Intelligent Skirmish Armored Robot

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***Abstract*-War zone disasters routinely invite sympathy not only for victims and their families, but also for heroic personnel who are faced with a tremendously complex, hazardous and often frustrating task environment. Military operations and rescue activities during and aftermath of wars and bombings indicate a tremendous need for greater access. Recent developments in the microcontroller and robot industries show great potential for employment of small robotic systems in expanded roles for security, and rescue operations.**

Increasing attacks from enemy states as well as internal issues, nations started using of robots in the defense field. Since tracking of enemies at different areas are very much difficult for soldiers. There is a possibility of losing soldiers and civilians at the war situation. So our idea is to replace the soldier with the combat robot system. Hence, today is the era of revolution in the field of robotics which has wider scope and approach across many fields.

***Keywords*: Skirmish, ARM7, DTMF**

I. INTRODUCTION

The aim of the project is to develop an intelligent combat robotic vehicle using DTMF for remote operation. A wireless camera has been installed on it, so that it can monitor enemy remotely whenever required. This kind of robot can be helpful for spying and monitoring purpose in the war fields. The sensors used in combat robot system will be detecting the Intruders/Obstacles/Metal by using ARM7 board, by mounting the IR Sensor, PIR Sensor, and Metal detectors. At the transmitting end using push buttons and commands are sent to the receiver to control the movement of the combat robot. A laser gun has been installed on it, so that it can fire on enemy remotely when required; this is not possible until a wireless camera is installed. Wireless camera will send real time video and audio signals which could be seen on a remote monitor and action can be taken accordingly. It can silently enter into enemy area and send us all the information through its tiny Camera eyes. It is designed for, fighting as well as prevent attacking by the enemy states

II. EXISTING METHODS

Literature survey was extinguishable done in advance robotic systems. First, project topics related to mobile systems, healthcare systems, industrial systems, and human-robot interaction were studied. Later I have concentrated much on human-robot interactions and industrial systems which are much used and in demand where lot of research has been going on. Due to everyday war around the world and increase in fatality rate of both civilians and army I did chose intelligence combat robot controlled through human-robot interaction. The foundation of my project was through base paper which I referred IEEE publications i.e., “An Intelligent Combat Robot” and “Remote Robot control System based on DTMF of Mobile Phone”.

In order to get the idea of design and understanding of the embedded and mobile systems used in the combat robot system I have gone through the books “The 8051 Microcontroller and Embedded Systems: Using Assembly and C”, Through this book I have got enough confidence to design and make a prototype combat robot system. In order to make design I have also studied the book “Embedded Systems: Real-Time Interfacing to Arm(r) Cortex –M Microcontrollers”. It begins with basic fundamentals, which allows the reader to solve new problems with new technology. Second, the book presents many detailed design examples. These examples illustrate the process of design. There are multiple structural components that have assisted in learning.

Further, research was done by looking into the old journals related to the combat robotic systems. I have analyzed that most of the journal papers presented represented a single unit of combat robot system viz. Wireless camera or RF/DTMF/Zigbee communication or GSM and GPS or Sensors using 8051 micro-controllers and at mega32 micro-controllers.

2.1 Objective

The goal of the project is to incorporate a complete unit of combat robotic system using ARM7 LPC2148 board. While for embedded coding the software used was Keil µvision and Flash Magic.

III. PROPOSED METHODLOGY

ROBOT UNIT: This unit is placed on the robot. It has mainly 4 parts:

- Microcontroller: It is the heart of the device. It controls all the activities of the unit.
- Sensors: sensors like temperature sensor, humidity sensor, obstacle detection are installed on the unit to get different environment parameters.
- Trance-receiver: This unit communicates between the unit uc and the base station.

- Motor drivers and motors: Motors are used for movement of robot i.e. Left, Right, Forward, Backward & to point the laser gun.
- Wireless camera: This is a CCTV camera which is used to monitor surrounding environment conditions.

GPS and GSM: GPS tracks the signal and loads data into the microcontroller and GSM sends the message

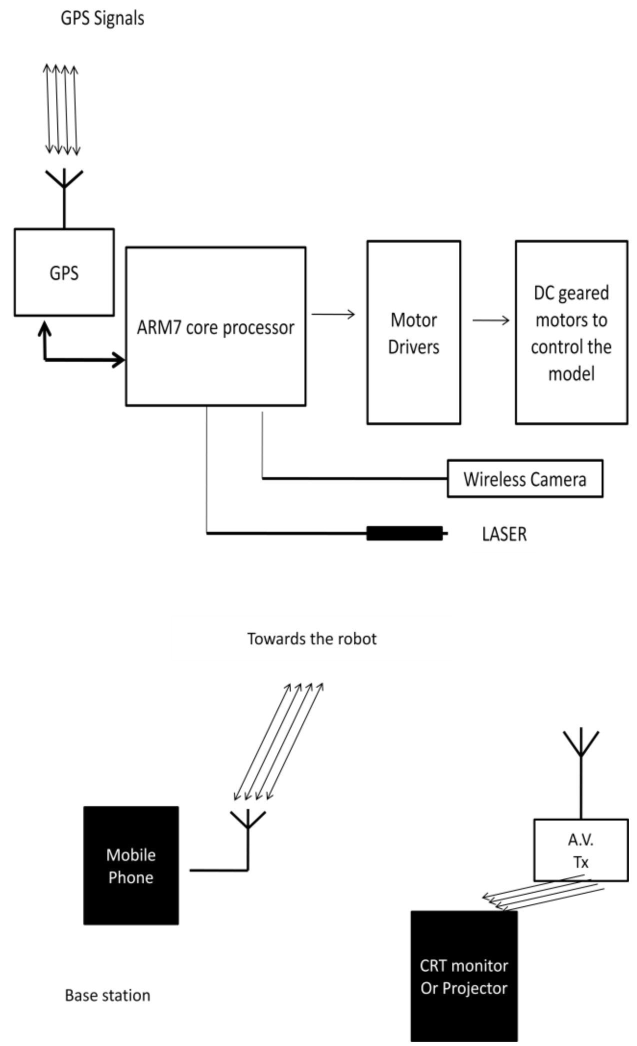

Fig1. Transceiver and Receiver section of ROBOT.

The features of ARM7 microcontroller are described as follows:

- 16/32-bitARM7TDMI-S microcontroller in a tiny LQFP64 package.
- 8 to 40Kb of on-chip static RAM and 32 to 512Kb of on-chip flash program memory. 128 bit wide interface/accelerator enables high speed 60 MHz operation.
- In-System/In-Application Programming (ISP/IAP) via on-chip boot-loader software. Single flash sector or full chip erase in 400ms and programming of 256 bytes in 1ms.
- Embedded ICE RT and Embedded Trace interfaces offer real-time debugging with the on-chip Real Monitor software and high speed tracing of instruction execution.
- USB 2.0 Full Speed compliant Device Controller with 2Kb of endpoint RAM. In addition, the LPC2146/8 provides 8Kb of on-chip RAM accessible to USB by DMA.
- One or two 10-bit A/D converters provide a total of 6/14 analog inputs, with conversion times as low as 2.44µs per channel.
- Single 10-bit D/A converter provide variable analog output.
- Two 32-bit timers/external event counters (with four capture and four compare channels each), PWM unit (six outputs) and watchdog.
- Low power real-time clock with independent power and dedicated 32 kHz clock input.
- Multiple serial interfaces including two UARTs (16C550), two Fast I^2C-bus (400 Kbit/s), SPI and SSP with buffering and variable data length capabilities.
- Up to 45 of 5 V tolerant fast general purpose I/O pins in a tiny LQFP64 package.
- Up to nine edge or level sensitive external interrupt pins available. 60 MHz maximum CPU clock available from programmable on-chip PLL with settling time of 100µs.
- On-chip integrated oscillator operates with an external crystal in range from 1 MHz to 30 MHz and with an external oscillator up to 50MHz.
- Power saving modes include idle and Power-down.
- Individual enable/disable of peripheral functions as well as peripheral clock scaling for additional power optimization.
- Processor wake-up from Power-down mode via external interrupt, USB, Brown-Out Detect (BOD) or Real-Time Clock (RTC).

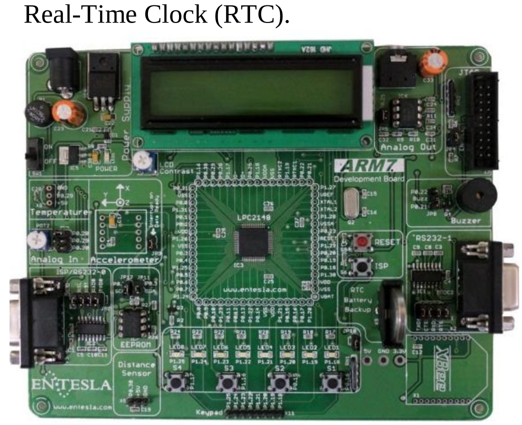

Fig2. LPC2148 Board.

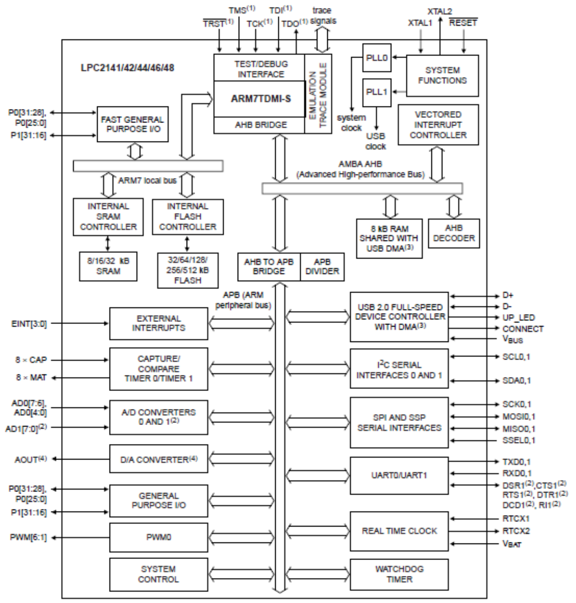

Fig3. LPC2148 Block Diagram Applications

The embedded system micro-controller produced by ARM company viz. ARM7 (LPC2148) is being applicable in the following industries:

- Industrial control
- Medical systems
- Access control
- Point-of-sale
- Communication gateway
- Embedded soft modem
- General purpose applications

Dual Tone Multi-Frequency (DTMF)

The mobile based robot incorporates a cheaper GSM phone with a active service provider telecom connection and a DTMF decoder which sends binary signals to the microcontroller. The tones generated from another GSM based phone is decoded through the headset port of the GSM phone connected to the DTMF Decoder.

DTMF is the signal communication to the phone company that you generate when you press an ordinary telephones touch keys. With this each key you press on your phone it generates two tons of specific frequencies, so that a voice can't imitate the tones, one tone is generated from a High frequency group of tones and the other is from a low frequency group.

DTMF Decoder

DTMF is a generic communication term for touch tone (a Registered Trademark of AT&T). The tones produced when dialing on the keypad on the phonecould be used to represent the digits, and a separate tone is used for each digit.However, there is always a chance that a random sound will be on the same frequencywhich will trip up the system. It was suggested that if two tones were used to represent a digit, the likelihood of a false signal occurring is ruled out.This is the basis of using dual tone in DTMF communication. DTMF dialing uses akeypad with 12/16 buttons. Each key pressed on the phone generates two tones of specific frequencies, so a voice or a random signal cannot imitate the tones. One tone is generated from a high frequency group of tones and the other from low frequency group. The frequencies generated on pressing different phone.

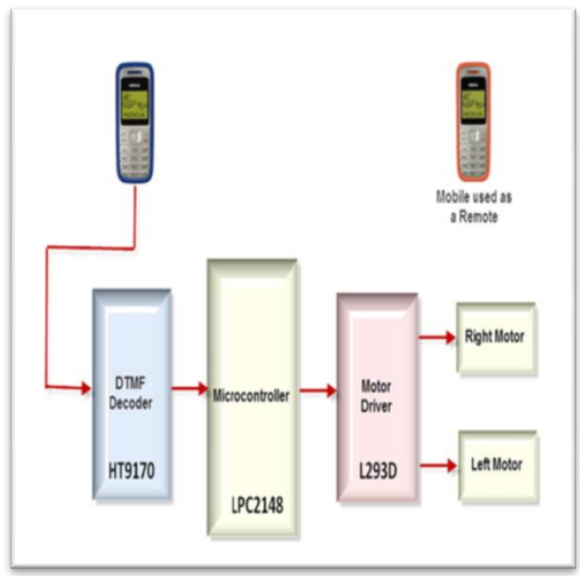

Fig4. DTMF Block Diagram

Description of DTMF

The standard DTMF signal is composed of two audio tones generated from a group of eight possible tone frequencies. The eight frequencies are divided into two equal groups, a low-frequency group and a high frequency group. The DTMF signal is an algebraic sum of two tone frequencies, one tone from each frequency group. If we do the math, we see that there are 4 * 4 =16 possible combinations. A sample 4*4 keypad matrix of individual DTMF frequency is shown in **figure6**. The low frequencies (R1 to R4) are referred to as the row group. The high frequencies (C1 to C4) are referred to as the column group.

Fig5. 4×4 Keypad Matrix Showing Individual DTMF Frequency.

Working of DTMF

In order to control the robot, make a call to the cell phone attached to the robot (through head phone) from any phone, which sends DTMF tunes on pressing the numeric buttons. The cell phone in the robot is kept in "auto answer" mode. (If the mobile does not have the auto answering facility, receive the call by "OK" key on the rover-connected mobile and then made it in hands-free mode.) So after a ring, the cell phone accepts the call. press any button on your mobile to perform actions as listed. The DTMF tones thus produced are received by the cell phone in the robot. These tones are fed to the circuit by the headset of the cell phone. The HT9170 decodes the received tone and sends the equivalent binary number to the microcontroller, as shown. According to the program in the microcontroller, the robot starts moving.

When you press key "2" (binary equivalent 00000010) on your mobile phone, the microcontroller outputs "10001001" binary equivalent. Port pins PD0, PD3 and PD7 are high. The high output at PD7 of the microcontroller drives the motor driver (L293D). Port pins PD0 and PD3 drive motors M1 and M2 in forward direction Similarly, motors M1 and M2 move for left turn, right turn, backward motion and stop condition.

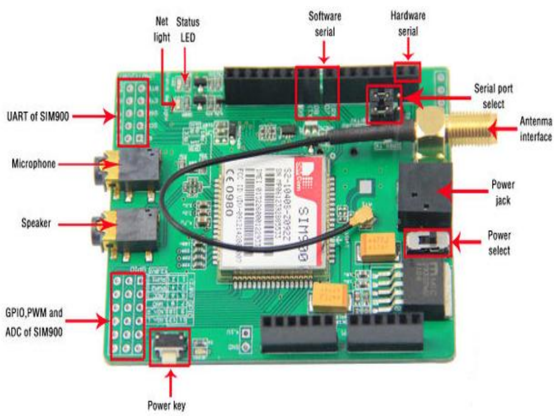

Fig6. GSM SIM900 Module.

3.1 Serial Communication in LPC2148

The serial communication has played a major role in designing the project as the communication with every external peripheral that are used to form a communication network is communicated with the serial protocol. The GSM module used in the project connected to the UART1 for both reception and transmission with the micro controller. The GPS module also communicates in the serial manner with the reception of the location information. The GPS module interfaced with the UART0 of the micro controller that too with the Rx pin of the UART0. The communication between the PC and the microcontroller is done by using the transmitter pin of the UART0 as there is only one way communication between the PC and the microcontroller. The registers used for the serial communication in the LPC2148 and the programming steps are as follows:

UOLCR: The line control register helps to set the pattern of the data stream that is the number of bits and the parity considered and the number of stop bits. In the project the value is set to 0x83 as the pattern is considered with no parity and one stop bit.

UODLL and UODLM: The UODLL and the UODLM registers are used to set the baud rate with the transmission or the reception is going to take place and for the baud rate of 9600 in this project the UODLL is set to 0x62.

UOTHR: The UOTHR register is the transmit hold register which contains the data to be transmitted. To check if any data is available in the UOTHR the UOLSR register is and with the value of 0x20 which indicates that the data is available for transmission.

UORBR: The UORBR is the receive buffer register which is used to receive data same as the UOTHR. To check if any data is available for the reception UOLSR register value is and with the value of 0x01 which indicates the status of the receiving data.

UOLSR: The UOLSR register is the line status register which contains the important data about the transmit and receive data ready bits for communication.

The registers discussed above are the just needed registers to establish a simple communication between two terminals using microcontroller. Similarly theUART1 contains the same registers with a change of the number of the UART like U1LCR and U1LSR. The flow chart for transmitting data is as shown in the **Fig7.**

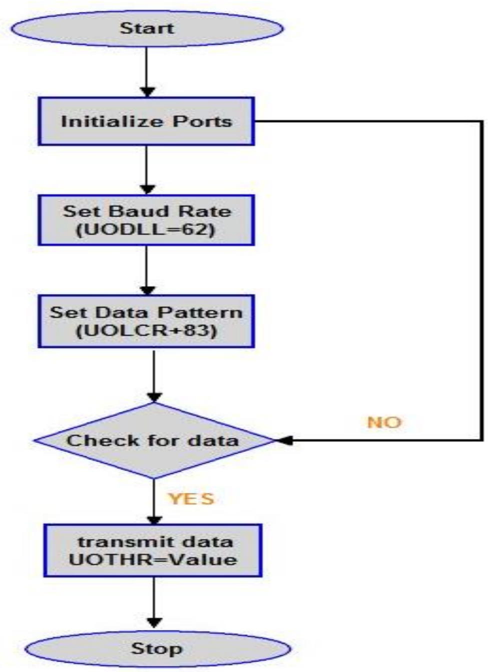

Fig7: Serial Communication of Transmission in LPC2148.

The data to be transmitted from the controller uses above registers in basically for the transmission of the data as shown in**Fig7**. However advanced registers like UOIER, UOACR are available for advanced applications. The data from the PIR, IR sensors and metal detector and the commands to GSM modem are transmitted in the above pattern. The flow chart for the reception of the data from the serial port is as shown in the **below flowchart.** The reception also uses the same data rate and the data pattern in order to process.

The below flow chart is used for reception of the GPS data and to send the GSM messages from the serial port to the LCD. The entire communication between the controller to its peripherals is follows the described flow above.

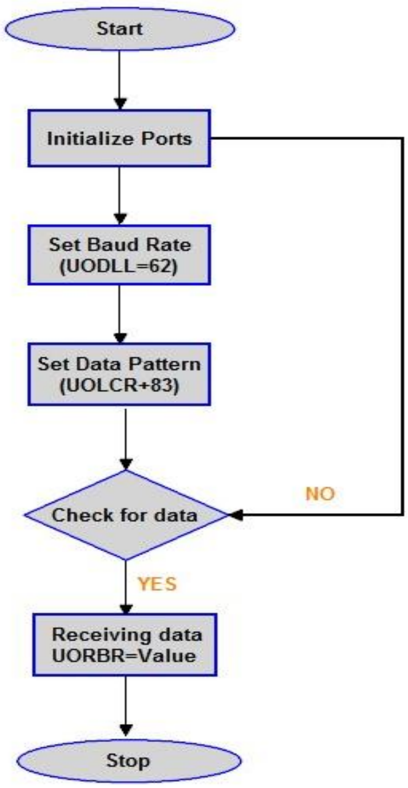

Fig8: Serial Communication of Receiver in LPC2148.

IV. RESULTS

4.1 Setting up the Robot and Control Section

Before switching on the combat robot system all the connections were verified. Once the combat system has been switched on(as shown in **figure 10**) the GPS co-ordinates, author name, and title name("Combat Robot") shall be displayed and the camera motor shall start rotating and start sending the A/V to the wireless receiver i.e., base station as shown in **fig9.**

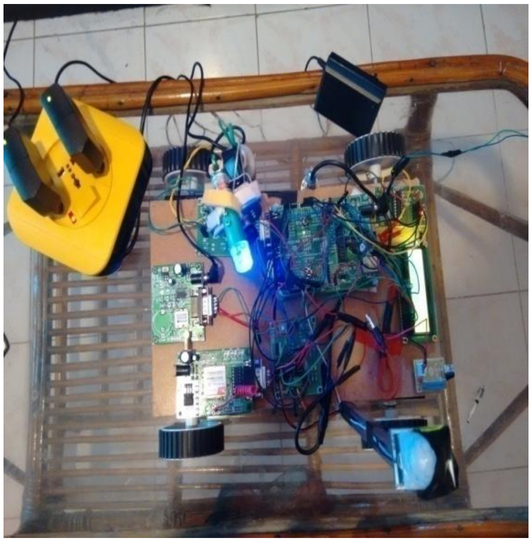

Fig9. Top view of the Combat Robot.

Fig10. Prototype of Combat Robot with live video transmission.

Once all the connections are established and verified the robot is ready to be deployed and shall be waiting for the inputs of the users i.e., control station as shown in **fig11.**

Fig11. Robot ready for Deployment after Verification.

Movement of the Combat Robot

The movement of the robot was controlled using DTMF communication through mobile phone (GSM) from the base station.

Firstly, the forward movement is given by the user from the mobile by pressing the keypad button “2” of the phone for the robot to move in as shown in **fig12.**

Fig12. Forward Direction Movement of the Combat Robot.

Secondly, the backward movement is given by the user from the mobile by pressing the keypad button “8” of the phone for the robot to move in as shown in **fig13.**

Fig13. Backward Direction Movement of the Combat Robot.

Further, the left movement is given by the user from the mobile by pressing the keypad button “4” of the phone for the robot to move in as shown in **fig14.**

Fig14. Left Direction Movement of the Combat Robot.

Finally, the right movement is given by the user from the mobile by pressing the keypad button “4” of the phone for the robot to move in as shown in **fig15.**

Fig15. Right Direction Movement of the Combat Robot.

In order to stop the movement or halt the combat robot, the user pressed the keypad “5” from the mobile as shown in **fig16**.

Fig16. Combat Robot Stopping after Detection of Obstacle/Human/Metal.

All the movements have been displayed in the LCD screen of the combat robot system

4.2 Obstacle, Intruder, Metal Detection

Many obstacles were placed along its path. When the robot confronted the obstacle, IR sensor sensed the obstacle. The robot automatically stopped while displaying the message as shown in **fig16**. To test the working of PIR sensor in the proposed system, human motion was introduced in its path. On sensing the motion, the robot stopped while displaying the message. When metal was placed in the vicinity of the moving robot, the robot automatically stopped.

Combat robot was made to move forward towards the wall, sooner the IR sensor sensed the obstacle while concurrently a message has been sent to the base station.

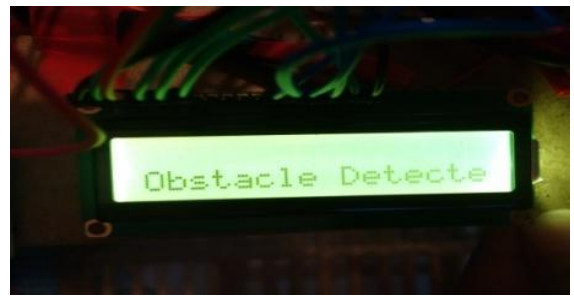

Fig17. Detection of Obstacle by Combat Robot.

combat robot was made to move forward while the human has interrupted the movement, sooner the PIR sensor sensed the intruder while concurrently a message has been sent to the base station and showing the GPS-coordinates along with the type of detection.

Fig18. Detection of Human by Combat Robot.

Fig19 .Detection of Metal by Combat Robot.

Fig20. Sending SMS by Combat Robot when Detection Obstacle/Human/Metal.

4.3 Receiving Message to the Base Station

The text message has been sent through GSM modem using SIM900 to the base station mobile phone. For example, when the obstacle/intruder/metal has been sensed the sensor module updates the flagship, thereby the ARM7 sends the information to the GSM module with the GPS co-ordinates. Hence, the message with type of sensed data viz. obstacle/intruder/metal along with GPS co-ordinates is sent to the base station mobile phone. Message Received from the Combat Robot to the Base Station Mobile on Detection of Obstacle/Human/Metal.

V. CONCLUSION

As we all know, these days India is sick off massive terror attacks, bomb explosions at plush resorts. To avoid such disasters technological power must exceed human power

The purpose of the combat robot is to decrease the incidence of human fatality, prevent the military personnel's from going to dangerous war zones, and help the army to know the targets at ground, and further determine any mines placed under the earth. So, in order to achieve such results the project has been developed to meet certain requirements hoping that the prototype setting up the Robot and Control Section

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