ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

Wireless Controlled Sailing Robot for Oceanic Missions

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Abstract— ***Ocean exploration and navigational research by supporting expeditions with computer vision techniques have shown potential for sailing robots development to make measurements on the ocean surface. Sailing robots explores the science and technologies for the identification of underwater features. Robot sailing is a challenging task in both building and controlling the boat; therefore it brings together many different disciplines. Overall tasks included in the project are human robot interaction, control of robot, location estimation, design, calculating ocean parameters using sensors, interpretation of video footage. An idea presented is the sailing robot which is controlled manually from some distance using laptop keypad. The ocean parameters, location information and video can be seen on laptop. The wireless media used for human robot communication is RF PRO wireless communication.***
Keywords— ***sailing robots, footage, Laptop keypad, ocean parameters, RF PRO***

I. INTRODUCTION

The development and deployment of sailing robot is possible by the effective combination of appropriate new and novel techniques that allows for a number of applications to be successfully completed. Autonomous robots have been successfully demonstrated in a number of applications, including planetary and underwater exploration. In this paper an autonomous sailing propelled robot is presented for oceanic missions. For oceanic missions such as finding metals, spy applications, measuring depth, etc., one has to travel on the boat. But it is risky, because climate can change suddenly on the ocean. For example cyclone may occur suddenly. Also while spying, the opposite one may fire and can result in death of driver controlling the boat. To overcome this, the boat has to be designed in such a way that it can be operated without a driver. So it has to use any means of wireless communications. In this paper RF pro wireless communication is presented.

II. BASE DESIGN

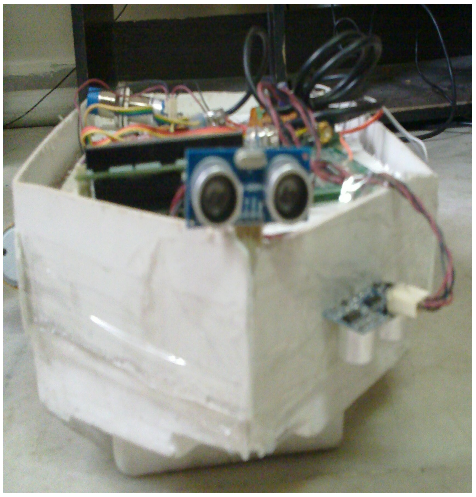

Fig. 1 sailing robot before protective sheet

To make the robot to sail, any material can be used. But it has to withstand the weight of all modules including ARM LPC 2148 board, sensors and even battery, which is more weight than other modules. So to be simple and effective, thermocol is used in the project. Thermocol is made into the shape of boat and used. But if thermocol collides with any rough surface it gets damaged easily. So if needed the thermocol can be surrounded by a thin material which acts as protective sheet against collisions. The image of sailing robot before and after protective sheet is shown in figure 1 and figure 2 respectively.

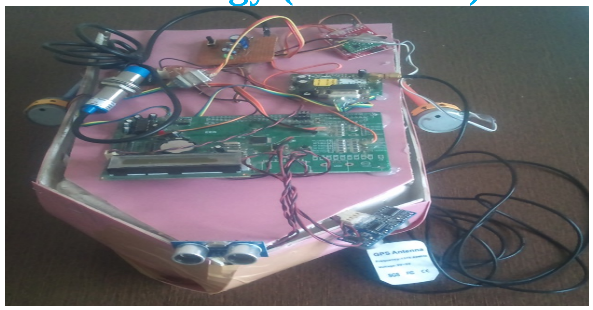

Fig. 2 sailing robot after protective sheet

III. RF WIRELESS COMMUNICATION

RF has a frequency range from 3 kHz to 300GHz that is corresponding to frequency of radio waves. There are some of the properties of radio frequencies. RF current flow along the surfaces of electrical conductors and they does not penetrate deep into conductors. By supplying RF current to an antenna, it gives rise to an electromagnetic field that propagates through space. This paper introduces RF PRO module which operates at 2.4GHz.

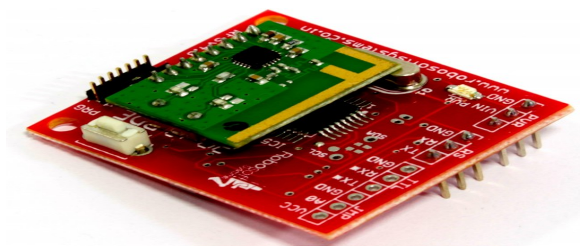

Fig. 3 RFSv4.3 module

The commands for respective movements of sailing robot are send from laptop keypad through RF PRO wireless communication. The module used for this purpose is RFSv4.3 (Figure 3). It provides easy and flexible wireless data transmission between devices. RFSv4.3 uses 2.4 GHz carrier frequency. On pressing keys on laptop keypad, respective action takes place. For example on pressing 8 the sailing robot moves forward. For this project two RFSv4.3 modules are necessary. One is used to send commands from laptop keypad to sailing robot. The second one is used to send sensor values from sailing robot to laptop.

IV. SENSORS

A. Depth Sensor

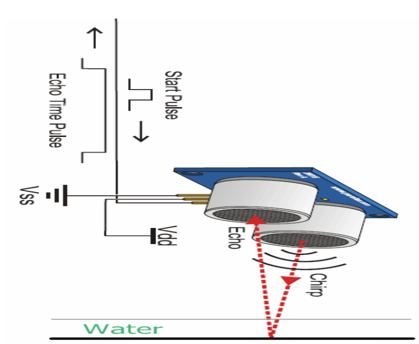

Fig. 4 working principle of Ultrasonic sensor

One of the applications of sailing robot is to measure depth under water. For this an ultrasonic sensor is used. It consists of an ultrasonic transducer which converts electrical energy to ultrasound frequencies. These transducers are also referred to as piezoelectric transducers. These transducers work on principle of inverse piezoelectric effect. When any piezoelectric crystal is

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applied an electric field, a mechanical strain is developed and it leads to oscillations. This effect is called inverse piezoelectric effect. Different crystals produce different frequencies.

The module used is Ultrasonic ranging module HC-SR04. The basic principle depends on echo reception (Figure 4). A short 10µs pulse is given to the trigger input. The module will send out an 8 cycle burst of ultrasound at 40 KHz. The pulse signal is reflected back from ground surface after hitting it. Now the range is calculated using the time interval between sending trigger signal and receiving echo signal. The formula is,

Range = (time taken × velocity of sound)/2

B. Obstacle Sensor

Although the sailing robot is monitored through camera, there may be chances of collision with obstacles because of controller inactive. So to avoid this ultrasonic sensor is used to detect the obstacles. When an obstacle is detected the sailing robot automatically stops or can be made to take turning until obstacle went off.

C. Metal Sensor

Fig. 5 Metal sensor

To detect metals under the water, a metal sensor is used. The metal sensor used is ID18 – 3008NA(Figure 5). This uses a coil which detects the metal. The principle of sensing is nothing but electromagnetic inductance. The module is water proof. This module is useful in finding missing ships.

V. GPS

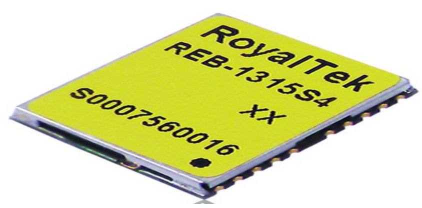

Fig. 6 Royaltek REB-1315S4 module

As the climate on ocean is unpredictable, there is a chance of missing of sailing robot. This may occur because of cyclone or some other reasons. So a GPS module is used to detect the sailboat when missed. The GPS module used is Royaltek REB-1315S4 (Figure 6). GPS receiver receives signals from different GPS satellites. Each GPS satellite transmits data indicating its location and current time. All GPS satellites are synchronized such that the repeating signals are transmitted at the same instant. GPS module can also be used for navigation purpose.

VI. CAMERA

Fig. 7 Wireless Camera

This module sends continuous video to the laptop for continuous monitoring. The camera (Figure 7) used in this project can send video from 50 to 100 meters distance if it in line of sight with receiver. This can also be used for spy applications.

VII. DC MOTOR

Fig. 8 DC Motor

Two DC motors are used in the project. These are the things that make the sailing robot to move. DC motor shown in figure 8 need 12V supply. But ARM processor cannot supply that much voltage to these motors. So a driver is added in between DC motors and ARM processor. L293D is used as driver.

VIII. X-CTU TERMINAL

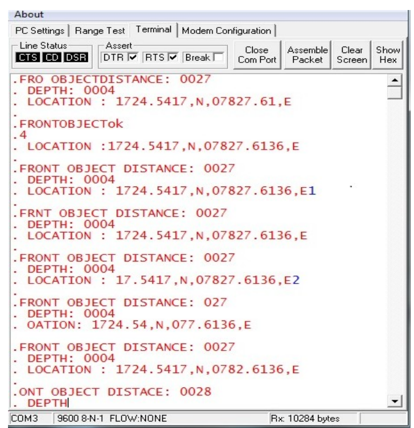

Fig. 9 X-CTU Terminal

As the sailing robot is far away from human controller, he is unable to see sensor readings on LCD. So all the sensor readings are to be transmitted to laptop. To display these values on laptop X-CTU terminal (Figure 9) is used.

IX. CONCLUSION

In this paper we introduce a successful working prototype model of sailing robot, designed for oceanographic research. Ocean exploration and navigational research can be studied through ultrasonic sensors, metal detector, gps module interfaced to the robot. Further development is required to improve the feasibility of a sailing robot for long term use in open sea and helpful for oceanographers and scientists.

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ISSN: 2321-9653

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