LIGHT GUIDED RESCUE ROBOT

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Abstract: — Human safety is one of the utmost priorities of today's requirements. A safe and reliable mechanism is the requirement of the time. This paper describes a system which may be effectively used to ensure the safety and security of the people in various situations like during mining operations, fire hazards and rescue operations after an earthquake. The light guided rescue robot system is built on the basis of four modules which are controlled by microcontroller. These four modules are light based movement of the robot, fire detection & extinguishing, semi-autonomous control of the robot and night vision feature of the robot. Microcontroller will be used to take the decision and to communicate with the four modules. The aim of the proposed system is to meet the safety and reduce the human requirement during the rescue operations.

Keywords:- Micro-controller, LDR, Zigbee module, UART, LCD

I. INTRODUCTION

Light Rover is a robot that can sense and follow light. A user can shine a flashlight at its front and Light Rover will respond by following the light source. Its speed is independent of the intensity of the light detected. Light Rover uses a microcontroller for processing the sensor readings and responds by controlling the motors.

The design of the proposed robot is very different. It is cheap and can be built from parts that are available almost everywhere around the world. It is an autonomous robot controlled by an AVR microcontroller. As an autonomous robot (not controlled by a person) it has been programmed to run towards the brightest spot in the room.

The Mechanics

A standard servo is modified to work as a motor. The robot has only 2 wheels which are driven by 2 independent motors. The third wheel is a Ping-Pong ball. This enables the robot to turn on the spot. Rubber wheels from toys have been used. The top of a marmalade jar with a rubber band around also makes for a very nice wheel. For an autonomous robot it is obviously important that it can operate from batteries. Since the microcontroller runs with 4.5V the motors also must work with 3-4.5 V. They must also not take too much current otherwise the batteries and the control circuit will get too big and heavy. For this design an integrated motor driver chip, called L293d has been used. The L293d motor driver chip can drive peak loads up to 0.5A. The motors should therefore need less than 0.5A under worst conditions. These mechanisms are built on the basis of several combinations of minor techniques. This requires a well combination of the hardware and software tools to operate it. The various hardware and software tools used to operate the robot has been described in the further sections of the report. This is probably the best solution after the robot has already been built.

II. OBJECTIVE

This project is aimed to design a Light Chaser robot along with rescue task. The robot will turn towards the brightest light and move forward chasing or following it. It has two motors (left & right) in order to make the turns; on top two light sensors (photodiodes) separated by a PC board in order to simulate "a nose". This nose
is particularly important because it will provide a shadow thus preventing both sensors from being illuminated when a sidelight is present (the motor on the non-illuminated sensor side will turn on thus aiming the robot towards the light). When the light is right in front of the sensors, there will be no shadow and both sensors will be equally illuminated, i.e. both motors will be running and the robot will move forward.

To understand the function of components for the robot, there are some theories about project background research and literature review that must be studied. The components such as PIC microcontroller, light dependent resistor (LDR) sensor and motor will be considered as main component in this project. Light Guided Path Tracker Robot uses a microcontroller for processing the sensor readings and responds by controlling the motors. The microcontroller that is used in this project is PIC 16F877A, this is due to its internal ADC which is important in converting the analog signal from the light dependent resistor (LDR) sensor to digital signal that can be read by the microcontroller.

**III. METHODOLOGY**

In this project, a light guided robot is developed to be used as multipurpose rescue robot. For this purpose several techniques like interfacing with PIC Microcontroller, ZigBee wireless control, fire sensing and extinguishing are used. All the instructions are given to the device in embedded C language style and they are implemented through the PIC microcontroller. The input to the Microcontroller is one(1) and the output from the microcontroller is zero(0) which are given to various devices connected to it. These devices are connected to the microcontroller through its five ports namely Port A, Port B, Port C, Port D and Port E.

The robot has only two wheels which are driven by two independent dc motors. The third wheel is a ping-pong ball. This enables the robot to turn on the spot. The top of a marmalade jar with a rubber band around also makes for a very nice wheel.

Further, two small gear-box motors from Conrad have also been used. In fact the best solution would have been to use standard Servo Motors as used for the remote control of small boats, cars or planes. Normally these Servo Motors can turn only a certain angle but after opening the gear box of the Servo, the stopper is taken out, the potentiometer and the electronic are removed. It's a perfect small but strong motor and Servos are easy to get. To build the robot mount the motors under a small hatch board (12cm x 9cm) and position them almost at the back such that most of the load will be on the two axes. The third wheel, the ping pong ball, must take only a small fraction of the weight of the robot to ensure that it can slide in an effective manner on the bearing which has been provided to the robot. The bearing for the ping pong ball is a small metal which happens to have exactly the right size. For the operation of the robot only one battery is used. Position the battery holders as shown below. The battery is quite heavy so care is taken so that most of the load is on the wheels and only a little bit on the ping pong ball. Switch can be placed to power on/off the robot somewhere on the side. The robot is provided with light sensors to find the brightest spot in the room.

The light sensors are 3 photo resistors. Cards are placed between the resistors. This card board creates shadows on the resistors when the light comes from the side. Only when the light comes exactly from the top it provides for an equal amount of light on all the three sensors. After comparing the values of the three sensors the robot can decide in which direction to go. Three photo resistors on a small experimentation board are soldered. (those boards with a lot of holes) and whole thing with a single screw on the robot is fixed.

The fire sensing and extinguishing circuits have also been added which work on the instructions coming from the microcontroller. These instructions are generated by the microcontroller based on the detection of rise in the temperatures as detected by the fire sensing circuit. After the fire has been detected by the robot, it automatically starts extinguishing operation. For this purpose a small plastic jar filled with water is placed on the robot. This set-up also consists of a thin pipe tube through which water is ejected when required.

Further, the wireless control used in this project is based on ZigBee. Earlier the project was planned to be implemented using the RF/TX controller but they are low in operating range and are very easy to get deflected. Also they are not as much economical as
ZigBee module, so due to these reasons ZigBee module is preferred over the RF/TX module.

The demonstration of the project is done on a model basis. For this purpose, the required setup is done and the robot is connected to a laptop which is located at the base station. Then, the instructions for movement of the robot are loaded in the microcontroller. As the robot starts moving, some extra light is provided to the robot on its left side to check for its light based movement. After that a matchstick is burned to see if the robot sensed the heat of matchstick and started extinguishing. On verifying these applications, the robot is made to move into a dark room with manual control from the base station. This is done to verify the working of LCD, wireless control and antennas at the transmitting and receiving end of the proposed system. The methodology of this project design can be divided into two sections; hardware and software implementations. The hardware implementation consists of the development of the Zigbee and GLCD while the software implementation focuses on the programming of the microcontroller using Proteus 7 (Embedded C).

**Hardware Implementation**

The block diagram of the project and design aspect of independent modules is considered. Block diagram is shown in figure 1(a) and 1(b). Microcontrollers are widely used in embedded systems products. Microcontroller is a programmable device. A microcontroller has a CPU in addition to a fixed amount of RAM, ROM, I/O ports and a timer; embedded all on a single chip. The fixed amount of on-chip ROM, RAM and number of I/O ports in Microcontrollers make them ideal for many applications in which cost and space are critical. Here we use PIC18F452 and PIC18F452 for transmitting and receiving sections.

**Regulated Power Supply**

Power supply is a supply of electrical power. A device or system that supplies electrical or other types of energy to an output load or group of loads is called a power supply unit or PSU. The term is most commonly applied to electrical energy supplies, less often to mechanical ones, and rarely to others. A power supply may include a power distribution system as well as primary or secondary sources of energy such as Conversion of one form of electrical power to another desired form and voltage, typically involving converting AC line voltage to a well-regulated lower-voltage DC for electronic devices. Low voltage, low power DC power supply units are commonly integrated with the devices they supply, such as computers and household electronics.

**IV. PROPOSED SYSTEM OVERVIEW:**

As with all of the robots in use at the Centre for Information Technology and Robotics (CITR), the autonomous vision based robots, these are designed as general-purpose systems and are constructed from commercially available components. While custom built robots designed around specific problems would have a higher performance, evaluating competing solutions to a given problem would be difficult and the resulting robots would be expensive and difficult to produce.

The chassis of the robot is the chassis of a 1:24 scale radio controlled car, which provides a drive motor capable of multiple speeds and a steering servo capable of multiple positions. The chassis does not have any form of odometry feedback for position or velocity information and the feedback from the steering servo is coarse, restricting the number of usable steering positions (to 21 for the purposes of this thesis).

The Microcontroller unit is an EyeBot controller produced by Thomas Braunl of the University of Western Australia [Brau1998]. The controller is based around the Motorola MC68332 32bit microcontroller and has one megabyte of RAM and 512 KB of FLASH RAM for running and storing the supplied operating system (RoBIOS) and user programs. The controller has a number of input and output connectors for: a camera, several servos, touch sensors, infrared distance measuring sensors, motors and a serial connection for exchanging data with a desktop computer.

The camera (called an EyeCam) is designed by the University of Western Australia to work with the EyeBot controller it is a 24 bit CMOS camera with a usable resolution of 80x60 pixels. The standard camera routines built into RoBIOS can run the camera at 3.8 frames per second, which is too low for the work...
at the CITR, new drivers are developed which improve the frame rate to 15 frames per second, or to 30 frames per second with a small amount of synchronisation noise on the right hand edge of each frame. While the camera is mounted on a panning servo it unnecessary to pan the camera as when the path is no longer in view a localisation module would take control.

**V. RESULTS AND DISCUSSIONS**

The Robot is made to undergo different situations using the different types of artificial situations. The behaviour of the robot is observed and seen if it has been working properly. Also the behaviour of the robot is noted along with verification of the aim and objectives. These observations have been tabulated below.

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>CONDITION</th>
<th>RESPONSE of ROBOT</th>
<th>MANUAL CONTROL</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Equal light on both sides</td>
<td>Keeps on moving in the straight path.</td>
<td>NO</td>
</tr>
<tr>
<td>02</td>
<td>More light on the left side</td>
<td>Turns left</td>
<td>NO</td>
</tr>
<tr>
<td>03</td>
<td>More light on the right side</td>
<td>Turns right</td>
<td>NO</td>
</tr>
<tr>
<td>04</td>
<td>More light on right side but the fire is detected</td>
<td>Turns left and starts extinguishing</td>
<td>YES</td>
</tr>
</tbody>
</table>

**VI. PERFORMANCE ANALYSIS**

To evaluate the accuracy of the proposed method, the robot is provided with different amount of light at different times. Also the condition is made contradictory one where the light is more at the right side of robot but there is fire on the left side of robot. In that case, the wireless control property of the proposed method came in to play. The user at the base station has to deploy commands to the robot to perform the rescue task of extinguishing. These commands are strictly followed by the robot and the fire is successfully extinguished. Further, the robot is made to move in the dark places. It is found that the user is able to control the movement of the robot even in the dark places with the help of night vision camera that was attached to the robot. This is possible because of the wireless control method as proposed in this project. The user is able to get the next view coming in the way of robot even in the dark.

The important points to be noted here are:

The main purpose is to rescue the people by extinguishing fire in a building. The various features exhibited by this robot like sensing, extinguishing are quiet useful in the scenarios where there is a need of instant and risky helps. It happens specially during the natural disasters like earthquakes, landslides. It is also very helpful in man-made disasters like mining slides. In record maintaining rooms where fire can cause loss of valuable data: Nowadays the maintenance and safety of important data is very important in day to day work whether that is an official file or personal file. There is always a risk of loss of files due to any fire hazards. Such a risk poses a great threat to the safety of the important data related to the highly important and confidential status. So this robot can be effectively put in those type of places as is it is able to detect the fire before any human senses that fire. Also it is able to extinguish the fire. This proactive safety measure will save from the losses caused due to such incidents. It can be used in Server rooms for immediate action in case of fire: The proposed system is highly useful when it comes to the protection of computers and other applications.
electronic accessories. Such an important place is the server room through which a lot of passes. The potential application of the multi-functional firefighting system has been defined as a group that includes the chemical and oil industry, nuclear plants, military storage facilities, as well as mine fields and dangerous substance transport.

VII. CONCLUSION AND FUTURE ENHANCEMENT
In this world of technological advancement and the need to protect precious human lives, the concept of light finder robot will always be ‘THE NEED OF THE HOUR’. This robotic platform for surveillance purpose can be extended to many applications where human life would be at stake. This project is aimed at looking into the coding required for a light seeking robot. The rational for this is to look into what AI programming techniques can be used to enable a robot to cope with a dynamic environment. A dynamic environment is an area that is not clear of obstacles and the robot must be able to navigate them in an appropriate manner whilst taking into account its own power considerations.

This project aims to produce a small light seeking robot to demonstrate some of the coding produced. To control the robot an embedded microcontroller chip is to be used. The base of the robot is simply two bidirectional dc motors in a plastic casing. An L293N driver chip has been selected, this chip is capable of supplying a constant 1A per channel, to two bidirectional controlled motors.

The concept of robotic has been extended to ‘Land Mine’ detection, just by incorporating a metal detector and high resolution camera along with the robot chassis developed. In case of fire accident or smoke detection, the robot can be fitted with the respective sensor units, so that the information regarding the hazardous situation can be made available for the people. The efficiency of the robotic movement has further been enhanced by using efficient intelligent control algorithms and servo motors.

Thus the automation system being developed has the inherent advantages of flexibility, safety monitored control and easily reconfigurable to other robotic applications where human finds toxic environment such as oil refinery, nuclear reactor control, coalmining fields, dimension and path tracing etc.

ACKNOWLEDGEMENT
We express our humble gratitude to Dr. C.V.Ravishankar (H.O.D ECE. Dept, Sambhram Institute of Technology) for his invaluable guidance. We are highly thankful to our guide Mrs. Debarati Bhattacharya for her guidance. They pacified our intense times with their creative and innovative ideas, reinforcing out interest in the work.

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