

Design of Intelligent Combat Robotic System for Defense, Security & Military Application

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Abstract—Various Intelligent machines and robotic systems are used today for performing various processes in industries and in day to day life. For data transmission there are number of standards that address low to high data rates for voice, PC LANs, video, etc. However, there hasn't been a wireless network standard that meets the unique needs of sensors and control devices till now. Sensors and controls don't need high bandwidth but they do need low latency and very low energy consumption for long battery lives and for large device arrays. Zig-Bee is a low-cost, low-power, wireless mesh networking standard. So data transmission is based on Zee-Bee. This paper is specially designed to save the life of soldiers in war fields, which is an unmanned ground vehicle. This robot is capable of performing multiple functions in the war field since it comprises a gun, flasher, bomb detector and camera in it. It can silently enter into enemy area and send us the live information about the opponents with the help of the wireless camera attached to the gun in the rover. Since human life is always precious, these kind of robots act as replacement of fighters against terrorist in war areas. This spy robot can be used in star hotels, shopping malls, jewellery show rooms, and in ATM centres to monitor and also to avoid the illegal activities of intruders. GSM technology is implement to robot for giving the information about power system via SMS. This Rots has a combination of wireless camera integrate in such a way, so as to provide simultaneous data acquisition and data transmission to the remote user through a Zee-bee.

Keywords:- Micro-Controller, SMS, GSM, Zig-bee, wireless camera, Landmines, Flasher, Spying, ATMEGA328

I. INTRODUCTION

A. Introduction to Embedded & Robotics:

Our paper is based on the domain of embedded system and robotics where an embedded system is a computer system with a dedicated function for specific task in which microcontroller programming is used, often real time constrains. Microcontroller chip is as a system on a chip which contains a little amount of inbuilt RAM, ROM, Flash memory itself. Merriam-Webster defines robot [2] as “a machine that looks like a human being and perform various complex acts; a device that automatically performs complicated, often repetitive tasks; a mechanism guided by automatic controls.” ISO describes a robot as “an automatically controlled reprogrammable, multipurpose manipulator programmable in three or more axes, which may be either fixed in place or mobile for use in industrial automation applications”. A Robot is a mechatronics` device which also in includes resourcefulness or autonomy. The word robot was first used in 1927 play titled R.U.R. Rossum's Universal Robots, by Karel Capek. Robot is a Czech word

meaning “worker”. Merriam- Webster defines robot as “a machine that looks like a human being and perform various complex acts; a device that automatically performs complicated tasks, often repetitive tasks; a mechanism guided by automatic controls”. In, the author explained that the robot is an automatically controlled reprogrammable, multipurpose manipulator programmable in three or more axis, which is more useful for industrial purpose. Isaac Asimov stated three laws of robotics which represents and explained the relation between the robot and the human i.e. how to protect the intentional things made by these machines. The first law states that a robot may not injure a human being by its action. The second law explained that a robot must obey the orders given to it by humans, except where such order would conflict with the first law. The third law states that a robot must protect its own existence and don't conflict with first and second law. Using an ad-hoc network in wireless communication these robots can exchange information to its nearer network, so it leads to long range transmission. This work used Zig-bee technology to make the mesh network. This will help to get better security and very fast response for lower data rates. From the above discussion, it was clear that a robot is comprised of motors; gear, gear box and mechanical system for locomotion. There are sounds, light and other sensor to guide the robot to collect the necessary information from the environment and also to do the work as per the instruction given in it. The sensed environmental data can be analysed and perform the corresponding tasks by using powerful software which is coded in the microcontroller. It is also planned to be equipped with microphones, speakers, display devices, etc., to interact with human beings.

The main objectives of using robot are:

- 1 Where mandares not venture : Robots have traditionally been put to use in environments that are too hazardous for man
- 2 To rescue, pronto! : Robots also work under precarious conditions, for search and rescue after disasters. A host of robots built by the University of South Florida's Centre for robot assisted search and rescue were in action at the world trade centre site within hours after the disaster to delve into the rubble and rescue survivors. Similarly, robots are also put to work in underground mines. A lot of research today is focused on improving rescue functions of robots.
- 3 We even make them go to war: The faithful robots do not hesitate to tread even the dreaded terrain of battlefields [3]. Their use in Afghanistan and Iraq wars make us wonder if robots have indeed become intelligent! Battle robots of various shapes and sizes were deployed to defuse landmines, search for criminals hiding in caves, search for bombs under cars and in building, for

espionage and what not! These robots were controlled by humans.

B. Why Need for Design of intelligent Robotic system:

Necessities are the mother of inventions. Whenever human being finds the need of something, it will lead to a wonderful invention. After the 9/11 attack in USA, all country started focusing on how to control the attack of terrorism and how to improve the security to a nation. The global focus on terrorism and security may have geared up following the 9/11 attacks in the USA. The risk of terrorist attack can perhaps never be eliminated, but sensible steps can be taken to reduce the risk. As a result some 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 lose of soldier at the war situation. So our idea is to replace the soldier with the robot soldier.

II. SUBSYSTEM DESCRIPTION

A. Acceleration Sensor



Fig. 1: Accelerometer sensor

Accelerometer is nothing but an electromechanical device which measures the acceleration. The accelerometer used here is a 3 axes accelerometer with high resolution measurement. The digital output is accessible through SPI or I2C digital interface and running at the supply voltage from 2.0v to 3.6v. This sensor is used to change the direction of the gun and camera. It is a small, thin, 3mm*5mm*1mm, 14 lead plastic package. Figure 1 shows the accelerometer sensor. The accelerometer can measure acceleration in one, two or three orthogonal axis. It can be used in any one of the following modes. It can be used as a vibration sensor. It can be used as a sensor for tilt or orientation in two or three dimensions. It can be used for the measurement of velocity and position. It can measure both the static and dynamic acceleration. The activity and inactivity sensing detect the presence or lack of motion by comparing the acceleration in any axis with the user set threshold.

B. Microcontroller: ATMEGA328

Atmega-328p is a 28 pin High Performance microcontroller. It has 23 programmable I/O pins to process the digital and analog information, two 8-bits timers or one 16-bit timer, an improved 10-bit A/D converter with 6 input analog inputs. Figure 4 shows the ATMEGA 328P. It also has UART, fast I2C- bus, SPI with buffering and variable data length capabilities which is useful for serial interfaces.

ATMEGA 328P has 32 Kbytes flash programmable memory to store the program. It also has an on-chip static SRAM hence it is well suited for communication gateways and protocol converters. It has

low power consumption which can be in the mode such as active mode, Power-down mode and Power-save mode.

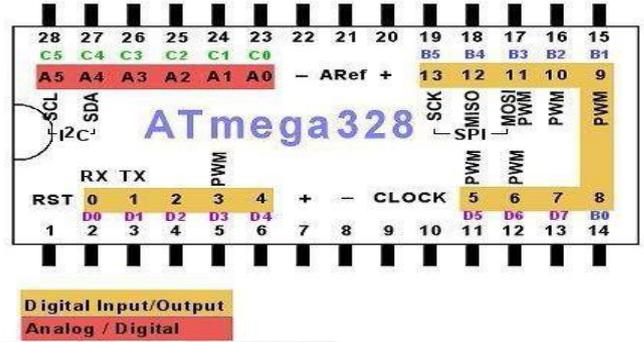


Fig. 2: ATMEGA 328

C. Zig-bee

Zig-Bee is used to transfer the data from the control unit to the rover unit and vice-versa. It uses mesh topology which allows Zig-Bee devices to automatically connect with and transmit data through one another without the need of central gateway like a router. It has low power consumption and low data rate. Hence it is easy and efficient to send the instructions like turn on the device, rotate right, left, etc. It is capable of transferring data up to 1600m with the frequency range of 865 MHz to 869MHz. It is easy to integrate with RS-485, RS-232and serial data. It can fit into anything because of its small 24mm * 36mm * 3mm form factor. Data can be preserved by using Encryption with encryption configurable -key, hence it is more secured one. It is configured by using terminal software.



Fig. 3: Zig-bee

The ZigBee standard is built on top of the IEEE 802.15.4 standard. ZigBee is an established set of specifications for wireless personal area networking (WPAN), i.e. digital radio connections between computers and related devices. ZigBee provides specifications for devices that have low data rates, consume very low power and are thus characterized by long battery life.

D. GSM module

Remotely the system allows the user to effectively monitor and control the power system and equipment's via the mobile phone set by sending commands in the form of SMS messages and receiving the appliances status. The main concept behind the project is receiving the sent SMS and processing it further as required to perform several operations. The type of the operation to be performed depends on the nature of the SMS sent.

A GSM modem is a specialized type of modem which accepts a SIM card, and operates over a subscription to a mobile operator, just like a mobile phone. From the mobile operator perspective, a GSM modem looks just like a mobile phone. When a GSM modem is connected to a computer, this allows the computer to use the GSM modem to communicate over the mobile network. These GSM

module work based on AT-Command.

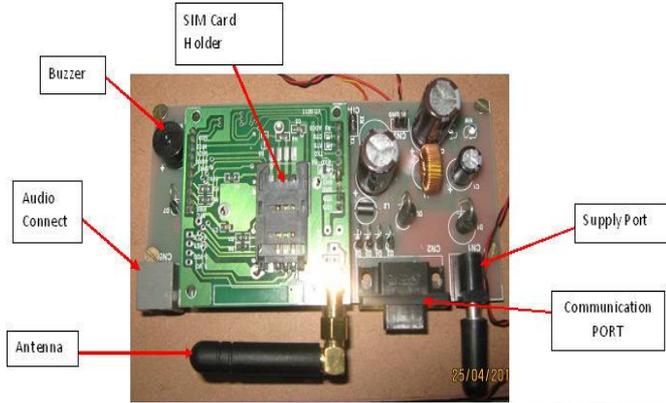


Fig. 4: GSM Module

E. Motor Driver IC

L293D is a monolithic integrated high voltage; high current four channel driver designed to accept TTL logic levels and drive switching power transistors. L293D is assembled in a 16 lead plastic package which has 4 center pins connected together and used for heat sinking. It is designed to control 2 DC motors. It requires separate power supply because it operates at high current and low voltage hence the operation of the whole circuit is protected from it by using separate battery supply. There are 2 Input and 2 Output pins for each motor. This device is more suitable for switching application at frequencies up to 5 kHz. It has two H-bridge hence it drives two motor. Its operation is shown in the table below

Table 1: Operation of Motor driver.

OPERATION	DRIVER 1	DRIVER 2
Stop	Low	Low
Clockwise	Low	High
Anti clockwise	High	Low
Stop	High	High

F. Metal Detector

Metal detectors are useful for finding metal enclosure hidden within the object or metal objects buried underground. Metal detector is used here as a bomb detector. Inductively coupled coil is used to find out the metal present inside the ground. It absorbs the magnetic field comes out from the metal and gives the acknowledgement to the control unit. Metal detector consists of an oscillator producing an alternating current that passes through a coil producing an alternating magnetic field. If the current carrying metal is close to it, eddy currents will be induced in the metal and this produces a magnetic field. Magnetometer is used to measure the magnetic field, the change in magnetic field indicates the metal present inside the surface.

G. DC motor

DC motor is used for movement and locomotion purpose of the rover. It has high revolution per minute and low torque. In general robotics requires low revolution per minute and high torque. Hence gearbox is used to achieve this configuration, which reduces the rpm and increases the torque. The operation is based on the principle of electromagnetism which states the magnetic field is

generated by a current carrying conductor and when it is placed in an external field, it experiences a force proportional to the current in the conductor. The speed of the motor can be controlled by changing the voltage applied to the armature or by changing the field current.

H. Servo motor

Servo motors are widely used in radio control models and also used in robotics because of its small size and low cost. Servomotor has built in motor, gearbox, position feedback mechanism and motor controller. The servo motor can be adjusted to any position, by using simple pulse controlling. The dimension of the servomotor is 40.7mm*20.5mm*39.5mm and it operates at the supply range of 4.8 to 6v. It has the torque range of 15.5.kg/cm at 4.8v and 17kg/cm at 6v. The operating speed is 0.15sec for every 60 degree rotation. The designed armed can be applied in variety of applications. They are Security purpose, Spying purpose, Military fields, Minimize the Casualties in terrorist attack, this can be used as a fighting robot in the war field as well as where the terrorist hidden in the area and used as a self-bomb if it was traced by the opponent group (Terrorist).

I. TV tuner card & wireless Camera

A TV capture card is a computer component that allows television signals to be received by a computer. It is a kind of television tuner. Most TV tuners also function as video capture cards, allowing them to record television programs onto a hard disk. Digital TV tuner card is as shown in the Figure



Fig 5: Display unit, camera receiver & t capture card

III. METHODOLOGY & WORKING

The main objective of this paper is to save the life of humans in the war field. The Armed robots designed in this paper can be used in the environment which is hazardous to human. Battle field robots are used to determine the landmines, bombs and also used for surveillance purpose. These kinds of robots gain its importance in search

& rescue operations after natural disasters. The block diagram of the proposed control unit is shown in Fig 1. The control unit consists of a touch screen, acceleration sensor, liquid crystal display, display unit and a Zig-bee module. The touch screen and acceleration sensor are used as the input devices. The touch screen is used to control the direction and movement of the rover. Acceleration sensor is used here to drive the servo motor which in turn changes the direction of the camera as well as the position of the gun. The driving of servo motor is done by using processor. LCD unit displays the acknowledgement for the corresponding actions

Performed by the receiver and also in the transmitter. Display unit displays the information captured by the camera. Zig-Bee is used to transmit the data from the control unit to the receiver unit and vice-versa.

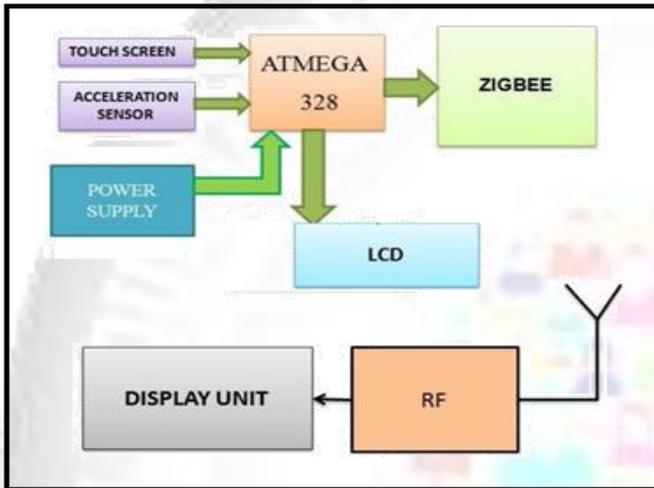


Fig. 6: Block diagram of Control unit

The Rover Unit consists of Flasher, motor driver, metal detector, servo motor, Zig-bee module, camera and a gun. Figure 2 shows the block diagram of proposed rover unit. The Zig-bee module receives the data and instruction from the control unit through the Zig-Bee transceiver in the control unit and performs the corresponding actions. In return it sends the

Acknowledgement to the transmitter using the same Zig-Bee transceiver. All the operations are carried out with the help of the processor. GSM module is used for the purpose of power security; this is a kind of combat robot. If someone switches off its main power, so the system is just like a dead or useless, so especially an arrangement of an internally power supply is used which works as in sleep mode. When someone switches the power of the robot by external means, then the GSM system detects and automatically sends a message to the predefined user mobile no. as well as, by using wireless remote section, the main power can be switched on because an internally battery connection previously runs the circuit. By particular SMS service power as well as moment of robot can be controlled.

The RF camera is used to capture the live video present in the opponent environment and it will be transferred to the control unit. Then the processor transfers the live video captured to the display unit. This display unit may be a tablet PC, laptop, etc. In this work, a laptop is used as the display device. To detect the landmines, a metal detector is used. Motor driver is used to achieve enough

current to run the motor with the required rpm. Atmega-328 is used as a processor to accept and send the corresponding data to the other section.

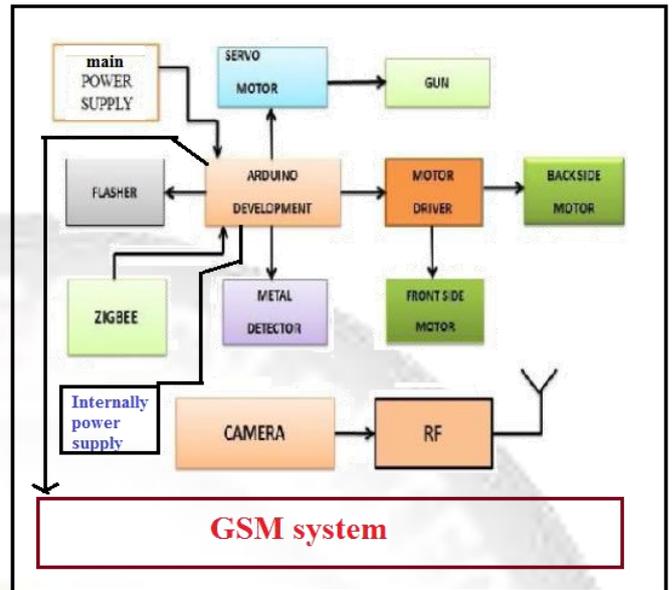


Fig. 7: Block diagram of Rover unit.

IV. RESULT

During tests, our design works as expected. The primary metric for our paper would be accuracy. This has been tested to the best of our ability. We have been able to view the things accurately that are happening. In our experience, our design has not caused any sort of disturbances. The robot will move based on the motor direction depending upon the input we give through command by remote section unit.



Fig. 8: hardware design with display unit

Remote controllers are designed to direct the orientation of the robot and to operate the laser gun. The robot keeps on moving in two modes, i.e., Manual mode and self-mode. It's brought under user's control in the case of manual mode. In self-mode, the robot starts moving over the surface and takes action according to the scenario. To detect the obstacles, we have deployed Infrared sensors (left sensor and right sensor) in the front portion of the module. While moving on the surface, if the left sensor is detected, the robot takes back the

position for a moment and moves right. If the right sensor is detected, robot gets back and moves left. The front view and top view of designed combat robots & also GUI is also implement over the visual basic or MATLAB software these are shown in the figures 9.



Fig. 9: GUI base remote control unit & robot

V. APPLICATION

- These systems give direct user connectivity through the mobile and also remote user connectivity.



Fig. 10: Easily operated by cell phone

- Can be adequately implemented in national defense through military-industrial partnership. It is shown in the figure 14.



Fig. 11: Top view of combat robot

- Can be vastly applied in Resorts, borders of noted buildings. It is shown in the figure 15

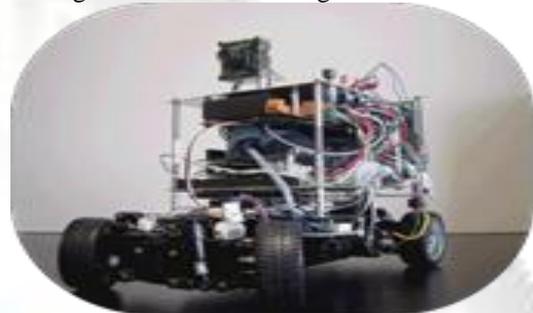


Fig. 12: front view of combat robot

- Installation of combat robots in the stadiums, sacred places, and government and non-government organizations assures top security.

VI. 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. Human life and time are priceless. It's our onus to take an initiative to design a model of an apt robot that meets combatant needs. So to avoid terror attacks, to ensure more security at the border and high density areas it's wise to maintain a world class military technology in accordance with combatant needs. Even every nation needs its own defence system for their integrity and security. In such a way construction of these robots will carry nation's name, fame globally. In the near future armed robots will be used in the War field in order to save the life of soldiers. This kind of robot is also well suited for surveillance, to reduce the casualties and attack the enemies in shopping malls, Jewellery showrooms and ATM centers. The additional features that planned to be added are microphone (to capture the audio signals and act accordingly) and tear gas or chloroform diffusion or smoke bombs to make enemies to reach sub conscious stage. Hence, it will be easy to attack them. In our Model, so many sensors are used as need for transmitting data zig-bee is better because Sensors and controls don't need high bandwidth but they do need low latency and very low energy consumption for long battery lives and for large device arrays. ZigBee is a low-cost, low-power, wireless mesh networking standard.

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