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Stair-Climbing Robot for Rescue Applications

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Abstract: ***If we want to save our manpower loss there is need in today's world to place equipments in dangerous areas such as cameras and sensors. Robots are best option in place of manpower to do this task because of which we are able to know the situation and dangers in that area. For that we require a mobile device which is accessed by the remote. This paper gives the information about hoe can we design and implement the robot easily. For that we are using the PIC16F877A as a brain of robot. This robot is able to climb the stairs and we can operate the device using video that are captured by the camera on the robot.***

Keywords: PIC16f877A, OrCad.

I. INTRODUCTION

To take place of humans the use of robots get increased day by day into working. The working such as office, military tasks, hospital operations, industrial automation, dangerous environments and agriculture [1]. The robots are available in different design and dimensions for various robotic applications. For aiding rescue employees the robot is designed. The situations that include urban disasters, explosions and hostage situations. The advantages of employing robot to these situations is that reduced personnel requirements, reduced manpower loss at unreachable areas [2]. It is such that to into destroyed areas to find and help to rescue people. The main part of the robot is microcontroller use to control all the actions of the robot. Speed is controlled by PWM. Arm controlled by the servo motor. Stepper motor is use to control the camera actions

II. MAIN BLOCKS OF ROBOT

The heart of the system is microcontroller PIC16f877A.ew can control whole system by controlling this controller. This figure shows the main structure including power sources, controlling elements, wireless unit and various motors use to move robot. All these elements are connected to the controller. The movement of system is controlled by the serial joystick. The hardware such as wheels and gears are connected to the motors for the movement of the robot. Wireless module is also main part as a rescue robot we need to control whole robot from the safe distance, hence need wireless robot. By programming the PIC16f877A we can make our robot working properly. The battery is also useful to provide power to the robot.

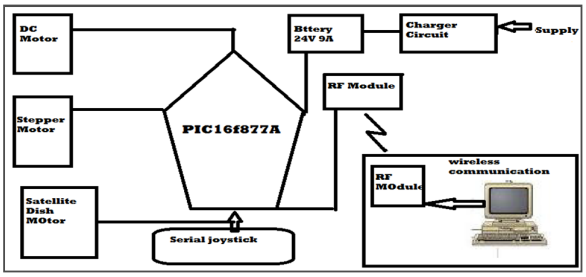

Fig.1 Block diagram

III. HARDWARE ROBOT DESIGN

The design of robot is such that it is capable of finding human existence and helping to rescue them, and also capable of going into areas like collapsed buildings, or any unstable areas. The below information gives the description of the designs and dimensions of the robot. The hardware of the robot is divided into two parts: Mechanical designs.

A. Mechanical Design

The below figure shows the mechanical design of the system. The figure shows the dimensions (60x40x13) which includes length, width and height of the robot respectively. As shown in Fig.2

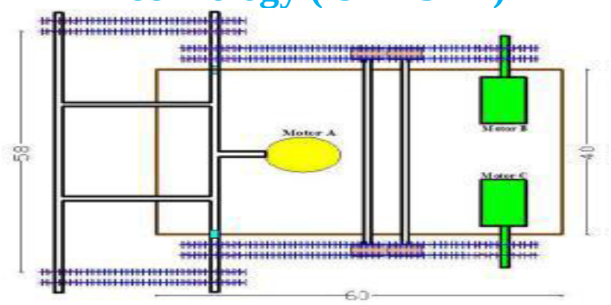

Fig.2 Top view of robot

1) *Gears and its Dimensions :* This robot requires twelve large gears 17cm which are used to move the robot forward and backward. Another four gears are used for joining the four small gears of 8cm each. These legs are used for climbing the stairs fluently. Here we are using bicycle chain for joining all the gears to each other as shown in Fig.3

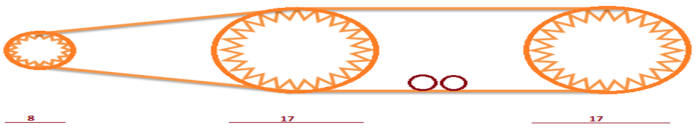

Fig.3 Gears dimensions

2) *Robot Movement Mechanism:* The motors are directly connected to the back gears which provide all powers to the robot the front wheels are connected or drive through the series chain. As shown in figure 2. Servo motors are used for movement of legs which are used for climbing the stairs

Advantages of Rear Wheel:

a) Maintenance is cheap and easy.
b) Fixed in long lines and roads.
c) It's Strong and less carrying havoc.
d) More comfortable and stable

IV. SOFTWARE ROBOT DESIGN:

The movements of the robot are controlled by the software programming. The heart of the robot is get programmed by using different process:

A. Mikro C program

For programming the PIC controller it is the most power tool, it provides easiest way for development of programs for PIC controller [3].

B. Proteus Program

Provides detailed instructions on how to create new simulator models, using both schematic and programmatic (DLL) based techniques. It is an interactive system level simulator. It combines mixed mode circuit simulation, micro-processor models and interactive component models to allow the simulation of complete micro-controller based designs. OrCAD PCB Program: used for PCB design. An interactive environment for creating and editing simple to complex multi-layer PCBs, it uses powerful shape-based algorithms for speed and efficient use of the routing area. OrCAD facilitates rapid design-and-simulate cycles, allowing engineers to explore various design configurations before committing to a specific circuit implementation [4].

V. PIC16f877A

PIC16f877A is used as the brain of the robot that can be programmed by connecting the serial port of the computer to the PIC

microcontroller. The serial port operates at +/- 13V, and the PIC serial operates at +5V/0V. MAX232 is used as a level shifter to connect the serial port of the computer to pins RX/TX on PIC as shown in Fig.5 [6].

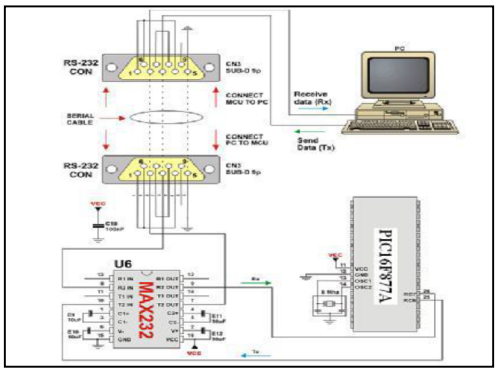

Fig.5 PIC interface

VI. COMPONENTS

A. *L298N Dual Full-Bridge Motor Driver*

For driving the motor we need to connect them by using the H-bridge IC L298N Dual Full-Bridge Motor Driver which supports dual channel and provides up to 2A current to each channel. Below are some of its specifications available**.** As shown in Fig.6

B. *L298N Features and Specifications*

1) Operation to 46 V
2) Up to 2 A per channel
3) Outputs can be paralleled to drive up to 3 A
4) Independent ground connections for each channel allow independent current sensing.
5) Multiwatt15 through-hole package allows convenient heat sink mounting and easy prototyping with 0.1" breadboards.
6) L298N can control 2 DC Motors, their direction using control lines and there Speed using PWM.
7) The outputs of the two motors are connected in parallel to drive only one motor

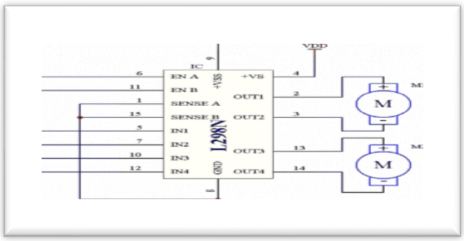

Fig.6 L298 Dual bridge driver

C. *Stepper motor control*

A stepper Motor is an electromechanical device which converts electrical pulses into discrete mechanical movement. The main advantage of stepper motor is that it can achieve accurate position without getting any feedback signal [7].

D. *Uln2003 - Seven Darlington Arrays*

ULN2003 is High Voltage / High Current Darlington Transistor Arrays; it's monolithic high voltage and high current Darlington transistor arrays. Seven NPN Darlington pairs in it that feature high-voltage outputs (50V) with common cathode clamp diode for switching inductive loads. Single Darlington pair has collector current rating of 500mA. The Darlington pairs may be paralleled for higher current capability. Applications include relay drivers, hammer drivers, lamp drivers, display drivers (LED gas discharge), line drivers, and logic buffers Its inputs pinned opposite outputs to simplify layout. This is more adequate to control a four phase unipolar stepper motor [5].

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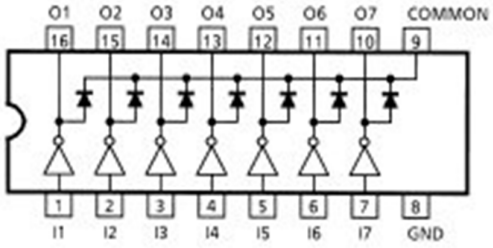

Fig.7 ULN2003

VII. WORKING PROCEDURE:

There is stepwise working procedure for the movement of the robot.4 steps are there for taking the movement of the robot.

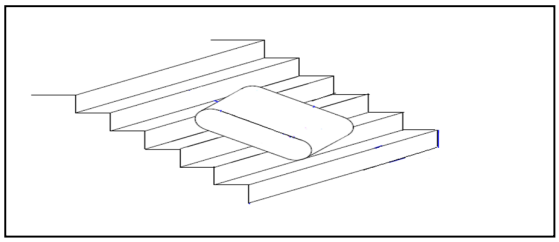

Fig.8 Stair climbing

A. Lifting the front Part

Initially robot is horizontally placed. When there is stair available in front of the bot it will lift its both arms upward then place those arms on the stair. Then rotate its wheels forward.

B. Lifting the middle part of the bot while moving forward

After moving the front part of the robot it will lift its middle or back part by just controlling the movement of servo motor by the programming.

C. Lifting the back part of the bot

After moving the back part it will start moving wheels forward for making it to move forward. After getting sufficient space on next stair it will then find for that another stair is there or not. If there is another step available then it will repeat the above procedure.

VIII. WIRELESS COMMUNICATION

Electromagnetic spectrum is mainly involved in the wireless communication, having many unique qualities. Works on the property of radio waves which propagates according to spectrum's wavelength. It is very easy to use RF module here because of its cost effectiveness and the convenient wireless capabilities and easy interface to the device, having two ICs Tx and Rx

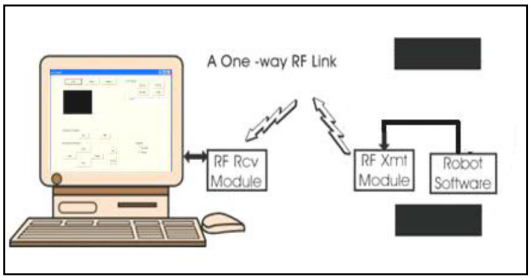

Fig.9 Wireless communication between the PC and Robot

A. Connection of RF module in Robot

In Stair-Climbing Robot TX is located near the computer connected to it by a cable from the computer to max circuit where the TX locate, RX is located on the surface of the Stair-Climbing robot as shown in Figure, in order to control the movement of the robot from the wave transmit from the computer throw TX to the robot throw RX.

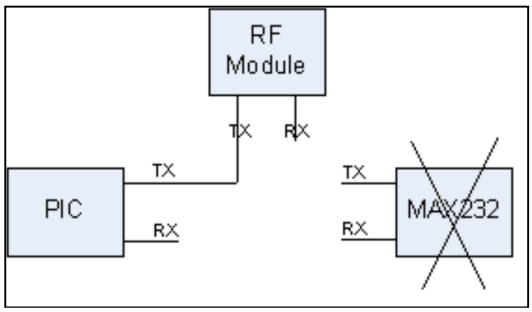

Fig.10 Wireless connection

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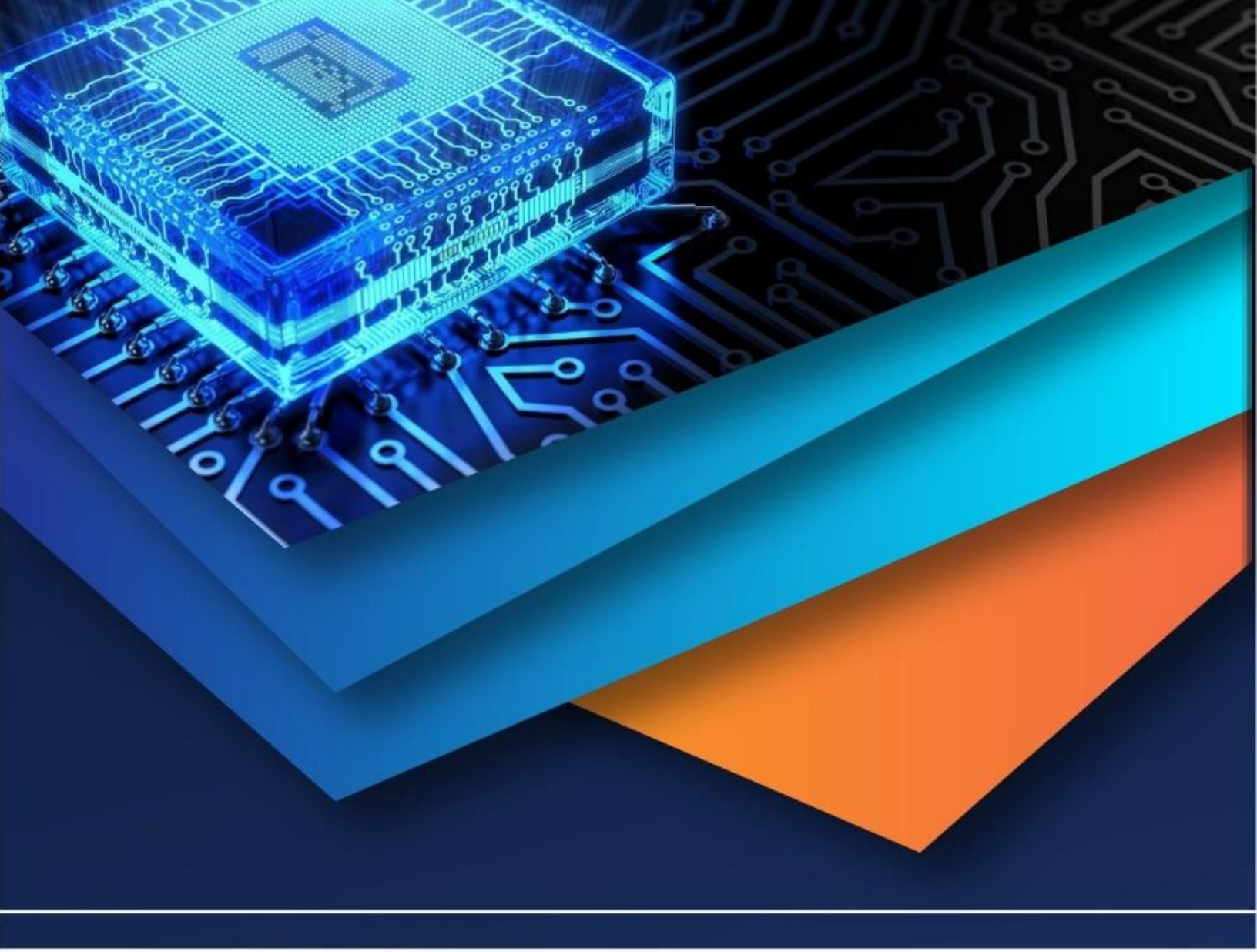

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