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Autonomous Rough Terrain Rescue Mobile Robot

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Abstract : The mobile rescue robot is developed to improvise the search and rescue operation. This consist of two systems, first the base station and the other mobile robot itself. The base station is used for monitoring the mobile robot. The video sent by the mobile robot is stored in the database for further use. The video is timestamped with the time, date and the longitude and latitude values. This help us to know where the humans are located. GPS data is sent wirelessly to the base station via ZigBee module. A PIR sensor is used to detect the humans. The autonomous operation will ease the operator from controlling the robots movement. This robot can be used in earthquake disasters and to monitor or find humans in man caused disasters such as hostage situations. The mobile robot is built to go on rough terrain.

1. INTRODUCTION

Search and rescue robots play an important role in saving human lives from natural and man caused disasters like earthquake, terrorist attack, and hostage situations. It is mainly used to find human/any survivors in the disaster struck area. During these events, *i.e*. disasters, it may occur that many of the victims would die due to time-consuming rescue, because the rescue for the victims after these disasters were under extreme time pressure. The victim's state would go worse owing to exposure and lack of water, food, and medical treatment. Also the search and rescue operation is very difficult and also very dangerous for the rescuers. Hence these search and rescue roots are used instead of rescuers to find humans in disaster struck area.

In the last few decades a number of technologies and systems for the support of disaster mitigation activities have been improved. Some of them are creative like autonomous robots that helps the responder team, and hence act accordingly. A number of systems with new technologies are available as commercial systems. But many systems are only research prototypes. There are a many examples of robot operations in disaster situations. One of the interesting examples of robot applications is the Center for Robot-Assisted Search and Rescue (CRASAR) of Texas AM University in the USA.

The main objective is to develop a rescue robot capable of searching human beings in a disaster struck area. The robot is built to cover area of ruins and also to notify the presence of humans in an area. An application is developed to mark the location of the human by using .NET and ASP.NET. Once the location is notified, the rescuers can rescue the human from that location. Hence helping the rescue operation speed up the process.

Changlong et.al. built the shape shifting mobile robot which can change its shape. The design concept is based on track and snake like robot. The modular mobile unit is to be designed with high environment adaptability and contact area which should be large to get the propulsion [1]. Gao Junyao et.al. surveyed

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about different types of mobile robot with a particular structure mainly built to move in mine tunnel. He had built a robot which can carry small things like food to the survivors and also can climb on obstacle. This is only suitable for mine tunnels [2]. Wongwirat had done a project which is about controlling mobile robot from base station via bluetooth. Here the hardware composes of Lego MINDSTROM's MPU, sensors and wireless camera which is implemented by JAVA [3]. Bhatia et.al. built a rescue robot which can be controlled wirelessly. These robot are not suitable for rough terrain [4]. Kaur, Bharathi et.al. had developed projects which aims at reducing the human effort for rescue operation in borewell. The mobile robot has a camera which is interfaced with MATLAB. It can also be used to detect any leakage inside the pipe [5] [6]. Bok et.al. built the navigation method using multi sensor for UGV. He proposed an algorithm of navigation method using multi-GPS, IMU and compass and multi-GPS and receive more precise data than existing system in a impossible area of receiving data of GPS sensor [8]. Noor et.al. designed and developed the remote-operated multi-direction robot. It tells about different commands to control a mobile robot. It tells about the direction of movement of wheels [9]. Fujita et.al built a mobile robot with main track and many sub tracks, hence helping it to move up the staircase. Mechanism of how to build the tracks is explained here [12].

2. METHODOLOGY AND SYSTEM OVERVIEW

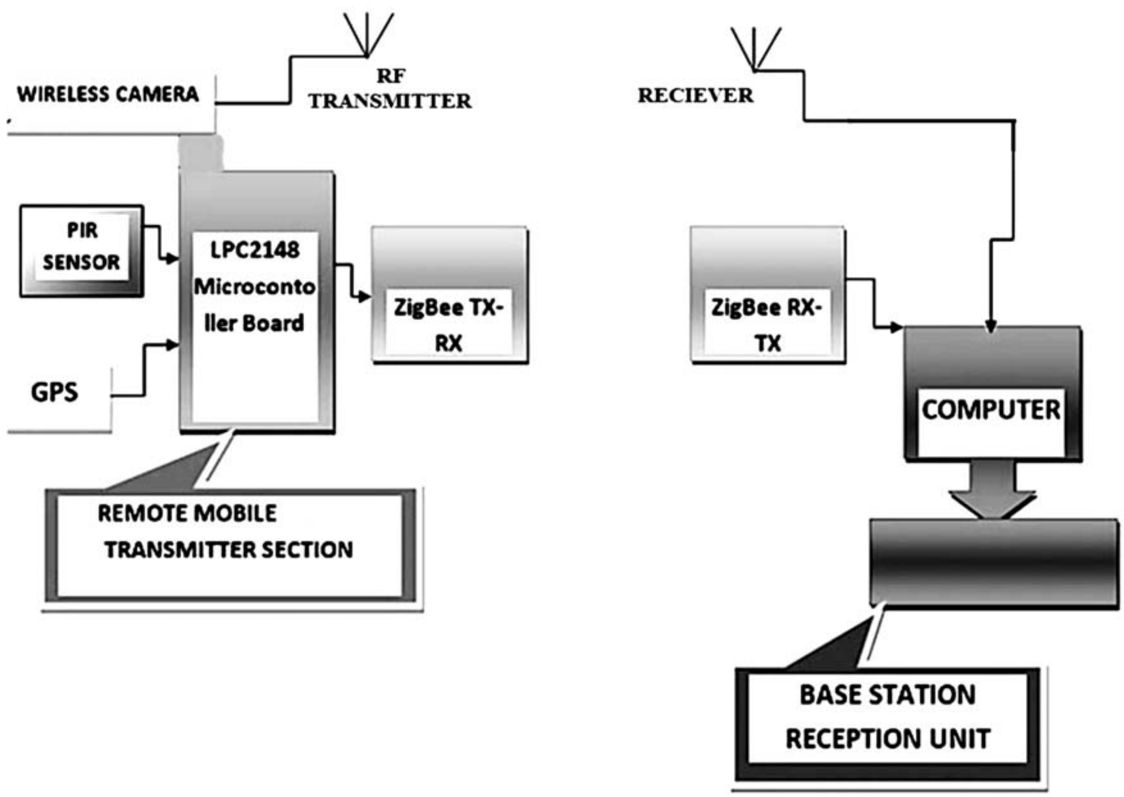

Figure 1: Block Diagram of the proposed system

The robot is made to go into the disaster scenario. It is wireless controlled from the base station. GPS module is used to send latitude and longitude coordinates. The latitude and longitude values is sent wireless to the base station. At the base station the data is stored in .DAT file using. NET application. Each 5 seconds th. DAT file will be updated with the current location of the mobile robot. This updated. DAT file will be used by the ASP.NET application. Using ASP.NET, the location and directions of the robot in the Google map can be found. Video Streaming is done using IR camera, the video is streamed wireless through RF transmitter and receiver. PIR sensor is used which helps in the detection of human. At first it is controlled wireless later it is made autonomous. Once the start and stop values are updated, it goes to the start point and starts its search till it reaches the end point. The video is time stamped with the date, time, and latitude and longitude values. Hence by doing so we can run back the video to check whether there were any humans alive in the search area.

2.1. Proposed Method

The system consists of two sections. They are receiver and mobile section. The receiver system requires a PC or TV for display of the location and should have the ZigBee module to receive the GPS, *i.e*. latitude and longitude with the direction of the robot. It should also have the RF receiver to receive the video. Data logging using Microsoft Visual Studio2010 is done, first Configuring COM Port. Then retrieving longitude and latitude values. Converting the values into degrees. Mapping to real time port map for Latitude and Longitude and then displayed on the Google Map by the help of ASP.NET Application. The mobile section consists of a PIR sensor, GPS, and wireless camera module. The mobile unit consists of ARM7 which is used to give signal if human is detected and also to process and send latitude and longitude values to the base station via ZigBee.

2.2. Automation

The rescuer loads the region of interest (ROI) into the robot. The region of interest considered here is from B($x0$, $y0$), x is latitude and y is longitude, to D($x1$, $y1$). The rescuer places the robot at a region A. The robot takes a path to the B, starts searching the region till region D. Once the task is completed, the robot comes back to region A, otherwise if it gets stuck at a point, still comes back to region A.

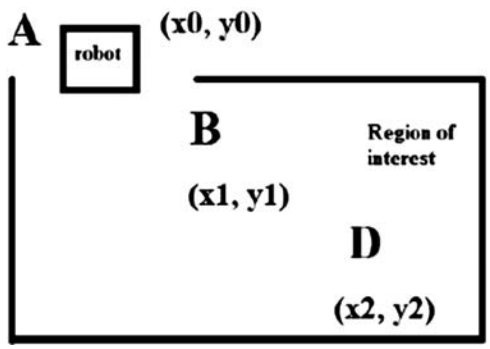

Figure 2: Scenario of the automation of robot

3. EXPERIMENT RESULTS AND DISCUSSION

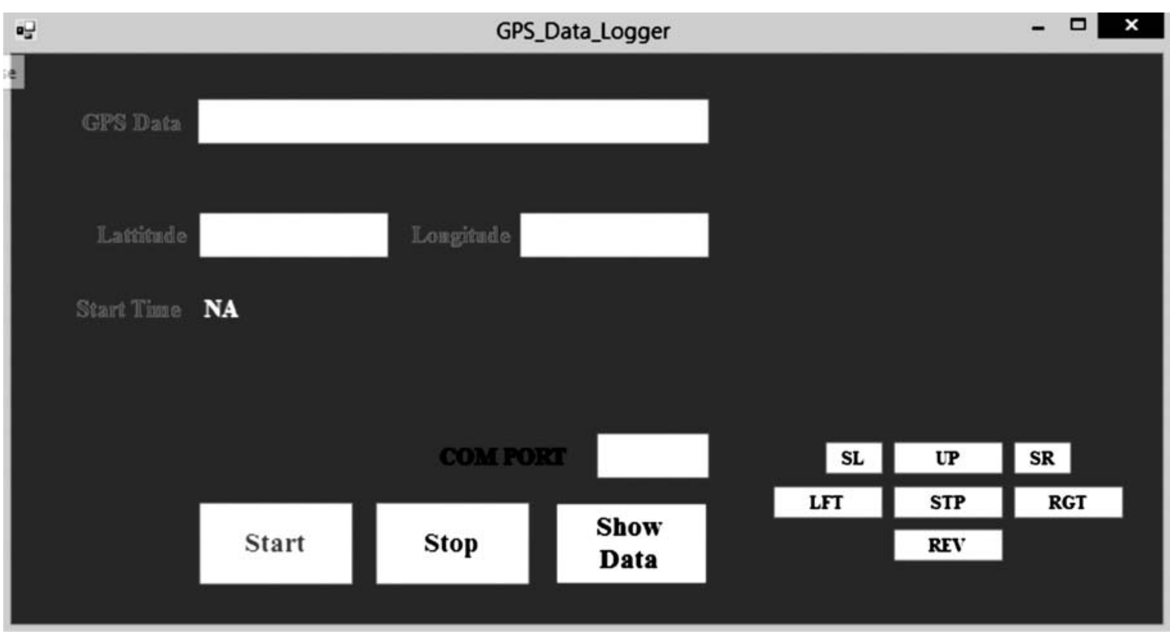

Figure 3: Screenshot of first window (App)

The application for data logging is developed using .NET. The application window parses strings for Latitude and Longitude in the Format: 1248.567N,7200.6789E. Savedata is called to save latitude, longitude values. The tracked location are then carefully converted into degrees and then mapped to the real time port map for Latitude and Longitude and then displayed on the Google Map by the help of ASP. NET application. Obtained GPS location is then suitable to be viewed for the rescuer.

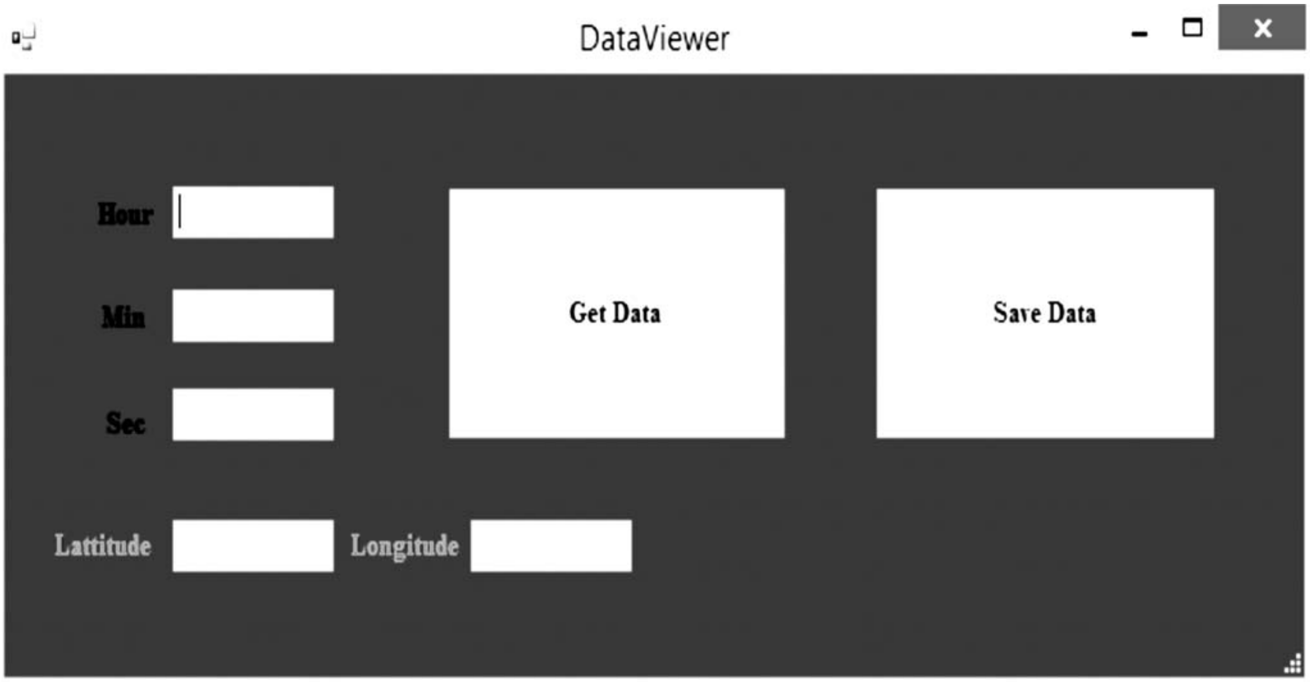

Figure 4: Screenshot of second window (App)

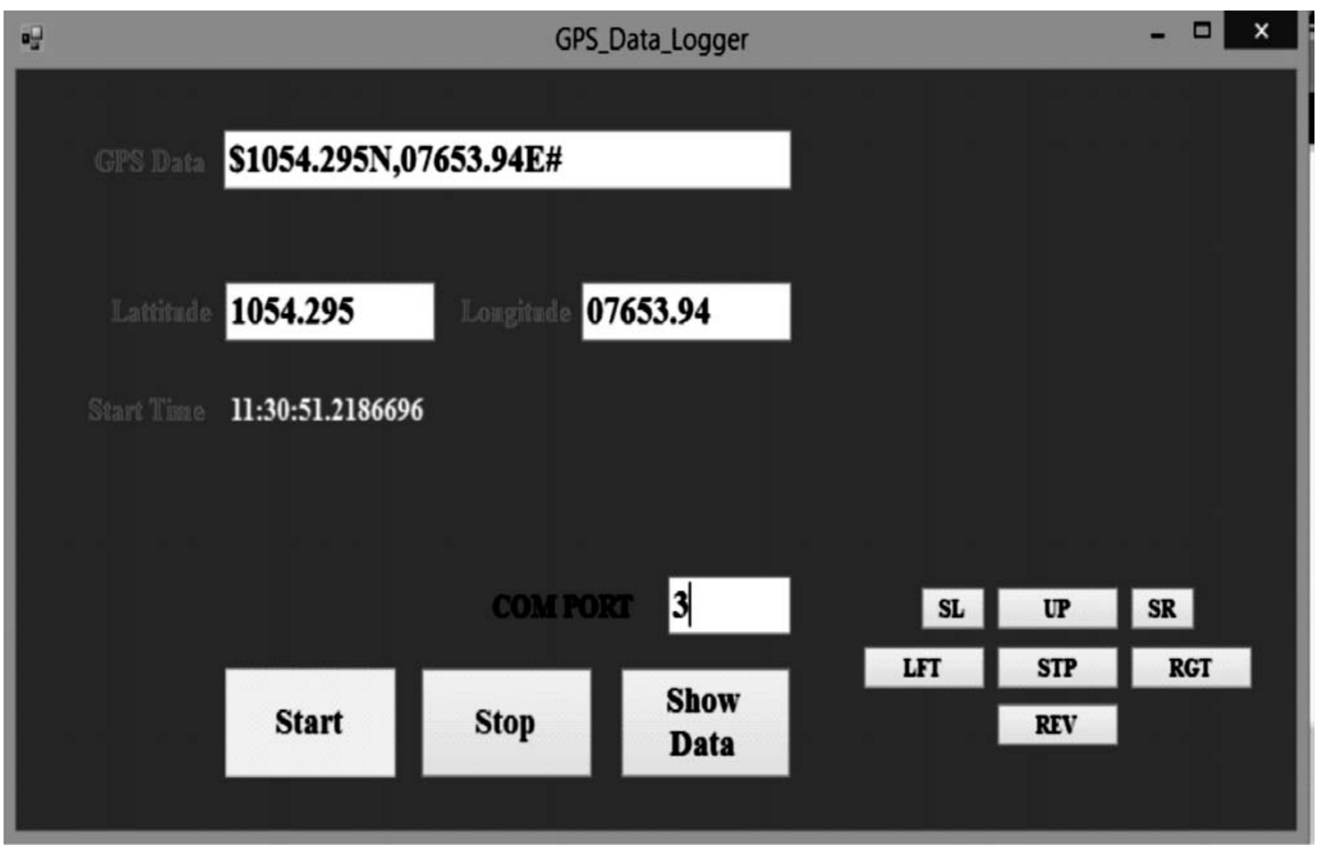

Figure 5: Sample result showing GPS location

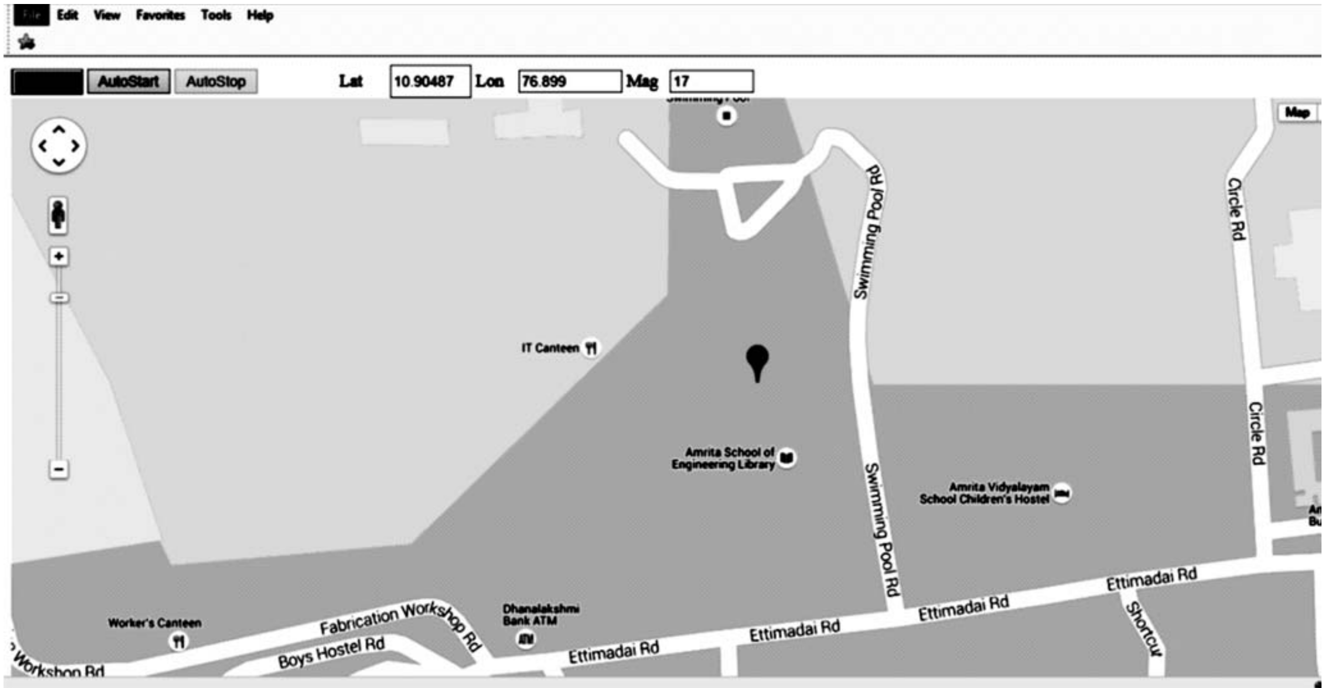

Figure 6: Location of the mobile robot at base station

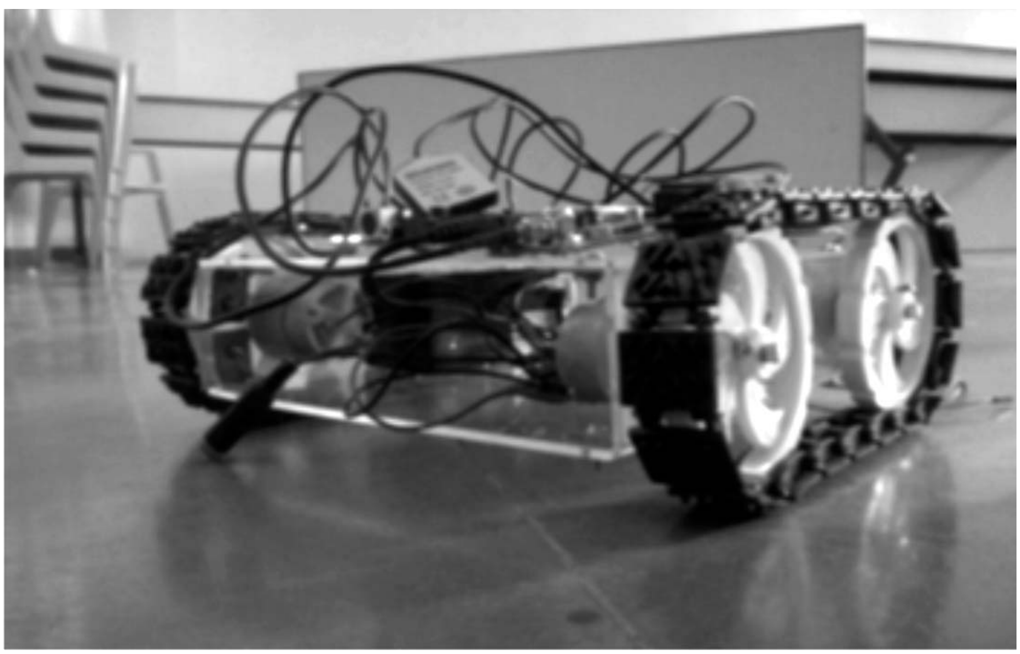

Figure 7: Mobile Robot

The mobile robot is tested for different scenarios. The test scenarios considered are rought terrains, terrains with obstacle and disaster like environment consisting of ruins with human. In all the test scenarios the robot performed well. The bot is not tested in wet areas and in fire environments. Modifying the bot for such conditions will make it suitable for all terrain.

4. CONCLUSION

The mobile rescue robot is developed for search and rescue operation during disasters. The robot is a semiautonomous wireless system where the video, location and human detection information is sent wirelessly to the base station. The robot performed well for all test conditions except for wet regions and fire environments.

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