International Journal of Research
Available at https://edupediapublications.org/journals
p-ISSN: 2348-6848
e-ISSN: 2348-795X
Volume 04 Issue 02
February 2017

Design and Implementation of Face Detection on a Raspberry Pi Robot

[1]A.Rajendra Prasad, [2]V. Ramakrishna Reddy
[1]M.Tech, Balaji Institute of Technology & Science,Telanagana, India
[2]Assistant Professor,Dept. of ECE, Balaji Institute of Technology & Science, Telanagana, India

ABSTRACT: Effective face detection in real-time is an essential procedure for achieving autonomous motion in telepresence robots. Since the procedure demand high computation power, using it to create autonomous motion in low-cost robots is a challenge. This paper addresses this issue and making three contributions. First, the process to enabling the real-time face detection on Raspberry Pi's graphical processor is presented. Second, the development of an autonomous robot to follow an interlocutor face using two Raspberry Pi-1 model B is demonstrated. Third, the evaluation on resource requirements when operating the robot in various scenarios is described. In our project , we made use of some functions (in Matlab) that together make up the Viola-Jones face detection algorithm.We built a robot that tracks the movement of a face from the video stream using Matlab and Raspberry Pi's.

IndexTerms:Face Detection, Face Recognition, ARM 11

I. INTRODUCTION

Telepresence robot is an invention for making users feel as if they were in two places at the same time. The user controlled his/her avatar robot remotely, while being in another place. Telepresence robots equipped with video conferencing module. Thus, the user can interact with his/her interlocutor at the robot site. Various types of telepresence robots are available for commercial, in both mobile and desktop features. Apart from using as a tool for scientific discovery in unmanned area, telepresence robot usage has gained advantage over video conferencing in wide range of applications e.g. for research, elderly health care, office, school and general purpose uses [1]. The usage of telepresence robots are still limited as commercial robots are not affordable. Emerging of the ultra-low cost computer for education [2], the Raspberry Pi (RP), has brought attention on telepresence robot research. As the RP computer is a platform aimed for teaching computer component in the DIY fashion, it has a limited computation power. A research on telepresence robot has used the RP computer for controlling the robot motion and offloaded some computation on the Cloud [3]. Using this technique, the robot has been equipped with some autonomous features like following an interlocutor face.Real-time face detection is a key step in controlling the pan and tilt unit (PTU) of telepresence robots to automatically follow the face of an interlocutor. By doing so, the robot autonomy is enhanced; and it could be extended to maintain eye contact with the interlocutor. Several research have shown that this feature increases users' satisfaction when using telepresence robots in office environment [4-6]. Some research has proposed techniques to add more user interaction capabilities to the robot using the Kinect camera, e.g. implementing motion tracking and image-based face tracking [5]; having gesture based recognition [6]. The key success factor for face tracking and face recognition tasks in the robots is the effective face detection technique used in real-time.

The real-time face detection unit has been added to the development of a telepresence robot. This is to allow the robot to have autonomous PTU to follow the interlocutor face. The robot consists of a monitor, a web cam, an RP camera module, a ServoBlaster library and two servo motors, a power supply.

Teleoperated security robots are remotely controlled to carry out many different operations such as surveillance, inspection, hostage retrieval and other lawenforcement operations [1].

Human teleoperated robots come in a large variety. They are used for many different purposes such as inspection, bomb disposal, as well as other operations with high risks [1]. The main two

reasons for using teleoperated robots rather than autonomous robots are [1][2]:

1. The utilization of artificial intelligence may result in an emergent response when an autonomous robot is programmed with an unconstrained learning algorithm. Consequently the robot may exhibit a non-deterministic response and take a critical decision, such as shooting a human with a weapon.

2. An environment is too unstructured, unpredictable or complex to be modeled efficiently and as such a robot may not be controlled effectively.

Teleoperated robots have some advantages [3] such as:

1. Getting humans out of harm's way, such as in hazardous or polluted areas.

2. To access areas unreachable by humans for any reason.

However, the disadvantage of teleoperated robots is that they do not operate on their own unless equipped with some degree of autonomy, and therefore would be useless in helping a human unless another human controls them to do so.Teleoperated robots may be equipped with a normal or an omnidirectional camera.

II. PROPOSED FRAMEWORK

Following Fig.1 show the system architectureblock diagram including the ARM processor baseddevelopment board, web camera, and motor controlling board (motor driving card),LCD andrelated hardware.

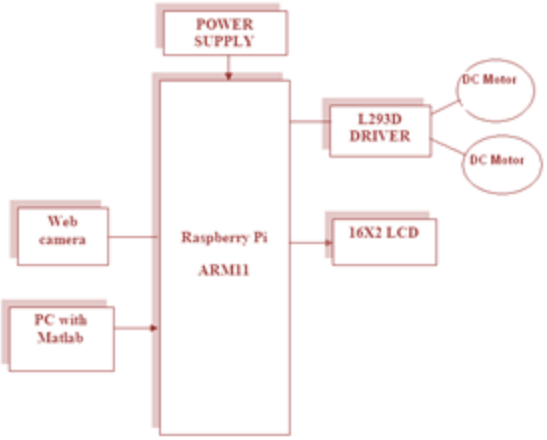

Fig.1 Block diagram of functional unit

A. Raspberry Pi

The Raspberry Pi has a Broadcom BCM2835 system on a chip (SoC), which includes an ARM1176JZF-S 700 MHz processor, VideoCore IV GPU and was originally shipped with 256 megabytes of RAM, later upgraded (Model B & Model B+) to 512 MB. It does not include a built-in hard disk or solid-state drive, but it uses an SD card for booting and persistent storage, with the Model B+ using a MicroSD.The Foundation provides Debian and Arch Linux ARM distributions for download. Tools are available for Python as the main programming language, with support for BBC BASIC (via the RISC OS image or the Brandy Basic clone for Linux), C, Java and Perl.

B. DC Gear motor

A geared DC Motor has a gear assembly devoted to the motor. The speed of motor is counted in terms of rotations of the shaft per minute and is termed as RPM .The gear assembly helps in increasing the torque and dropping the speed. Using the correct arrangement of gears in a gear motor, its speed can be reduced to any required figure. This concept of reducing the speed with the help of gears and increasing the torque is known as gear reduction. Reducing the speed put out by the motor while increasing the quantity of applied torque is a important feature of the reduction gear trains found in a gear motor. The decrease in speed is inversely relative to the increase in torque.DC Geared motors with robust metal gear box for heavy duty applications, available in wide RPM range and

ideally suited for robotics and industrial applications. Very easy to use and available in standard size. Nut and threads on shaft to easily connect and internal threaded shaft for easily connecting it to wheel.

Specifications:

•100 RPM 12V DC motors with metal Gearbox.
• Same size motor available in various rpm.
•Shaft diameter : 6mm
•weight :122 gm
•Torque : 2 Kg-cm
•No-load current :- 70mA (Max)

MATLAB testing of face detection

As our final aim was hardware implementation , so theMatlab testing is done with the face detection given incomputer vision system toolbox. It comes with alreadytrained classifiers. This was to test the required efficiencyof face detection.Whenever any human face is detected andrecognized and found in database, then ARM 11 boardsends commands via RS232,and which drives the DC motor for 15 seconds inclockwise direction i.e. to open the door driven by DCmotor , then waits for next 15 seconds and then againdrives the DC motor for 15 seconds in anticlockwisedirection, i.e. to close the door. The DC motor is driventhrough through the motor driver IC L293D.

III. RESULTS AND DISCUSSIONS

This is part of my "Building Robots using Raspberry Pi" tutorial series, explaining how you can create robots using Raspberry Pi. In this article we will see how we can control the speed of the DC motor using Raspberry Pi. This section explain how we can control the speed of the motor as well using the IC. Also We will talk about how we can encapsulate the entire logic into an Raspberry Pi Library.

Controlling Speed of DC Motors

To control the speed of the motor, all we need to do is to replace digitalWrite function on L293D enable pins to analogWrite. The speed of the motor depends on value that was passed to the analog Write function. Remember the value can be between 0 and 255. If we pass 0, then the motor will stop and if you pass 255 then it will run at full speed. If we pass a value between 1 and 254, then the speed of the motor will vary accordingly.

Remember, we connect the enable pins of H-bridge to pins 10 and 11 of Raspberry Pi. This is because pins 10 and 11 are PWM pins.PWM motor output calculation functions. Accordingto the polarity of the left and right electrodesÿ outputcontrol amount, superposition of a small dead zonevalue to overcome the mechanical static friction forceof platform. Function calling period is 10milliseconds.PWM output function: Calculate value of the PWMcontrol register according to the two motorsoutput.Set the value of the four PWM control register.Function calling period is 1 milliseconds.

IV. CONCLUSION

A different design of a robot in which two dc motors are used to drive four big wheels in a differential manner to increase stability while maintaining high speed capability. Many of the other robots do not perform face recognition.

REFERENCES

[1] T. Theodoridis and H. Hu, "Toward Intelligent Security Robots: A Survey," IEEE Trans. Syst. Man, Cybern. Part C (Applications Rev., vol. 42, no. 6, pp. 1219–1230, Nov. 2012.

[2] P. Lina, G. Bekeyb, and K. Abneyc, "Robots in War : Issues of Risk and Ethics," in Ethics and Robotics, 2009, pp. 49–67.

[3] D. Gonzales, D. Criswell, and E. Heer, "Automation and robotics for the Space Exploration Initiative: results from Project Outreach," 1991.

[4] "iRobot Robots for Defense & Security," 2014. [Online]. Available: http://www.irobot.com/us/learn/defense.aspx.

[5] A. Birk and H. Kenn, "Roboguard, a teleoperated mobile security robot," Control Eng. Pract., vol. 10, no. 11, pp. 1259–1264, 2002.

[6] M. Rasheed and I. Hussain, "Cost Effective Spy Ball Robot for Surveillance, Rescue and Exploration," Trans. Electron. Commun., vol. 57, no. 1, pp. 3–8, 2012.

[7] S. Ushio, K. Okada, Y. Kido, T. Kitahara, H. Tsuji, S. Moriguchi, M. Narita, and Y. Kato, "A Home Security Service Robot System Using the Network Service Platform and Its Implementation," 2011 IEEE/IPSJ Int. Symp. Appl. Internet, pp. 402–407, Jul. 2011.

[8] Y. Takahashi and I. Masuda, "A visual interface for security robots," in Robot and Human Communication, 1992. Proceedings., IEEE International Workshop on, 1992, pp. 123–128.

[9] C. Lundberg and H. I. Christensen, "Assessment of man-portable robots forlaw enforcement agencies," Proc. 2007 Work. Perform. Metrics Intell. Syst. -Permis '07, pp. 76–83, 2007.

[10] H. R. Everett, E. B. Pacis, G. Kogut, N. M. Farrington, and S. Khurana, "Towards a Warfighter's Associate: Eliminating the Operator Control Unit H.R.," pp. 267–279, Dec. 2004.

[11] C. h. Kuo, C. c. Chen, W. c. Wang, Y. c. Hung, E. c. Lin, K. m. Lee, and Y. m. Lin, "Remote Control Based Hybrid-Structure Robot Design for Home Security Applications," 2006 IEEE/RSJ Int. Conf. Intell. Robot. Syst., pp.4484–4489, Oct. 2006.

[12] J. Lee, H. S. S. Oh, J. Hong, J. Kyounghwan, H. Kwon, and J. Kim, "Operating a six-legged outdoor patrol robot," 2007 Int. Conf. Control. Autom. Syst., pp. 1034–1039, 2007.

[13] L.-Y. Chung, "Remote Teleoperated and Autonomous Mobile Security Robot Development in Ship Environment," Math. Probl. Eng., vol. 2013, pp. 1–14, 2013.

[14] J. Ryu, B. Yoo, and T. Nishimura, "Service Robot Operated by CDMA Networks for Security Guard at Home," in Service Robot Applications, Yoshihiko Takahashi, Ed. INTECH, 2008.

[15] J.-G. Ryu, S.-K. Kil, H.-M. Shim, S.-M. Lee, E.-H. Lee, and S.-H. Hong, "SGRobot: CDMA network-operated mobile robot for security guard at home," in IEEE International Conference on Intelligence and Security Informatics, 2006, pp. 633–638.4.