Disaster Rescue Robot

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Abstract: **The main aim of this project is to help the victims during disasters and escape from that situation. For that we are using 4 x 4 high powered wheeled robot with an arm. The devised project is a disaster management pick & place robot and also used during natural disasters using its pick & place mechanical options. It has an arm with a shoulder and also the wrist and elbow movement. The complete arm is mounted over a moving vehicle with 4 wheels. The whole mechanism has 8 motors for each of its function. The mechanism is controlled using wireless communication. The Robot utilizes a microcontroller on the transmitter section with the remote control and also at the receiver section. The microcontroller exists from the family of INTEL 8051 known as 89c51.The receiver section has 8 motors controlled by the microcontroller by receiving the control instruction from the remote control. The microcontroller is communicated in assembly language. [3]**

Keywords: **INTEL 8051, disaster management pick & place robot.**

1.   INTRODUCTION

Earthquakes, landslides, cyclones, floods are some of the natural disasters that time and again make us realize that there is no power bigger than that of the Nature around us. With the evolution of science and technology at an uncontrolled pace, and the creation of sky scraper buildings and dwellings and encroachments everywhere, the risks of losing life due to such calamities has all the more increased and added to the complete disorder and confusion in people. Moreover, with the improvement in nuclear technology, the risks of manmade calamities like nuclear explosions and nuclear radiation leaks have also reached an all-time high. Many people get killed instantly due to these natural and manmade disasters when they hit a region. Many others get trapped under debris for hours and days because their presence there cannot be detected by the rescue teams easily. Hence, they die a painful death as help could not reach them on time. For many years dogs have been used for the rescue purposes. But the rescue dogs need to be trained to a great extent before they can be used for these purposes. Moreover, a fully trained dog costs anything between Rs.2000 to Rs.3000 and can be used for not more than 5 years.[1]

The disaster rescue robot is mainly built for helping the injured people in the areas where it is not possible for humans to reach. A robot is a mechanical or virtual intelligent agent that can perform tasks automatically and with guidance, typically by remote control. A robot is usually an electro-mechanical machine that is guided by computer and electronic programming. Robots can be autonomous, semi-autonomous or remotely controlled. Robots are also used in an increasingly wide variety of tasks such as vacuuming floors, mowing lawns, cleaning drains, building cars, in warfare and in tasks that are very expensive or very dangerous to be performed by humans such as exploring outer space or at the bottom of these. Arms are typically defined by fourteen different parameters. Normally two axes are needed to reach any point in a plane. Three are required to reach a point in space. Roll, pitch, and yaw control are required for full control of the end manipulator. Number of points a robot can be directionally controlled around. A human arm has seven degrees; articulated arms typically.[2]

In the control system we have to divide in two different parts like:
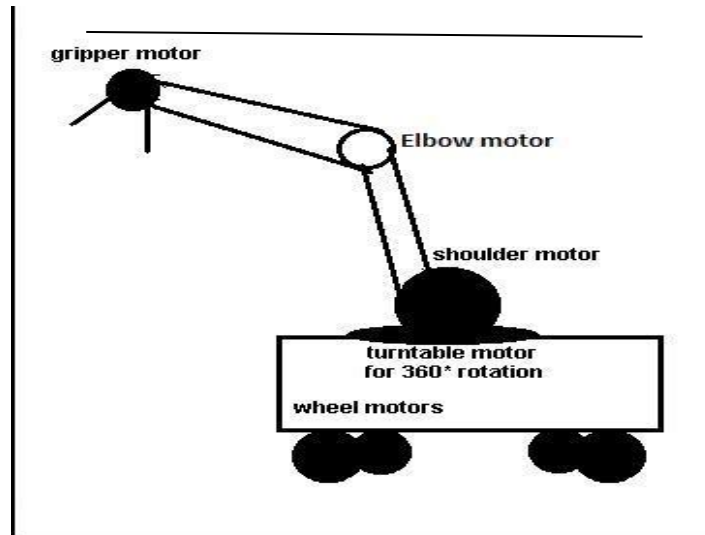
1-Mechanism

2-Remote controlling

Fig. 1 Overview of Disaster Rescue Robot

2.   LITERATURE SURVEY

We choose to make a disaster management rescue robot because it has various advantages. Such robots are mainly designed for working in high terrain hilly regions where it is difficult for humans to reach and to perform various activities. Recently there occurred many natural calamities which proved that it is not possible for humans to execute each and every task of rescuing people. [2]

For example In September 2011, Japan was hit by a tsunami due to which their Fukushima nuclear plant was damaged and harmful radioactive elements were leaked from the plants. During that time it was impossible for humans to enter in those areas for collecting the various samples required for research. Thus in such circumstances it is possible to send UGVS for collecting ground samples Wirelessly and with great ease. [1]

Other example In April 2015, Nepal was hit by a major earthquake which had destroyed vast area at various regions. During this calamity many people were struck beneath the surface of debris. Due to which it was not possible for humans to carry out rescue operation at small confined areas. At such instances it possible to carry out relief operations by UGVS of carrying food, medicines and other needed material at such small confined areas.[3]

3.   DESIGN SPECIFICATION

Table no 1. Design Specification[1]

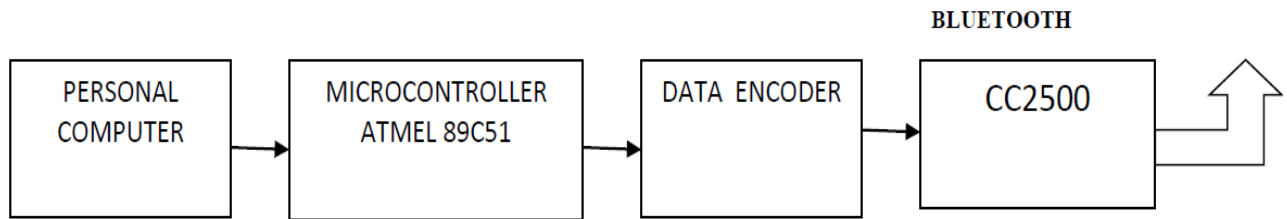| SR No.	PART NAME	DIMENSIONS		
		AREA	THICKNESS	DIAMETER
1.	Aluminum Sheet	130× 200 mm	1 mm	–
2.	Hollow square channel	15× 15 mm	0.5 mm	–
3.	Wheel	–	–	70 mm
4.	Round plywood sheet for Turntable	–	–	120 mm

4.   DISCUSSION

Fig 2. Transmitter Block Diagram[2]

The fig. 2 shows the circuit diagram of the transmitter section. The transmitter section is also known as REMOTE CONTROLLER. This section has many parts and main parts are microcontroller 89c51, encoder and data transmitter. [6] The transmitter transmits the data at the frequency rate of 2.4GHz via Bluetooth. The communication between transmitter and receiver is wireless communication. The type of modulation type used for wireless communication is called amplitude shift keying (ASK) mode.

The receiver section of the robot is attached with the mechanism. This receiver section drives the 8 motors to perform the action. It has many parts such as microcontroller, CC2500, decoder, current amplifier, relays and motors. There are two relays used for each Motor. One for forward motion and second for reverse motion. The negative pin of relay coil is directly connected to GND terminal of IC 7805 and positive pin of the coil is connected to the relay driver IC. [2]
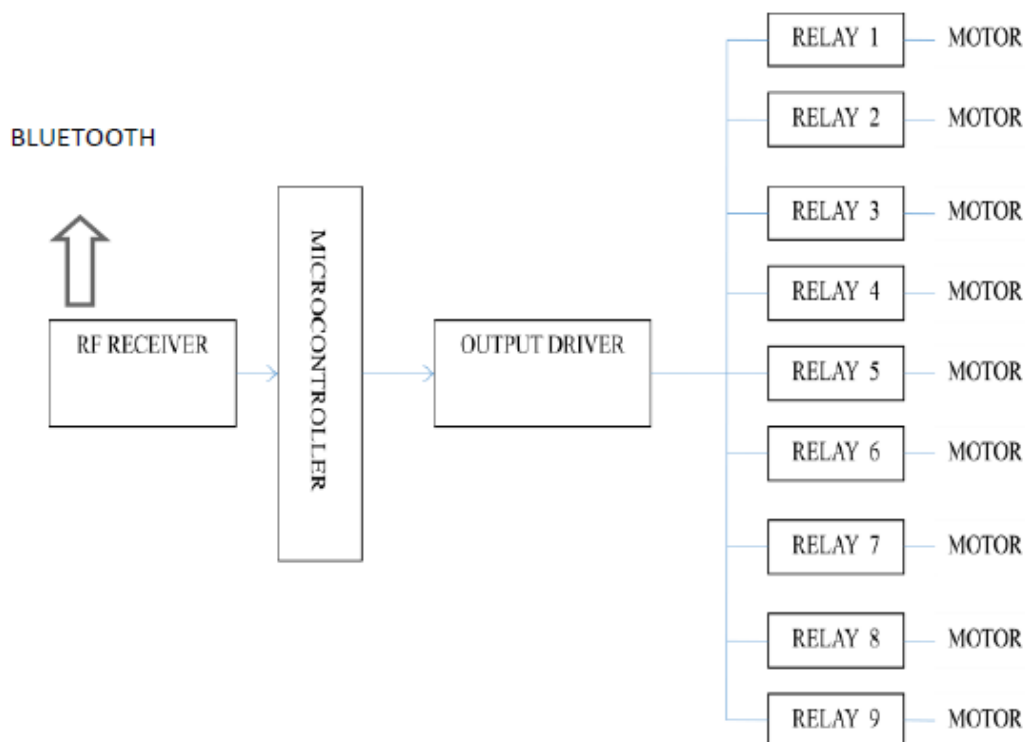

Fig 3. Receiver Block Diagram[2]

A. CC2500-(Transceiver):

The CC2500 is a low-cost 2.4 GHz transceiver designed for very low-power wireless applications. [3] The circuit is intended for the 2400-2483.5 MHz ISM (Industrial, Scientific and Medical) and SRD (Short Range Device) frequency band.CC2500 provides extensive hardware support for packet handling, data buffering, burst transmissions, clear channel assessment, link quality indication and wake-on-radio. The CC2500 will be used together with a microcontroller and a few additional passive components.
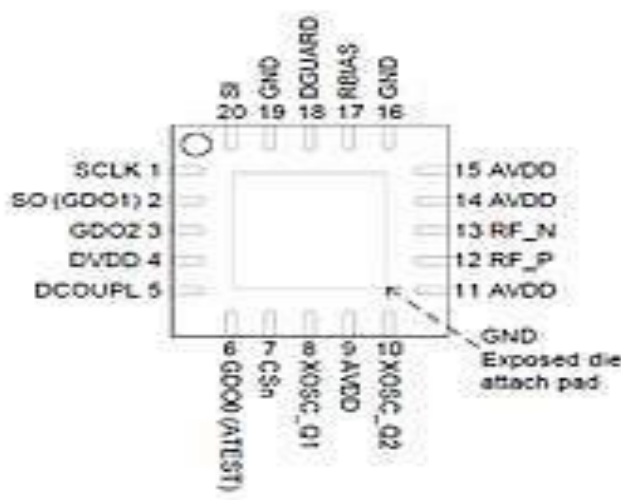
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Fig 4. CC2500

B. ISM Band:

The industrial, scientific and medical (ISM) radio bands are radio bands (portions of the radio spectrum) reserved internationally for the use of radio frequency (RF) energy for industrial, scientific and medical purposes other than telecommunications.[1]

Examples of applications in these bands include radio-frequency process heating, microwave ovens, and medical diathermy machines. The powerful emissions of these devices can create electromagnetic interference and disrupt radio communication using the same frequency, so these devices were limited to certain bands of frequencies. In general, communications equipment operating in these bands must tolerate any interference generated by ISM applications, and users have no regulatory protection from ISM device operation. [5] The ISM bands are defined by the ITU Radio Regulations (article 5) in footnotes 5.138, 5.150, and 5.280 of the Radio Regulations. Individual countries' use of the bands designated in these sections may differ due to variations in national radio regulations. Because communication devices using the ISM bands must tolerate any interference from ISM equipment, unlicensed operations are typically permitted to use these bands, since unlicensed operation typically needs to be tolerant of interference from other devices anyway. The ISM bands share allocations with unlicensed and licensed operations; however, due to the high likelihood of harmful interference, licensed use of the bands is typically low. [7] In the United States, uses of the ISM bands are governed by Part 18 of the Federal Communications Commission (FCC) rules, while Part 15 contains the rules for unlicensed communication devices, even those that share ISM frequencies. In Europe, the ETSI is responsible for governing ISM bands.

Table no 2 ISM Band Frequency Range

Frequency range		Availability	Licensed users
6765 kHz	6 795 kHz	Subject to local acceptance	FIXED SERVICE & Mobile service
2400 MHz	2 500 MHz	Worldwide	FIXED, MOBILE, RADIOLOCATION, Amateur & Amateur-satellite service
24 GHz	24.25 GHz	Worldwide	AMATEUR, AMATEUR-SATELLITE RADIOLOCATION & Earth exploration-satellite service (active)

5.   FUTURE WORK

Further development can be done to increase the system efficiency by increasing the tensile strength of robot arm. Instead of using CC2500 Transceiver for data transmission we can use RF module. Also we can implement this project using Raspberry-Pi. [3]

6.   CONCLUSION

Disaster Rescue Robot can be used as pick & place robot applications comprise both primary handling and case packing. Common situations that employ rescue robots are mining accidents, urban disaster, hostage situation, and explosion. It speeds up the process of picking parts up and placing them in new locations, while also increasing production rates. More accurate and do not fatigue while doing back-breaking. These systems are also versatile and can be reprogrammed and tooled to provide multiple applications for consumers. An increase in output with a pick and place robot system offer long-term savings to companies. The developed application has communication capabilities to provide system feedback which allow for robust communication in different environment.

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