International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 4 Issue 05, May-2015

LabVIEW GUI Based Air Cushion Vehicle – Hovercraft

Abhilash B N, Abhishek K N, Nischal V and Siddharth S Anikar
Dept of Telecommunication Engineering
Dayananda Sagar College of Engineering
Bangalore, Karnataka, India

Mahesh D
Assisstant Professor
Dept of Telecommunication Engineering
Dayananda Sagar College of Engineering
Bangalore, Karnataka, India

***Abstract*--This paper focuses on construction and control of an unmanned hovercraft. Two high speed DC motors are used for hovering and two other DC motors are used for navigation. Remote access of the hovercraft is done using a laptop via ZigBee. The user interface has been designed in LabVIEW. Ultrasonic rangefinders have been used to detect and range objects. A sensor has been implemented to keep a check on the surrounding temperature. A camera has been installed onboard to relay live feed to the user.**

Keywords—PIC18, LabVIEW, ultrasonic rangefinder, high speed dc motors

I. INTRODUCTION

A vehicle or a machine that is capable of traversing on both land and water over a blanket of air is known as a hovercraft (Fig 1). Such a vehicle first came into picture in 1956 all thanks to its inventor Christopher Cockerell. The basic principle for hovering is to blow air into the skirting with an appropriate pressure such that it fills up and a blanket of air is formed. A vehicle traversing on such a blanket of air experiences hardly any friction. This makes way for less wear and tear and swift movement across the terrain. The lift is provided by a downward facing high speed dc motors with a fan attached to it. The thrust is provided by a high speed motor mounted at the rear of the vehicle in the vertical plane.

Fig. 1. Manned Hovercraft

A hovercraft has ample amount of space for harboring payload which makes it feasible for many applications in various fields. The application include River, lake geological surveys, Civil emergency infrastructure support, oil industry survey, exploration ,pipeline patrol, defence , Fish farm & low tide access.

To represent the data acquired by the sensors and to control the movement we have used LabVIEW. LabVIEW (Laboratory Virtual Instrument Engineering Workbench) is a system-design platform and development environment for a visual programming language. It is commonly used for data acquisition, instrument control, and industrial automation on a variety of platforms including Microsoft Windows, various versions of UNIX, Linux, and Mac OS X.

II. HOVERCRAFT MODEL

Our hovercraft model consists of two major parts. They are body, skirt.

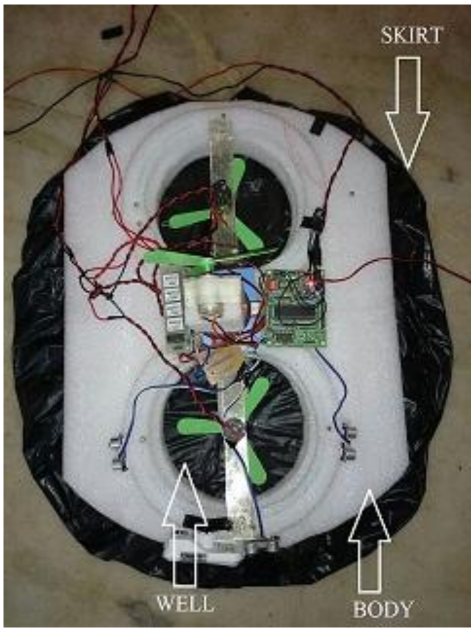

Fig. 2. Hovercraft Model

(This work is licensed under a Creative Commons Attribution 4.0 International License.)

A. Body

The basic considerations for the body are

i) It should be large enough to hold the required components and possible payload.

ii) It should be strong and flexible enough to overcome any infractions.

iii) It should be robust and should be able to withstand any environmental factors such as moisture, rust etc.

iv) It must be light weight and at the same time provide stability to the model.

In our model the body is made of two Styrofoam sheets.. Styrofoam is composed of ninety-eight percent air, making it lightweight and buoyant. Because of its insulating properties and buoyancy it is the most suitable material to build the base of the hovercraft as weight is a major constraining factor that decides the applicability of a hovercraft. Each Styrofoam sheet used is 2.54cm thick, 59cm long and 43cm wide. The body provides the base to hold all the electronics that go on board. Two holes of diameter 18cm each are made into the Styrofoam sheets that act as the wells upon which thermocol rings are placed to provide support for the motors.

B. Skirt

A hovercraft skirt is required to fulfill the following functions.

i) Contain the cushion of air beneath the craft at the required hover height.

ii) Have the ability to conform and contour efficiently over obstacles so as to keep the loss of cushion air to minimum.

iii) Return to its original shape after having been deformed.

iv) Give adequate stability.

v) Offer little resistance to the passage of obstacles beneath it.

vi) Have the ability to absorb a large proportion of the energy which is produced on impacts or collisions with obstacles greater than hover height or cushion depth.

To achieve the above, the skirt material used is a polymer which repels water and is rugged so that it can traverse on coarse surfaces without the risk of damage as well as on water without sinking. The ends of the polymer material used for the skirt are sandwiched between the two layers. A slit is cut across the bottom of the skirt to maintain appropriate air pressure in order to achieve proper hovering.

III. HARDWARE

This section gives the details about the major hardware components that have been used in our model.

A. PIC18 Microcontroller

PIC is a family of modified Harvard architecture microcontrollers. The name PIC initially referred to Peripheral Interface controller. PIC devices are of low cost, free development tools are provided and have serial programming and re-programmable flash memory capability. The PIC microcontroller used on board has 64Kb Program Memory, Data EEPROM up to 1024 bytes Data RAM 4kb. It has Four Crystal modes up to 64 MHz and two external Clock modes up to 64 MHz in addition it has 2-UART, 2-A/E/USART for serial communication, 3 8-bit and 4 16-bit timers, 2 10 bit ADC Comparators an operating Temperature Range of -40 to 125 C and an operating Voltage Range of 1.8 to 5.5 V.

The PIC microcontroller has several advantages. It has small instruction set which makes it easier to learn. It has RISC architecture which results in short lenght codes. A built in oscillator with selectable speeds. The cost is also less expensive. Programming is easy and it is done using MP Lab.

B. Motors

We have used four High speed dc motors out of which two are used to provide the lift. The third motor is used to control the direction in which the model travels. The last motor is used to control the movement of the third motor.

The motors run on a 12v dc and can withstand a current upto 2.5A. It yields a speed of 12000rpm.

C. Ultra sonic range finder

An ultra sonic range finder is a device which is used not only detect an object but also determine its distance from the device.The basic principle involves transmitting signals and analyzing the echo signal.Three ultra sonic range finder have been used in our model. One in the front and the other two facing sideways. The detection range is between 2cm – 400cm and operates at frequency of 40Hz. For its working it requires a voltage of 5v dc and a current of 15mA. The measuring angle is 15 degrees and the speed of the signal is 340ms.

(This work is licensed under a Creative Commons Attribution 4.0 International License.)

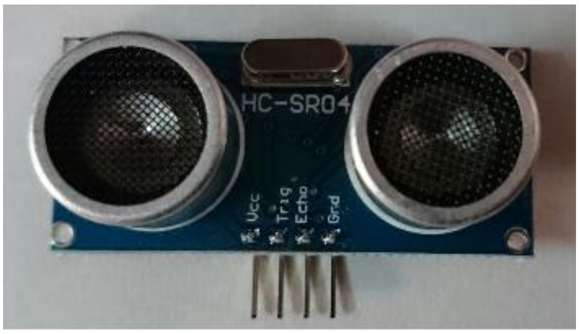

Fig. 3. Ultra sonic range finder.

Along with the above components relay circuits have been used to control the motor. A sensor has been used to monitor the temperature. Also a camera has been used to provide real time feed to the user in LabVIEW front panel.

Communication between the model and the LabVIEW has been achieved via ZigBee module which transmits and receives data using UART methodology.

D. Temperature sensor

The temperature sensor used in our model is LM35. It has an analog output which is directly calibrated in degree Celsius. It has an accuracy of 0.5^{o}C at a temperature of 25^{o}C and can sense temperatures of range between -55^{o}C to 155^{o}C. This sensor is highly suited for remote application purposes as it costs less, tough and has an operating range of 4V to 30V.

IV. SOFTWARE

MP lab has been used to program the PIC microcontroller using embedded C. The control of direction of motion and the visualization of data received by the sensors is represented by a GUI designed in LabVIEW.

A. LabVIEW Front Panel

The LabVIEW front panel is as shown in the figure 4.
The start button activates the hover motors while the stop button deactivates them. The front button is used to activate the vertically mounted motor to move the hovercraft. The left and right buttons are used to rotate the vertical motor to turn the hovercraft left or right. The temperature and distance meters are used to visually represent the values obtained from the temperature sensor and the range finders. The sensor value gauges show the numerical values of the same. The read string box shows the string obtained from the microcontroller. A real time screenshot is as shown below. The LEDs show if any object has been detected within 4 meters by turning red.

V. RESULTS

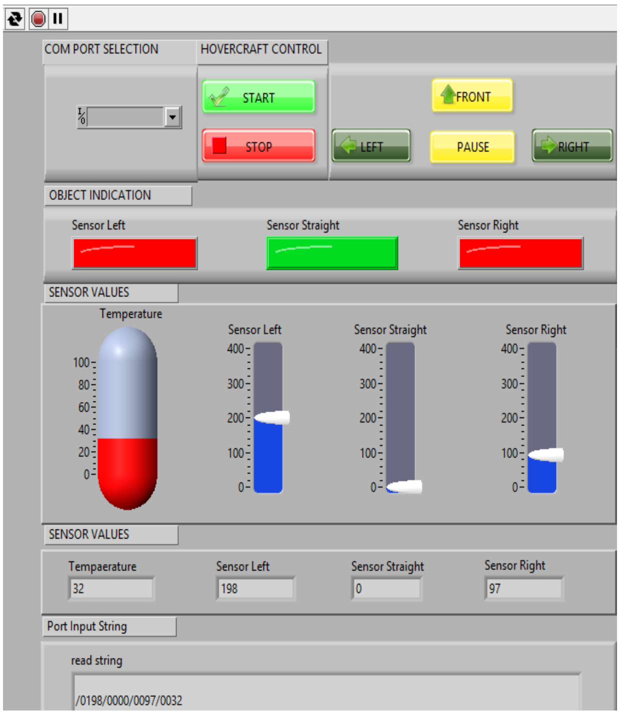

Fig. 4. LabVIEW front panel

Fig. 4 shows the screenshot of the front panel of the LabVIEW interface. The data is obtained as a string from the microcontroller as shown in read string. The string consists of four 4-digit numbers. The first number represents Left sensor reading, the next number represents straight sensor reading, the third number represents the right sensor reading and the last number represents the temperature reading. According to the string, the values are represented by the temperature gauge which shows 32^{o} C and the distance meters for each sensor. The LEDs of the left and right sensors have turned red to indicate that objects have been detected at 198cm and 97cm respectively. The camera feed can be observed by logging into mydlink.com.

Fig. 5 shows the hovercraft before the hover motors are turned on. The hover motors can be started by pressing the START button, on clicking which the skirt gets filled with air and the craft gets lifted up as shown in Fig. 6.

(This work is licensed under a Creative Commons Attribution 4.0 International License.)

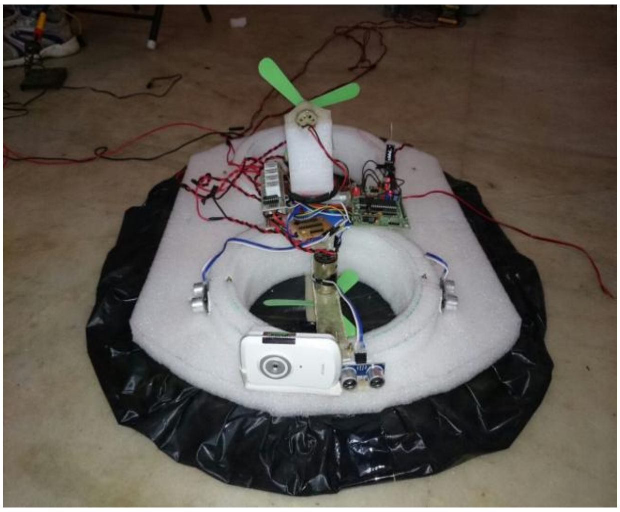

Fig. 5 The hovercraft before hovering

Fig. 6 The hovercraft after starting the hover motors

VI. CONCLUSION AND FUTURE WORK

We were able to construct a cost effective hovercraft which runs on both land and water. It can be used for variety of applications such as object detection, video monitoring, temperature sensing and payload carrying.

We have designed a very convenient Graphic User Interface (GUI) using LabVIEW which is used to control the hovercraft.

Further developments such as efficient use of energy could be achieved with a more appropriate power source. Range of communication could be extended by using other communication standards and GPS tracking can be implemented.

ACKNOWLEDGMENT

We extend our sincere thanks to Mr. Mahesh Dali, Assistant Professor, Telecommunication department, Dayananda Sagar college of engineering, Bangalore, India for his valuable guidance and support all the way through the process.

We would like to express our gratitude to Mr. Nitin Awasthi, VP-technical, Apsis solutions, Bangalore, India for his immeasurable technical inputs.

REFERENCES

(1) Kilsoo Kim, Young-Ki Lee, Sehwan Oh, David Moroniti, Members, IEEE, Dimitri Mavris, and George J. Vachtsevanos, Senior Members, IEEE, Nikos Papamarkos, Member, IEEE, GeorgeGeorgoulas, Member, IEEE (2013) "GUIDANCE, NAVIGATION AND CONTROL OF AN UNMANNED HOVERCRAFT" (06608750)

(2) Pragyan an ISO 9001 and 20121 certified organization (2013) NIT Trichy, " THEORY OF HOVERCRAFT"

(3) I. Fantoni, R. Lozano, F. Mazenc, and K. Y. Petterson, International Journal of Robust and Nonlinear Control, vol. 10 (2011) "STABILIZATION OF A NON LINEAR UNDERACTUATED HOVERCRAFT"

(4) Web sources: http://www.ti.com/product/lm35
http://www.micropik.com/PDF/HCSR04.pdf
http://en.wikipedia.org/wiki/Hovercraft

BIBLIOGRAPHY

1. Abhilash B.N is pursuing Final year B.E in Telecommunication Engineering, Dayananda Sagar College of Engineering, Bangalore.
2. Abhishek K.N is pursuing Final year B.E in Telecommunication Engineering, Dayananda Sagar College of Engineering, Bangalore.
3. Nischal V is pursuing Final year B.E in Telecommunication Engineering, Dayananda Sagar College of Engineering, Bangalore.
4. Siddharth S Anikar is pursuing Final year B.E in Telecommunication Engineering, Dayananda Sagar College of Engineering, Bangalore.
5. Mahesh D is serving as an assistant professor in the dept. of telecommunication engineering, Dayananda Sagar College of Engineering, Bangalore.

(This work is licensed under a Creative Commons Attribution 4.0 International License.)