Smart Rescue Robot

Ms.B.Kalaimathi
Assistant Professor
SNS College of Engineering
Coimbatore
kalaimathi.snsce@gmail.com

Keerthana Ramesh, R.Kanimozhi and R.Sangeetha
UG Scholars
SNS College of Engineering
keerthanaramesh1992@gmail.com

Abstract: - **The decrement in availability of manpower leads every industry to make use of robotics. Smart rescue robots are designed to help the search and rescue team to analyze the situation in the disaster prone area (like terrorist bombing, serious accident leak of dangerous substance) and direct them to collect the information so that the team can make the work less hazardous. This paper presents a maxi-sized rescue robot whose primary motivation is to save life and more civilian response. The microcontroller that has been used is PIC-16F877A with flash memory. It can navigate autonomously through any rubble and checks the atmosphere temperature using temperature sensor. The real-time locating system is used to automatically identify and track the location of objects or people usually within building debris using GSM. The programming language used is embedded C which is executed by visual basic.**

General Terms: - Rescue robots, search and rescue, prone area, autonomous, maxi-sized, sensor.

Keywords: - PIC-16F877A, flash memory, GSM, temperature sensor, RTLS, embedded C, visual basic.

I. INTRODUCTION

Earlier in 1990s we didn't had much development in search and rescue operation. The robots were not used for wider applications. It's only during 1980s we began the use of search and rescue robots. Although robots are not widely used in actual situation the development in this field seems quite promising. At present we need robots that could penetrate rubble piles and find people beneath them. Even if it is quite daunting, search and rescue is much wider than that. There are many possible situations and different tasks that could be done by robots.

If we analyze the search and rescue situations preparedness for disasters is a more complex process, and includes activities such as devising, testing, and implementing disaster plans, providing training for responders, and communicating with the public and others about disaster vulnerability (Mileti 1999).This paper sought to gain a better understanding of the large-scale operation in a major urban environment. In an Urban Search and Rescue (USAR) operation the goal is to locate and deliver aid to the victims as soon as possible in a race against a retreating survival window. Respondents reported there was minimal planning for rescue operations because preparation was limited for these organizations because of enormity, scale, and urgency of the situation The major problem is that rescue coordinators have little knowledge of what is happening inside an emergency area .Experience with disasters has shown the problems that emerged with the response to the fires included lack of common organization, poor on-scene and inter-agency communications, inadequate joint planning, lack of valid and timely intelligence, inadequate resource management, and limited prediction capability all of which would apply to the rescue operations. Rescue robot system integrated each of the subcomponents and prototype that works from end-to-end. The report explains the design and implementation prototype, including the decisions and tradeoffs made throughout the development process.

Emergency rescue workers respond rapidly to a variety of dangerous situations trying to save lives. In doing so they put their own lives on the line. In interviews with Charlottesville rescue workers we discovered that they lack critical information while in a fire. For example they do not know whether the temperature is high enough to melt their equipment, or if their air-tank is almost empty. With the innovative use of GSM technology, smart rescue robot system provides a rescue worker with data and voice communication capabilities. Sensors monitor information such as the ambient air temperature and the rescue workers to better plan and execute the operations. With this system, rescue workers can save lives with this system; rescue workers can save lives while reducing the risk to their own. The project explains the design and implementation prototype, including the decisions and tradeoffs made throughout the development process. In order to meet smart rescue robot's requirements, we decided to set the following goals. Rescue system will provide:

1. Short-range voice and data communication
2. easy to configure and use
3. Clear, accessible environmental data and status information to the user
4. Interface for monitoring and analysis of real-time data by the rescue coordinator

II. PRESENT SYSTEM SCENARIO

The problems occurred in present system were analyzed through a literature survey of existing techniques and robot models. Although there are many tasks on the rescue site, robots should be used where human or canine

rescuers are powerless or where robots can do tasks at hand more effectively. The unaccountable scale and number of natural and man-made disasters in the past decade has urged international emergency search and rescue communities to seek for novel technology to enhance operation efficiency. Tele-operated search and rescue robots that can navigate deep into rubble to search for victims and to transfer critical field data back to the control console has gained much interest among emergency response institutions. In response to this need, a low-cost autonomous mini robot equipped with thermal, sensor, accelerometer, sonar, pin-hole camera, microphone, ultra-bright LED and wireless communication module is developed to study the control of a group of decentralized mini search and rescue robots.

The robot can navigate autonomously between voids to look for the living body heat and can send back audio and video information to allow the operator to determine if the found object is a living human. This paper introduces the design and control of a low-cost robotic search and rescue system based on immune control framework developed for controlling decentralized systems. This feature proves to be very useful over rough terrain and narrow passages, as the operator does not need to know which side of the robot is up to drive the robot forward. Since this is only a prototype for testing the concept of controlling low-cost autonomous search and rescue robots with GSCF based system, it is fair to say the performance of the robot is in-line with design expectation and the GSCF based control system works well as the backbone of the system.

III. RESCUE ROBOT OPERATION

The proposed rescue robot system consists of a temperature sensor, RS232 and a GSM module. The principle involved in detecting the people who got trapped in the rubbles during disasters. The communication between RS232 and GSM module shows the presence of people in the building. When the communication takes place, the analog input to microcontroller from temperature sensor becomes high i.e., 5V. This change in voltage indicates the temperature change where the robot

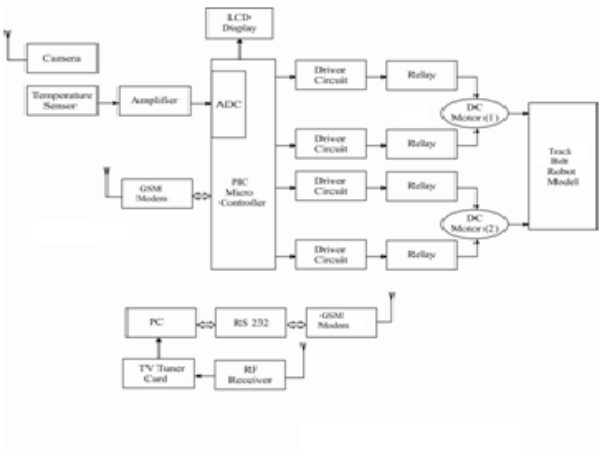


Figure 1. Block diagram of rescue robot

is present and the wireless camera attached to it record the continuous audio and video data using the PC tuner card. To communicate the received information, a GSM modem has been utilized. The function of the GSM module being used is to send the current temperature data to the relevant authority as an SMS. The aforementioned functionality has been achieved by interfacing the GSM module, RS232 and temperature sensor arrangement with a microcontroller. The robot is driven by four DC motors.

IV. ELECTRICAL DESIGN

A. Microcontroller

The microcontroller that has been used for this project is from PIC series. PIC microcontroller is the first RISC based microcontroller fabricated in CMOS (complementary metal oxide semiconductor) that uses separate bus for instruction and data memory. The main advantages of CMOS and RISC combination is low power consumption resulting in a very small chip-size with small pin count. The main advantage of CMOS is that it has immunity to noise than other fabrication techniques. Various microcontrollers use different kinds of memories. EEPROM, EPROM, FLASH etc. are some of the memories of which FLASH is the most recently developed. Technology that is used in PIC16F877 is flash technology, so that data is retained even when the power is switched off. Easy Programming and Erasing are other features.

The PIC start plus development system from microchip technology provides the product development engineer with a highly flexible low cost microcontroller design tool set for all microchip PIC micro devices. The PIC start plus development programmer and MPLAB IDE. The PIC start plus programmer gives the product developer ability to program user software in to any of the supported microcontrollers. The PIC start plus software running under MPLAB provides for interactive control over the programmer.

B. Temperature sensor

In this circuit the thermistor is used to measure the temperature. Thermistor is nothing but temperature sensitive resistor. Here we are using negative temperature co-efficient in which the resistance value is increased. Resistance value will be varied depend upon the temperature level. Temperature varied means the resistance value also varied. If resistance value increased means output also increased. The resistance value and output is directly proportional one. Then the final voltage is given to ADC for convert the analog signal to digital signal voltage is given to ADC for convert the analog signal to digital signal. Then the corresponding digital signal is taken to process in microcontroller. The ADC value will increase if the temperature increased. We can measure only with the help of any controller or processor.

C. RS232 communication

In communications, RS-232 is a standard for serial binary data interconnection between a DTE(Data terminal equipment) and a DCE(Data Circuit-terminating Equipment) It is commonly used in computer serial ports. In this circuit the MAX 232 IC used as level logic converter. The MAX232 is a dual driver/receiver that includes a capacitive voltage generator to supply EIA 232 voltage levels from a single 5v supply. Each receiver converts EIA-232 to 5v TTL/CMOS levels. Each driver converts TLL/CMOS input levels into EIA-232 levels. In this circuit the microcontroller transmitter pin is connected in the MAX232 T2IN pin which converts input 5v TTL/CMOS level to RS232 level. Then T2OUT pin is connected to reviver pin of 9 pin D type serial connector which is directly connected to PC. In PC the transmitting data is given to MAX232 through transmitting pin of 9 pin D type connector which converts the RS232 level to 5v TTL/CMOS level. The R2OUT pin is connected to receiver pin of the microcontroller. Likewise the data is transmitted and received between microcontroller and PC vice versa.

D. GSM module

The modem needed only 3 wires (TX, Rx, and GND) except power supply to interface with microcontroller/host PC. The built in low dropout linear voltage regulator allows to connect wide range of unregulated power supply (4.2v-13v). This modem can be used to send and read SMS. GSM networks operate in a number of different carrier frequency ranges (separated into GSM frequency ranges for 2G and UMTS frequency bands for 3G), with most 2G GSM networks operating in the 900 MHz or 1800 MHz bands. Where these bands were already allocated, the 850 MHz and 1900 MHz bands were used instead (for example in Canada and the United States). In rare cases the 400 and 450 MHz frequency bands are assigned in some countries because they were previously used for first-generation systems.

E. Light Emitting Diode (LED)

Light emitting diode (LED) is basically a P-N junction semiconductor diode particularly designed to emit visible light. There are infrared emitting LEDs which emit invisible light. The LEDs are now available in many colors red, green and yellow. A normal LED emits at 2.4 V and consumes milliamps of current. The LEDs are made in the form of flat tiny P-N junction enclosed in a semi-spherical dome made up of clear colored epoxy resin. The dome of a LED acts as a lens and diffuser of light. The common circuit symbols for the LED are shown in Fig. It is similar to the conventional rectifier diode symbol with two arrows pointing out. There are two leads- one for anode and the other for cathode. LEDs often have leads of dissimilar length and the shorter one is the cathode.

Electrically, a LED is similar to the conventional diode in that it has relatively low forward voltage threshold. Once this is exceeded the junction has a low slope resistance and conducts current readily. An external resistor must limit this current. Forward voltage drew across red LED is nominally 1.6 V but spread with commercial diodes, it may be as high as 2 Volts or so, while the Green LED drops 2.4 V. This difference accounts for use of lower limiting resistor used with the Green LED.

Another important parameter of the LED is its maximum reverse voltage rating. For typical Red device it is of the order of 3 volts. But for Green LED it is higher 5 to 10 volts. The LED produces light only when a DC current is passed in the forward direction and the amount of light emitted by a LED is proportional to the forward current over a broad range. It means that light intensity increases approximately linear manner with a LED is similar to the conventional diode in that it has relatively low forward voltage threshold. Once this is exceeded the junction has a low slope resistance and conducts current readily. An external resistor must limit this current. In our project we use green and red LED which works under this principle.

F. LCD display

Liquid crystal cell displays (LCDs) are used in similar applications where LEDs are used. These applications are display of display of numeric and alphanumeric characters in dot matrix and segmental displays. When a potential is applied across the cell, charge carriers flowing through the liquid disrupt the molecular alignment and produce turbulence. When the liquid is not activated, it is transparent. When the liquid is activated the molecular turbulence causes light to be scattered in all directions and the cell appear to be bright. This phenomenon is called dynamic scattering.

The construction of a field effect liquid crystal display is similar to that of the dynamic scattering type, with the exception that two thin polarizing optical filters are placed at the inside of each glass sheet. The liquid crystal material in the field effect cell is also of different type from employed in the dynamic scattering cell. The material used is twisted numeric type and actually twists the light passing through the cell when the latter is not energised.

When sufficient voltage is applied to the electrodes the liquid crystal molecules would be aligned in a specific direction. The light rays passing through the LCD would be rotated by the polarizer, which would result in activating/highlighting the desired characters. The power supply should be of +5 V, with maximum allowable transients of 10 mV. To achieve a better/suitable contrast for the display the voltage (VL) at pin 3 should be adjusted properly. A module should not be removed from a live circuit.

The ground terminal of the power supply must be isolated properly so that voltage is induced in it. The module

should be isolated properly so that stray voltages are not induced, which could cause a flicking display. LCD is lightweight with only a few, millimetres thickness since the LCD consumes less power, they are compatible with low power electronic circuits, and can be powered for long durations. LCD does not generate light and so light is needed to read the display. By using backlighting, reading is possible in the dark. LCDs have long life and a wide operating temperature range. Before LCD is used for displaying proper initialization should be done.

The pixels are addressed one at a time by row and column addresses. This type of display is called passive-matrix addressed because the pixel must retain its state between refreshes without the benefit of a steady electrical charge. As the number of pixels (and, correspondingly, columns and rows) increases, this type of display becomes less feasible.

Very slow response times and poor contrast are typical of passive matrix addressed LCDs. High-resolution colour displays such as modern LCD computer monitors and televisions use an active matrix structure. A matrix of thin-film transistors (TFTs) is added to the polarizing and colour filters. Each pixel has its own dedicated transistor, allowing each column line to access one pixel. When a row line is activated, all of the column lines are connected to a row of pixels and the correct voltage is driven onto all of the column lines.

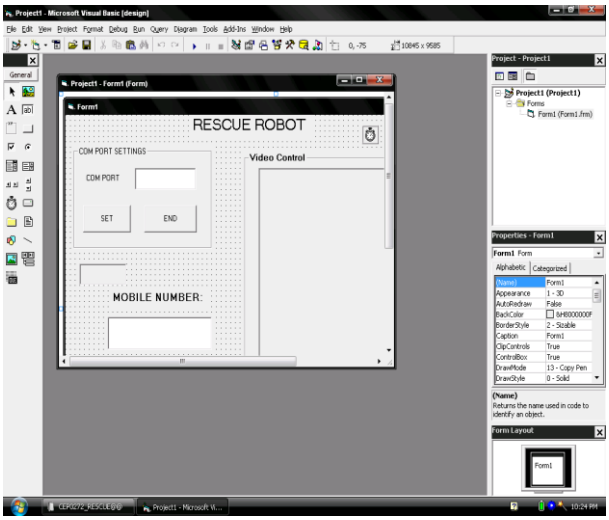
The row line is then deactivated and the next row line is activated. All of the row lines are activated in sequence during a refresh operation. Active-matrix addressed displays look "brighter" and "sharper" than passive-matrix addressed displays of the same size, and generally have quicker response times, producing much better images. A general purpose alphanumeric LCD, with two lines of 16 characters. So the type of LCD used in this project is16 characters * 2 lines with 5*7 dots with cursor, built in controller, +5 V power supply, 1/16 duty cycle.

Figure 2.LCD display

V. SOFTWARE DESCRIPTION

A. Programming language -Embedded C

Embedded programming is the term for the computer programming that lives in and operates the great many computer-controlled devices that surround us in our homes, cars, workplaces and communities. For every desktop or notebook computer you have, you may have a dozen or more (perhaps a great deal more) microcontrollers quietly doing their embedded duty, and in these devices most people don't even realize there's a computer running a program. But there is, and it is, and those programs had to be written, and that's why the world needs embedded programming. Embedded computers (microcontrollers) add intelligence to countless devices and systems, enabling those devices and systems to operate better, faster, more safely, more efficiently, more conveniently, more usefully, and in many cases allowing the very existence of devices and systems that could not be built otherwise. Embedded C is a set of language extensions for the C Programming language of the C Standards committee to address common issues that exist between C extensions for different embedded systems. Historically, embedded C programming requires nonstandard extensions to the C language in order to support exotic features such as fixed-point arithmetic, multiple distinct memory banks, and basic I/O operations. In 2008, the C Standards Committee extended the C language to address these issues by providing a common standard for all implementations to adhere to. It includes a number of features not available in normal C, such as, fixed-point arithmetic, named address spaces, and basic I/O hardware addressing. Embedded C uses most of the syntax and semantics of standard C, e.g., main() function, variable definition, data type declaration, conditional statements (if, switch. case), loops (while, for), functions, arrays and strings, structures and union, bit operations, macros and union. Visual Basic is used for controlling the movement and viewing the videos while robot is moving autonomously.



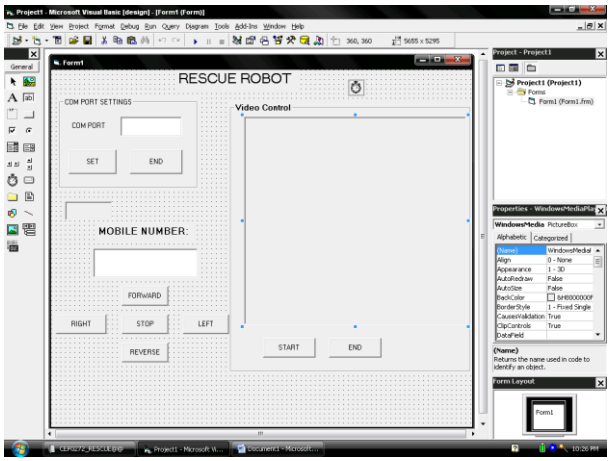


Figure 3. Figure showing operation of rescue robot in visual basic

VI. MECHANICAL DESIGN

The robot runs on conveyor type tracked wheels which keeps it almost steady in rugged paths. The circuit box containing mainly the PIC16F877A Board, the temperature sensor, RS232 and the GSM module is exactly centered on the aluminum rod. The proper packaging of wires is a crucial in design of the robot.

The entire circuit box is set up on a platform fitted with conveyor track wheels which is controlled by DC motor fitted on each arms. The wireless camera along with PC tuner card capture the video and audio scenario seen by the robot and the direction of robot is controlled by PC.

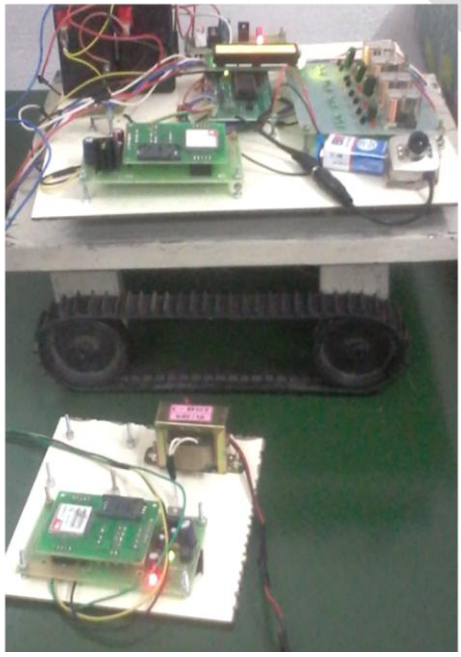


Figure 5. Hardware Design

CONCLUSION AND FUTURE WORK

In this present system we include GSM module (SIM-based) for localization, remote control and positioning of robots and temperature sensor to check the temperature where the robot is present. Relay to control the DC motor connected for movement of robot. Wireless camera is used to transmit video and audio signal to wireless receiver through a radio band DVBS2 TV tuner card to function as video capture cards, to record monitoring videos to hard disk .These are some of the components to overcome the challenge to see interior of rubble, location and condition of survivors, Now this act as a mobile beacon or repeater to extend the range of the wireless communication.

In future we are going to fix conveyer type wheel to overcome the obstacles that will come while moving the robot. By using these wheels the robot can move easily through any environment.

ACKNOWLEDGEMENTS

We thank the **Lord Almighty** for the grace and mercy showered upon us to finish our paper work successfully.

We wish to express sincere thanks to our College Chairman **Dr. S. N. Subbramanian, Ph.D.,** and our Technical Director **Dr. S. NalinVimal Kumar, M.S., Ph.D.** who has shouldered us to reach meritorious heights.

We are highly indebted to **Dr. N.Gunasekaran, M.E., Ph.D.,** SNS College of Engineering, Coimbatore for providing us the facilities to carry out this paper work.

We are greatly indebted to Project Co-ordinator **Dr. S. Poornachandra, M.Tech., Ph.D.** Dean of Electronics and Communication Engineering for the continuous evaluation and critical suggestion given to complete the paper work successfully. We are highly grateful to **Mr.V.V.Karthikeyan, M.E.,** Head of Electronics and Communication Engineering, for his valuable suggestions and timely assistance during the course of our paper work. We express a heartful and deep sense of gratitude to our project guide **Ms.B.Kalaimathi, M.E.** Assistant Professor, Department of Electronics and Communication Engineering for her valuable advice and guidance. Her positive approach had offered incessant help in all possible ways from the beginning.

By this, we express our heartfelt sense of gratitude and thanks to our beloved parents, family and friends and the experts who helped in collecting the resources and materials needed for this project and for their support during our paper work.

REFERENCES

[1] Bluetooth and ZigBee: compare and contrast, *By Joanie Wexler, Network World* | Network World US | *Published: 01:00, 16 March 2005.*

[2] "A Rescue Robot Control Architecture ensuring Safe Semi-Autonomous Operation "(2002) by' Andreas Birk and Holger Kenn' International University Bremen (IUB) School of Engineering and Science.

[3] "A Decision-Theoretic Framework to Select Effective Observation Locations in Robotic Search and Rescue Scenarios(2010)" by' Francesco Amigoni, Nicola Basilico'

[4] "Intelligent Robot-assisted Humanitarian Search and Rescue System" (2009), by 'Albert W. Y. Ko* and Henry Y. K. Lau' in Intelligent System Laboratory, The University of Hong Kong Pokfulam Road, Hong kong SAR

[5] IEEE/ASME TRANSACTIONS ON MECHATRONICS, VOL. 18, NO. 3, (JUNE 2013),"Smart Host Microcontroller for Optimal Battery Charging in a Solar-Powered Robotic Vehicle", b'y Tom´as de J. Mateo Sanguino and Justo E. Gonz´alez Ramos'

[6] "Design and control of a Miniature Quadrator(2007)", by' Samir Bouabdallah and Roland Siegwart 'of Autonomous Systems Lab, ETH Zurich, Switzerland presented the latest developments in ASL-MFR Project.

[7] International Journal of Advanced Science and Technology,Vol. 3, February, 2009, titled "Robot Assisted Emergency Search and Rescue System With a Wireless Sensor Network" by 'Albert Ko and Henry Y. K. Lau' of Intelligent Systems Laboratory, The University of Hong Kong, Pokfulam Road, Hong Kong SAR.

[8] http://en.wikipedia.org/wiki/GSM

[9] http://en.wikipedia.org/wiki/RELAY

[10] http://en.wikipedia.org/wiki/RESCUE SYSTEM

[11] http://en.wikipedia.org/wiki/DRIVER CIRCUIT