

Multi Domain Stair Climber Robot

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Abstract—There are many places in this world where the human being cannot get access, either due to the enormous danger and life-risks, or simply because of the natural inaccessibility of those places. Therefore, it is incredibly essential to lay down sensors and/or cameras in such places, before a human being goes there, in order to monitor the place. Some robots are specifically designed for this particular task, however, the requirements of these robots are very specific and stringent at the same time. In this Paper we are going to design and implement a multi-domain robot which can not only travel comfortably on rough terrains, but can also climb up stairs of the standard height. The mechanism enables the robot to move over the obstacles without any imbalance, by using a DC Motor on each wheel. The motors are driven by the Atmel Microcontroller. Additionally, Zigbee module is used for transmission of commands from the transmitter to the receiver.

Keywords: Inaccessibility, Incredibly, DC Motor

I. INTRODUCTION

The ability to climb stairs may be a crucial demand for search and rescue robots as several of the terrestrial mission eventualities occur in urban settings with stairs. During this paper, we have a tendency to gift the idea style of a step climber multi-domain golem, which will tackle overhangs on stairs and additionally equip it with sturdy style parameters to form its performance resistant to varied step dimensions. Though three-legged mechanisms have shown tremendous advantage in traversing uneven parcel and rising over obstacles, these robots have complicated styles [1], want complicated management methods and square measure sluggish. A wheeled mechanism may be a higher possibility because of its style simplicity,

lower power consumption and fast quality. This justifies our alternative of a wheeled robot. Robots are taking the place of humans and at the same time, are more and more being accumulated into performing the tasks to replace human beings. They're currently employed in a wide range of applications as well as workplace tasks for the military [2], operations in the hospital, industrial automation, security surveillance systems, harmful atmosphere and agriculture. Many designs of autonomous mobile robots with completely different dimensions with little alterations are designed for diversified robotic applications. This stair-climber robot is mainly used to help and assist rescue teams during natural calamities and disasters. Other common applications of robots include explosions, disasters in cities etc. This reduces the requirement of man-power and military personnel for rescue operations, and also prevents fatigue, due to minimal effort put in by humans. One of the main intentions of the golem is to try and pick out people in trouble in places where there is minimum accessibility. The golem can easily climb stairs, which in turn makes it simpler for the robot to navigate through relatively tall rocks and rubbles. It can also move up a slope, travel underground and glide through tall glaciers. This robot is comfortable in putting up with stairs, incredibly rough fields of terrain, and can move quickly on flat surfaces.

We connect the robot wirelessly to a circuit containing a transmitter and a receiver, through an RF module which guarantees a two-way communication which is quick and reliable [3]. The designated body of the robot was ready automatically and the elements were chosen to be appropriate for the given job. The brain of the robot is the Atmel AT89S52 Microcontroller. The movement of the robot is controlled by driving the motors through the motor drivers, and the robot direction can also be controlled. A PWM is generated

by the AT89S52, using which we can control the velocity of the robot.

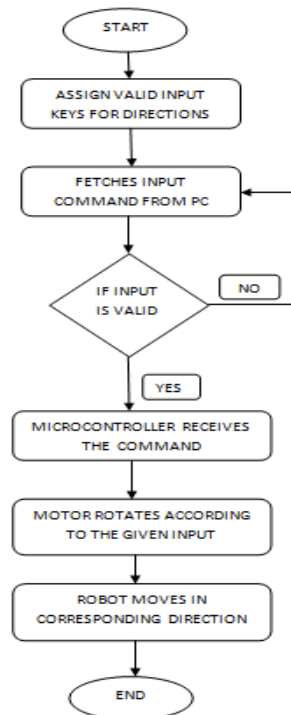


Fig 1.0 Working Flowchart

The Fig 1.0 represents the working flowchart. The stair climber robot is controlled by creating a robot-PC interface, by connecting a Zigbee module on the Transmitter and Receiver side. The Transmitter Zigbee module will receive the input commands from the PC and transmit it to the Receiver Zigbee Module. Additionally, the robot can also be controlled by using RF module to control the robot wireless, for which the frequency would be 433.92 MHz.

II.EXISTING SYSTEM

There is an already existing design of a stair climber robot which used RF interface with push buttons as a control keys for controlling the robot. It additionally requires a powerful 16 volts battery cell made up of cadmium which needs to be preserved carefully. In order to avoid this problem, the only thing that can be done is

to connect the transmitter and receiver through a wire, which makes it unportable.[3]

III.HARDWARE MECHANISM

Our Robot is basically 13cm tall, 60cm long and 40cm wide. The layout of the robot is shown in fig 5.1.

A.Wheel Mechanism:

The wheels of the robot are designed in such a way that there is a flexible joint connecting the front four wheels together, which makes it incredibly simple for the body to navigate up through a step[4]. The rear wheels are given with two motors on each side, which help them to hop-up whenever there is an obstacle or a staircase, and front wheels pull the rear wheels up the stairs. The power of the motors enables the robot wheels to comfortably glide through the stairs, provided the motors are provided with enough power from the batteries. Advantages of Wheels:

1. Simple to maintain and is affordable.
2. Have the ability to carry heavy weights and are placed in distant lines and paths.
3. Made with material which is easily available in the world
4. Front wheels do not take in a lot pressure compared to rear wheels, stable force and acceleration, that ends up in higher management of automation.
5. The wheels on the front are mainly used for direction, while the rear wheels are used for pushing.

B.Power Source:

There are two ways to supply sufficient power to the Robot. 1. AC Power 2. DC Power

1.AC Power:

The normal 240V Power Supply that we use for household can be given to a step-down transformer which will convert 240V into 12V alternating current which will be connected to the robot.

2.DC Power:

The robot can also be fed with the normal 9V batteries by coupling two cells together. The main

advantage with this method is that it can open a window for portability. Batteries can be easily replaced or charged when necessary.

IV. Transmitter Mechanism:

The fig 2.2 represents the transmitter Block Diagram of stair climber robot and the mechanism as given below.

1. This project is a PC-controlled Stair-climber robot, in which the commands from the PC are transmitted through a Zigbee module. This enables us to control the robot with wireless features.
2. The entire device is controlled using a single microcontroller, which is interfaced with a Zigbee module, for receiving the commands and connected to a motor driver to drive the motors.
3. The input is given from the PC, on which the keys assigned to the robot are selected, the input is then sent to the zigbee module which is used to transmit the input commands to the robot.

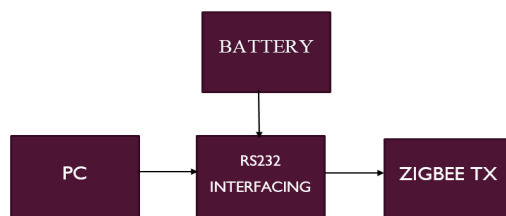


Fig 2.2 Transmitter Block Diagram

4. The input taken and sent over by the transmitter zigbee is received by the receiver zigbee module, which then sends it to the Microcontroller, for switching ON the motor drivers.
5. When the input is given to the microcontroller, it will start the motors and also gives the corresponding direction in which the robot has to move according to the input given.

V. Receiver Mechanism:

The fig 2.3 represents the Receiver Block Diagram of stair climber robot and the mechanism as given below.

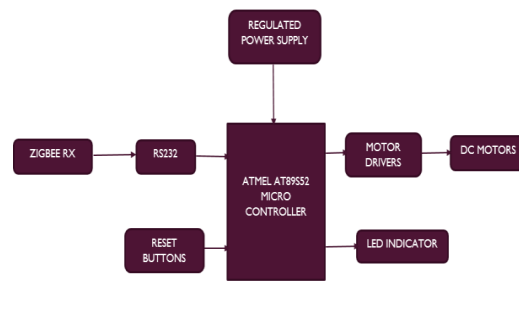


Fig. 2.3 Receiver Block Diagram

The Receiver mechanism is similar to the that of the transmitter side which minimal differences:

1. On the receiver side, the receiver zigbee module comes to the fore.
2. The input keys which are given on the personal computer or laptop, are taken in by the module and transmitted over to the microcontroller. Simultaneously, the LED's also start to blink and fluctuate.
3. As there is a program code written in Embedded C language, and incorporated into the microcontroller, it automatically gives the corresponding tasks to the DC Motors by starting the motor drivers. This enables the robot to move in the direction which is given to it.
4. If the system works perfectly, then we can assign any key for any direction. For example, when 'A' is pressed, the robot moves in forward direction. Similarly, when 'B' is pressed, the robot moves in backward direction. 'C' and 'D' keys on the keyboard are assigned for Left and Right directions respectively.
5. The AT89C52 Microcontroller is coded by using Embedded C Language in Keil U-Vision Software.

VI. SOFTWARE MECHANISM

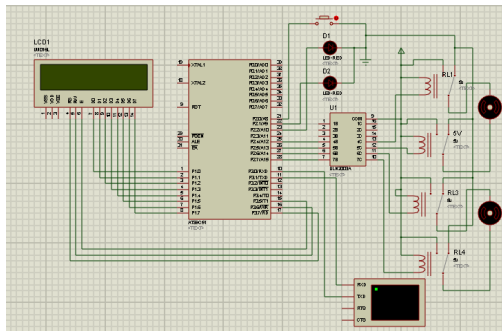


Fig. 3.1 Simulation Circuit in Proteus

The fig 3.1 represents the Simulation Circuit of stair climber robot in Proteus Software.

The required software to write the code and integrate it on to the robot, as well as to design the layout for simulation respectively are Keil U-Vision and Proteus[7]. The Microcontroller AT89S52 is connected to a 16x2 LCD display which is used to display the commands given on the PC.

A. LCD:

1. The 16x2 LCD is interfaced with the AT89S52 Microcontroller through the following ports:
2. Pin 4(register select) is connected to Pin 15 of AT89S52.
3. Pin 5(read and write) is connected to Pin 16 of AT89S52.
4. Pin 6(Enable) is connected to Pin 17 of AT89S52.
5. The data pins of LCD D0-D7 are connected to ports P1.0 – P1.7 respectively.

B. DC Motors:

The working conditions of DC Motors has shown in table 1.0

A stair-climber robot requires high-speed motors which use less power and give more output i.e. the torsion of the motors should be very high at reduced voltage and current. For this reason, special type of motors need to be incorporated into the robot.

INPUT KEY	DIRECTION OF DC MOTOR 1	DIRECTION OF DC MOTOR 1	RELAY CONDITIONS
A(FORWARD)	Anti - Clockwise	Anti - Clockwise	1,3 ON
B(REVERSE)	Clockwise	Clockwise	2,4 ON
C(RIGHT)	Anti-Clockwise	NILL	1,2 ON
D(LEFT)	NILL	Anti-Clockwise	3,4 ON

Table 1.0 Working Conditions of DC Motor

There are two types of such motors which are to be used: 1. Wiper Motors 2. Brushless DC Motors. The Brushless DC Motors are used to derive high speed at low input voltage, while the gears of Wiper Motors are used to derive high torsion.

VII. RESULT AND CONCLUSION



Fig. 5.1 Final Ouput

The final output has shown in fig 5.1. There are many existing robot which show similar application to the one which has been designed in this paper. However the ability of this stair climber robot to easily navigate through stairs, rough and uneven terrains gives much greater mobility and hence higher speeds, especially during rescue operations where there is a need of evacuation and urgency. Atmel AT89S52 micro controller has been used to as a controlling unit of the robot, while two types of motors(wiper motor and brushless DC motors) have been used to control the directions of the robot. Initially, we had checked the working of the robot using push buttons, one for each directions, connected serially to the microcontroller with wires. After successful implementation of the wired robot, the project was tested using Zigbee module for wireless transmission.

VIII. FUTURE SCOPE

The Stair-climber robot was successfully implemented with wireless interfacing using Atmel AT89S52, and Zigbee module for transmission/reception. Additional features of this robot in future may include moving over the obstacles by dodging them completely without making contact with the surface. This can be implemented by integrating a small piston which will push the robot chassis up, while the wheels remain on the ground[8].

Although this is just a theoretical concept, by successful execution, it can create a revolution in the series of Rescue Robots.

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