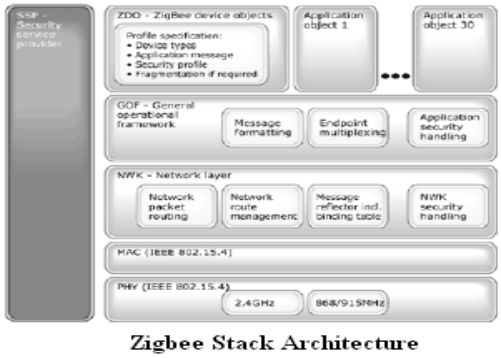

Figure – 6: ZigBee Architecture

GSM: GSM Module was interfaced to UART1 for SMS communication. Keypad (4 * 3) was interfaced at P0.16 – P0.23 of LPC2148. LCD Display (16 * 2) was also interfaced at P1.6 – P1.22 of LPC2148. Reset Circuit and Clock Circuits were interfaced at RST, XTAL1, and XTAL2 of LPC2148.

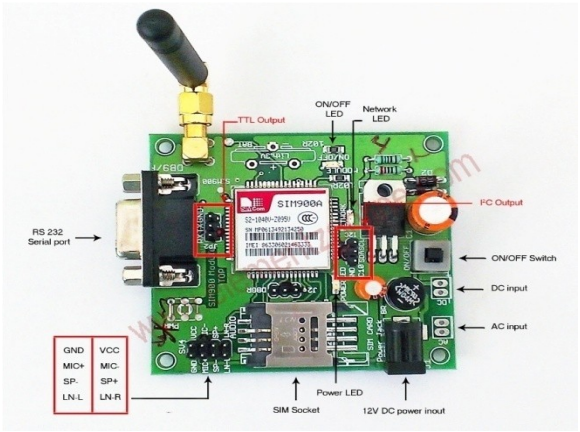

Figure – 7: GSM Module

L293D: The L293 and L293D are quadruple high-current half-H drivers. The L293 is designed to provide bidirectional drive currents of up to 1 A at voltages from 4.5 V to 36 V. The L293D is

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e-ISSN: 2348-6848, p- ISSN: 2348-795X Volume 2, Issue 09, September 2015
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designed to provide bidirectional drive currents of up to 600-mA at voltages from 4.5 V to 36 V. Both devices are designed to drive inductive loads such as relays, solenoids, dc and bipolar stepping motors, as well as other high-current/high-voltage loads in positive-supply applications.
Pin and block diagram of L293D shown below:

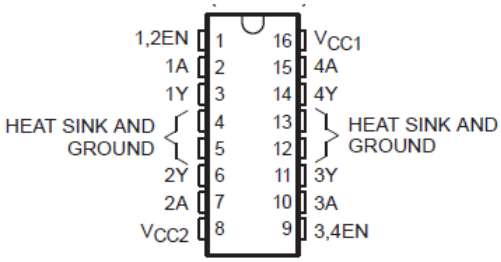

Figure – 8: L293D Driver

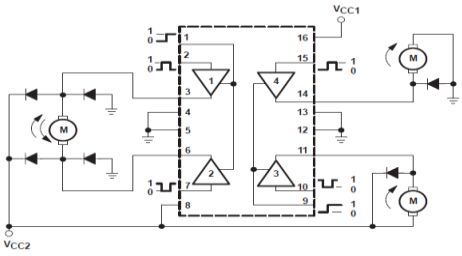

Figure – 9: L293D Architecture

8051 End: 8051 is an 8-bit processor, meaning that the CPU can work on only 8 bits of data at a time. Data larger than 8 bits has to be broken into 8-bit pieces to be processed by the CPU. 8051 is available in different memory types such as UV-EPROM, Flash and NV-RAM.8K Bytes of Re-programmable Flash Memory. RAM is 256 bytes.4.0V to 5.5V Operating Range. Fully Static Operation: 0 Hz to 33 MHz's Three-level Program Memory Lock.256 x 8-bit Internal RAM.32 Programmable I/O Lines. Three 16-bit Timer/Counters. Eight Interrupt Sources. Full Duplex UART Serial Channel. Low-power Idle and Power-down Modes. Interrupt recovery from power down mode. Watchdog timer. Dual data pointer. Power-off flag. Fast programming time. Flexible ISP programming (byte and page mode). Pin diagram of 8051 has given below:

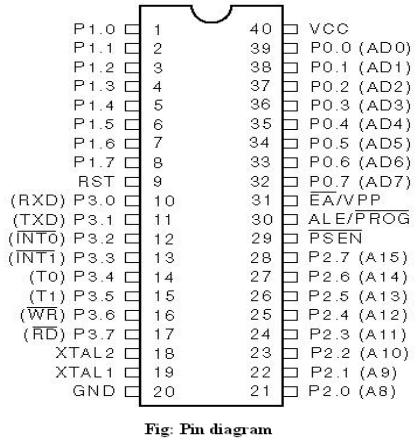

Fig: Pin diagram

Figure – 10: 8051 Pin Diagram

The architecture of 8051 has shown below:

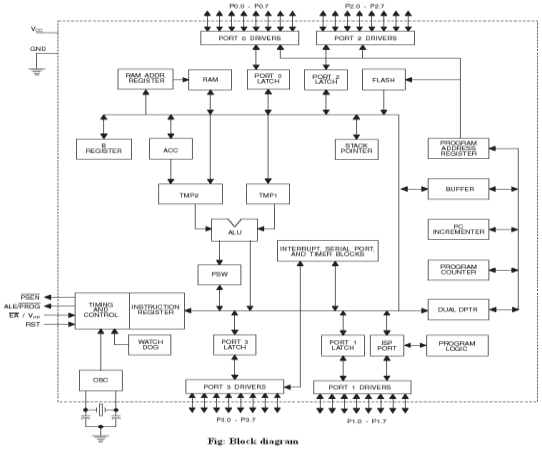

Fig: Block diagram

Figure – 11: 8051 Architecture

The remaining modules like Switches, Buzzer, AMG Sensor were assembled as per the following schematic diagram:

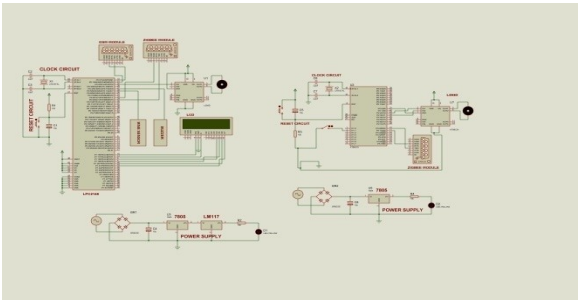

Figure – 12: Schematic Diagram

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XBEE was interfaced at UART0 of LPC2148 as per Figure – 7. Motor was interfaced to L293D (Motor Driver) at P0.3 – P0.5 of LPC2148 as per Figure – 7 which enables the vehicle action. GSM Module was interfaced to UART1 for SMS communication. LCD Display (16 * 2) was also interfaced at P1.6 – P1.22 of LPC2148. Reset Circuit and Clock Circuits were interfaced at RST, XTAL1, and XTAL2 of LPC2148. XBEE Transceiver is interfaced to 8051 at UART port; vehicle is connected at P2 of 8051.

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: Initialize ARM, LCD, XBEE and GSM Module in Vehicle 1 and 2.

Step – 2: Press Button in Vehicle 1.

Step – 3: Transmit message from Vehicle 1 to 2 using XBEE Communication.

Step – 4: AMG Sensor will detect, and then buzzer will produce beep sound.

Step – 5: XBEE Transceiver in vehicle 2 will receive information, and stored in variables.

Step – 6: GSM will send SMS to the number specified by vehicle 1.

FLOWCHART:

The flowchart of this paper is as shown below:

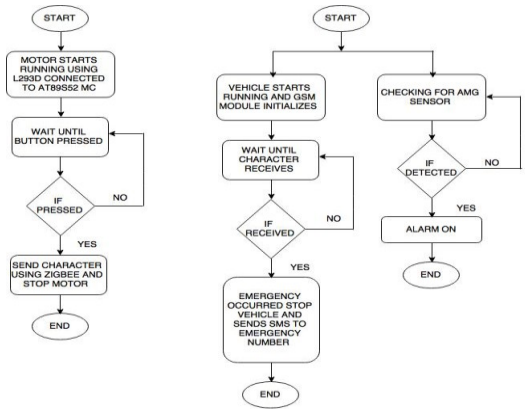

Figure – 13: Flow Chart

IV. RESULTS

Figure – 14: Final Prototype 1

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Figure – 15: GSM Module

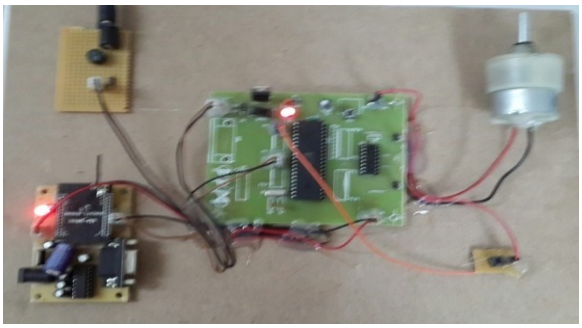

Figure – 16: Vehicle 1 Communication Unit

Figure – 17: Vehicle 2 Communication Unit

V. CONCLUSION

Here, a simple smart inter vehicular communication is designed and proposed and it is widely used in vehicle security applications and inter communication between the vehicles is the smartest way in communicating the emergency messages when the others are in critical situations.

ACKNOWLEDGEMENT

I would like to express my special thanks and gratitude to AsstProf A.RajKiran ,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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