Remote Controlled Rescue Robot Using Zigbee Technology

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Abstract

Human uses robot for various domestic and commercial purpose. There are small robots which are able to fly above damaged areas or crawl into collapsed buildings and under water. Bhutan due to its geo-physical location, is one of the seismically active zones experiencing deadly earthquakes followed by other natural disasters. After natural disasters, these often leave widespread damage and those injured can often be very hard to reach for rescue teams. Robot plays a vital role as life-saving aid where human and the rescue teams cannot access. In this project, it describes about the construction of the remote-controlled arm crawler robot which consists of transmitter (wireless remote) and receiver (Arm crawler with mounted camera) station. With the help of XCTU software, communication between two XBee devices are configured and used for longer distance. The movement of the robot is controlled by the remote wirelessly and the video can be displayed on android as well as the monitor.

Key Words :*Rescue Robot, XBee, Remote Control, Continuous Servo Motor, Monitor*

✓ INTRODUCTION

Bhutan is a small land-locked country and has handful of population with geographical disadvantage that results in many disasters such as earthquake, GLOF and landslides causing fire. In these situation, there arises many problems, one being the search for the injured people and rescuing the victims of the disaster. Although firefighters and rescue teams are involved for the life-aid, it consumes more time. A robotis a reprogrammable, multifunctional manipulator designed to move materials, parts, tools or specialized devices through variable programmed motions for the performance of a variety of tasks (Ukey,2016). The project proposes a small and movable rescue robot for search operation that fits anywhere that the human cannot. It has transmitter and receiver station as shown in Figure 1 and Figure 2. With this device, sending and collecting information using the wireless camera in the disaster-prone area can save many human lives and even their important property. The robot uses easy operating software such as Arduino, Proteus Professional 8 and XCTU for Zigbee configuration. The components used here are not expensive and can be controlled remotely to help searching operations.

Robots with cameras, microphones and sensors searched for victims stranded in flooded homes and on rooftops. They assessed damage and sent back images from places rescuers couldn't get. It was August 31, 2005, two days after Hurricane Katrina hit the Gulf Coast. These robots were a crucial connection between emergency responders and survivors. In the case of disaster relief and recovery, this means more effective ways to save lives and begin the arduous process of rebuilding after catastrophe (Chris, 2015). In this way, the rescue robot reduces the time taken to search these victims and renders help to medicate injured people.

Detection by rescue workers takes more time to search due to large area. This rescue robot helps to provide information for the rescue teams to enter the disaster-prone area and save people. The system consists of a Remote Control which sends the command to turn forward, backward, left and right. The signals are transmitted and received by XBee mounted on the robot. Motor drive ICs operates the motors by providing required signal outputs to drive the vehicle movement motors. Also, when the input is given to the continuous servo motor, it rotates in clockwise and anti-clockwise directions to capture the video which is displayed on the monitor.

The structure of the paper consists of Section II which discusses on the literature review of the present rescue robot, Section III on Circuit Diagram and Section

IV describes the prototype of the project.

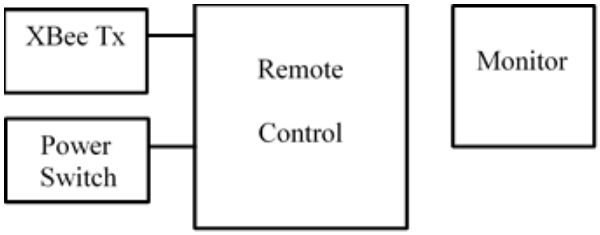

Fig.1 Transmitter station.

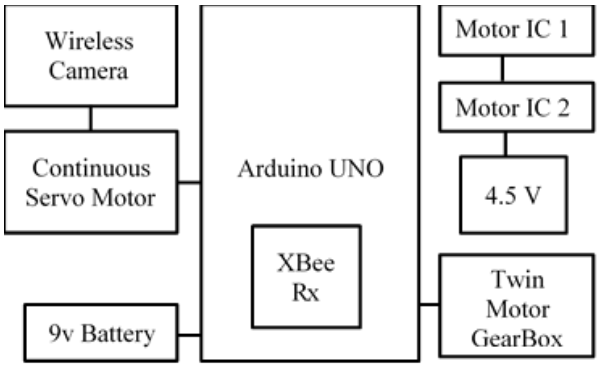

Fig.2 Receiver station.

✓ LITERATURE REVIEW

In the Design and Construction of Rescue Robot and pipeline inspection using ZigBee, B. Bharathi. Suchitha Samuel (2013) designs a robot which is operates using wireless Zigbee technology and using wireless camera where both audio and video displayed on the PC. This robot is used to monitor the changes of different parameters in the industrial pipes. The controlling device is a Microcontroller when pressed on keyboard, the robot moves accordingly with the help of servo motor. When the LDR sensor detects the darkness and gets turned ON. The live images from the camera in the robot see stem can be sent to monitor through AV transom bitter system. The Microcontrollers used in the project are programmed using C- programming. It also consists of ZigBee technology where its specification given is the operating range in 2.4GHz ISM band, with 20-250kbits/data. And typical distance of about 100m.

Remote Control Rescue Robotic Boat for Search Operationby Mohsin Iqbal (2016) proposes remote control rescue robot, a manual mode which controls the direction of the boat through visual basic. The manual mode is implemented using visual basic based serial communication application. Camera will be used for the live visual transmission. The problems faced in this project was in metal sensors. It detected metal as well as gave the signal when water and hand came in contact. Thus, to remove this problem, they designed other sensors which was made on ruler and two magnets were attached to with two wires. The direction of the boat was controlled by the H-Bridge which consist of SPDT relay and transistor. The base of the transistor is attached to the Arduino which will give the signals to turn on and off the motors. When the signal on the base of transistor is high the relay will switch and the motor will start rotation clockwise or anticlockwise.

Conference Paper on Arduino Controlled War Field Spy Robot by Patoliya, Mehta, &Pate (2015) has done a project on Arduino controlled spy robot using night vision wireless camera and android application. The main technology used here for serial communication with the robot was the Bluetooth technology. The Bluetooth module HC-05 is connected with the robot and the commands to the robot will be given through the android application. The war field robot consists of Arduino Uno board as a controller board. It has L293D motor driver IC's along with a HC05 Bluetooth module. Two DC motors are also used for the motion of the robot. The night vision wireless camera is attached with the robot in order to monitor the situation and the camera can be rotated 360 degrees through the android application using motor.

✓ CIRCUIT DIAGRAM

Figure 3 shows the circuit diagram of remote controlled arm crawler. The XBee which is configured as a coordinator receives the command from the Router XBee as a digital signal. The Arduino which is connected to the XBee reads the digital signal and passes to the motor driver IC. Input signals to two motor drive ICs are changed by the digital value, then the arm crawler is controlled forward, backward, right or left.

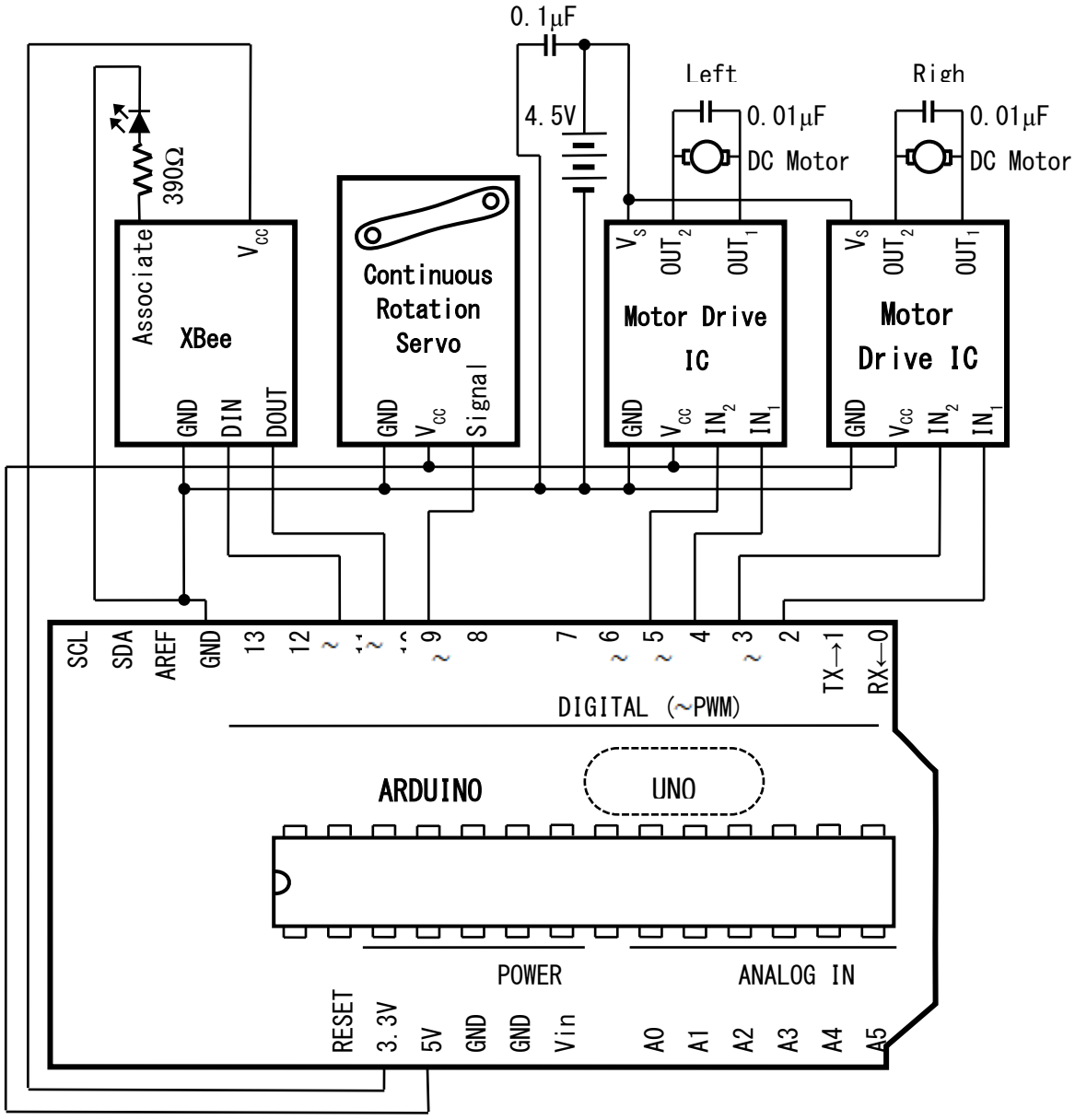

Fig.3 Remote controlled arm crawler.

Figure 4 shows the XBee (Router) transmitter or remote circuit. The arm crawler goes forward, backward, turns right, left, or the W-Fi camera turns right, left, by turning two toggle switches ON. The arms are fully rotating and move to match any undulations or obstacles which the model encounters, using the tracks to grip and pull the model over. It is capable of scaling height differences of 45mm.

The XBee transmitter circuit is composed of the internal pull-up resistors of XBee and toggle switches. When the toggle switch is off, a digital input pin is "HIGH" owing to the pull-up resistor. If the toggle switch is turned on, a digital input pin changes to "LOW".

Supply voltage for XBee PRO (S2B) is DC 2.7 – 3.6V. Thus, DC 9V from the 9V battery is transformed to 3.3V with the voltage regulator and supplied to XBee. The LED connected to pin 15 of XBee (Router) will start blinking once the router has joined a PAN (personal area network).

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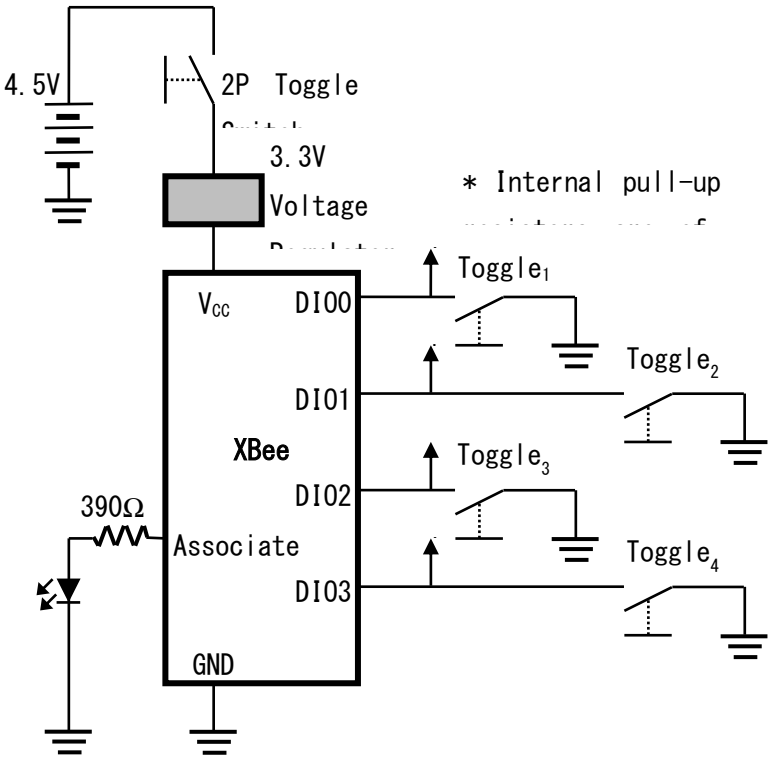

Fig.4 Xbee transmitter circuit.

✓ RESULTS

The entire designed circuit is tested on the breadboard for the fabrication. Figure 5 shows the testing of the circuits on the breadboard. The circuits consists of remote controller and robot (twin motor). When the powers are supplied to the circuits, LED indicators (blue led in the remote and yellow led in the robot) glows as shown in the figure. Initially, the yellow led on the receiver side starts blinking with the time period of 500 ms indicating the coordinator XBee has created a network (Personal Area Network). After about 10 seconds, the blue led at the remote side starte blinking with time period of 501 ms indicating that the transmitter XBee in the remote has joined the PAN network. Once the XBees start communicating each other, the data (API frame of 32 bits) from the remote XBee will be transmitted to the receiver XBee (and to arduino on the tank). The arduino will decode the signal and pass to the Driver ICs and to the twin motors.

✓ CRITICAL ANALYSIS

○ Power consumptions

A 9V Battery is used for the operation of rescue robot which has battery capacity of 600mAh. DC Current drawn by 2 motor drivers (connected to digital I/O pin of Arduino) is 40mA each and DC Current drawn by continuous servo motor (connected to digital I/O pin of Arduino) is 40mA.

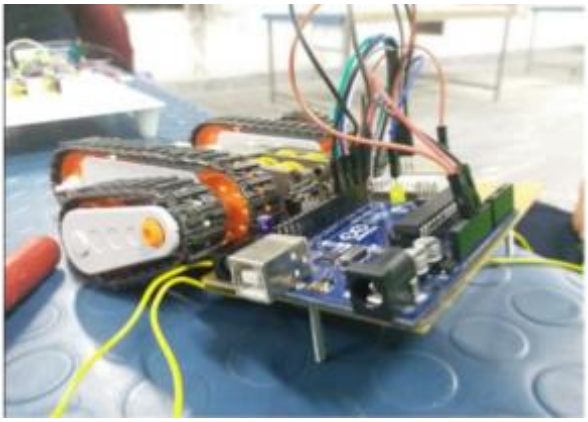

Fig.5 Prototype.

Whereas DC Current drawn by XBee PRO S2B (connected to 3.3 volts pin of Arduino) is 50mA.Total current drawn by the interfacing devices will be,

$$40 + 40 + 40 + 50 = 170\,\text{mA} \quad (1)$$

Here, lifespan of the 9V battery at 600mAh will be,

$$\frac{\text{Capacity of the battery}}{\text{Total curent drawn by the interfacing devices}} = \frac{600\text{mAh}}{170\text{mA}} \quad (2)$$

Therefore, the battery will last for about 3.5 hours. A 9V Battery is used for the operation of remote with its capacity as 600mAh and DC Current drawn by XBee PRO S2B is 50mA. Thus, the total current drawn will be $50mA$ applying the above formula. Here, lifespan of the 9V battery at 600mAh will be,

$$\frac{\text{Capacity of the battery}}{\text{Total curent drawn by the interfacing devices}} = \frac{600\text{mAh}}{50\text{mA}} \quad (3)$$

Therefore, the battery will last for about 12 hours. When it comes to the cost of the remote-controlled Rescue Robot which includes materials cost along with shipping charges and also the extra components bought from the nearby market which is given with addition of

$$10{,}055.6 + 275 = \text{Nu. } 10{,}330.6/- \quad (4)$$

whereas in the real-world application, the market value of Lego 5764 Rescue Robot cost Nu. 12,233/-.

○ Future scopes

The designed system renders help in searching the victims and injured human by giving their location status to the base station with the help of the wireless camera. It is recommended to the future researchers and developers to 0integrate some additional functions such as the design of the chassis to be fireproof and having the mechanism to detect alive human using PIR sensors to make a smart robot. In the designed system, XBee Pro S2B type is used but if the advancement of these technology avails, then also XBee device of larger communication range can be used for more distance coverage.

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