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Gesture Based Human Robot Interaction System Using Raspberry Pi

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ABSTRACT

Even after more than decades of input devices development, many people still find the interaction with the computers and robots an uncomfortable experience. Efforts should be made to adapt computers and robots to our natural means of communication. speech and body language. The aim of our project is to implement a real time command system through hand gesture recognition, using general purpose hardware and low costing sensor like a simple Raspberry-pie and an USB webcam, so any user can make use of it in industries or at home. The basis of our approach is a fast segmentation process to obtain the hand gesture from the whole image which is able to deal with large number of hand shapes against different backgrounds and lightening conditions, and a recognition process that identifies the hand posture for different control application.

Keywords . Raspberry-Pie, DC motors, Arduino

I. INTRODUCTION

Gestures can originate from any bodily motion or state but commonly originate from the face or hand. Many approaches have been made using cameras and computer vision algorithms to interpret sign language. However, the identification and recognition of posture, gait, proxemics, and human behaviors is also the subject of gesture recognition techniques. Gesture recognition seen as a way for computers to begin to understand human body language, thus there's a need of building a richer bridge between machines and humans than primitive text user interfaces or even GUIs (graphical user interfaces), which still limit the majority of input to keyboard and mouse. This could potentially make conventional input device such as mouse, keyboards and even touch-screens redundant. The project is an application for live motion gesture recognition using raspberry-pie camera module and performs the action corresponding to it. In our case we have controlled the motion of a mobile robot according to the gesture of the user.

II. PROPOSED METHODOLOGY

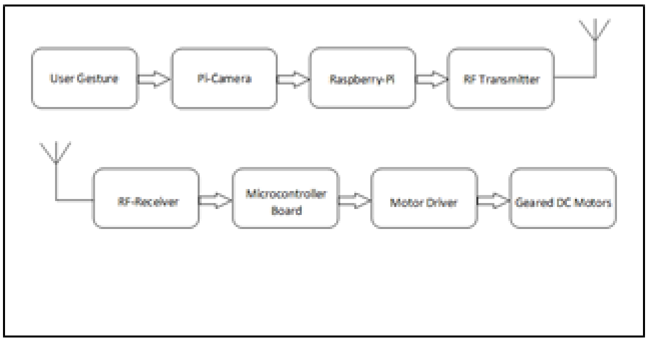

Figure 1.1. Block Diagram

Implementing image processing using hardware is a cumbersome and difficult task thus selection of the proper development board becomes an important issue. The most commonly used boards with which we all are familiar are the Ardiuno, Raspberry Pi and we choose to work on raspberry pi due to its high clock speed and cost-effectiveness. Raspberry Pi is based on the Broadcom BCM2835 system on a chip (SOC), which includes an ARM1176JZF- S700 MHz Processor, Video Core IV GPU, and has 512 MB of RAM. It has a Level 1 cache of 16 KB and a Level 2 cache of 128 KB. The Foundation provides Debian and Arch Linux ARM distributions for download. Tools are available for Python as the main programming language, with C, C++, Java, Perl and Ruby.

Communication

We have used RF-module, WIR-1186 available on robotics India Pvt.Ltd. For transmitting data from laptop to robot as RF has long communication range. This module integrates RF69, an extreme low-power sub-GHz transceiver, an MCU for wireless network control, data handling and hardware interface, a PCB antenna and matching circuit. It supports UART communication protocol and baud rate ranging from 9600bps to 115200bps.

Driving Of Robot

We have used two single channel motor driver (model no. RKI- 1340) available at Robotics India Pvt. Ltd. for controlling the speed of the motors used in robot. This driver is 6v-24v compatible 20A capable DC motor driver. It comes with a simple TTL/CMOS based interface that can be connected directly to I/Os of a MCU. Speed of the motor can be controlled by PWM signals generated by any MCU.

III. HARDWARE AND SOFTWARE DETAILS

HARDWARE USED.

1. ATmega328P microcontroller (Arduino UNO).

Figure 2. Arduino Uno microcontroller based development board

Fig 1.2 shows the arduino Uno board. Arduino/Genuino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller

2. ZigBee

ZigBee is an emerging technology designed for lowdata-rate, low power consumption and low cost applications. ZigBee technology is a wireless networking protocol with advantages like. low data rate, low power consumption, low cost, shorter time delay, and larger network capacity, high reliablity targeted towards automation and remote control applications.

3. Raspberry Pie

Figure 3. Raspberry Pi-2 model development board

The Raspberry Pi has a Broadcom BCM2835 system on a chip, which includes an ARM1176JZF-S 700 MHz processor, Video core IV GPU and was originally shipped with 256 megabytes of RAM, later upgraded to 512MB.It does not include a built-in hard disk or solid-state drive, but it uses an SD card for booting and persistent storage.

The components present in the raspberry pi module are

i) Processor/SOC (System on Chip).- The Raspberry Pi has a Broadcom BCM2835System on Chip module. It has an ARM1176JZF-S processor.

ii) Power source. The Pi is a device which consumes 700mA or 3W power.

iii) SD Card.

The Raspberry Pi does not have any on board storage available.

iv) GPIO General Purpose Input Output.

General purpose input/output(GPIO) is a generic pin on an integrated Circuit whose behavior, including whether it is an input or output pin, can be controlled by the user at runtime.

v) DSI Connector.

It defines a serial bus and a communication protocol between the host (source of the image data) and the device (destination of the image data).

vii) Audio Jack.

A standard3.5mm TRS connector is available on the RPI for stereo audio output.

4. DC Motors.

In this project we use simple DC motor for the rotation of the wheel which is responsible for the movement of the robot. Usually DC motors convert electrical energy into mechanical energy.

5. Motor Drivers.

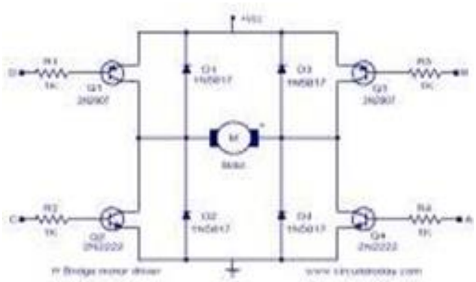

Figure 4. H Bridge Circuit

Motor drivers are used to describe the direction of movement of the robot. It is used to give high voltage and high current as an output to run the motors which are used in the project for the movement of the robot. Fig 1.4 is the circuit of the H Bridge which is used for the motor driving in the IC l293D and also provides bidirectional motor control. Bidirectional motor control.

6. RF Module

RF module is a small size electronic device that is used to transmit or receive radio signals between two devices. The main application of RF module is an embedded system to communicate wirelessly. The communication may be accomplished through radio frequency communication. RF communications incorporate a transmitter and receiver.

Types of RF Modules

1. Transmitter Module. A Transmitter module is capable of transmitting a radio wave and modulating wave to carry data.

2. Receiver Module. An RF Receiver module receives the modulated RF signal and demodulates it.

3. Transceiver Modules. An RF transceiver module incorporates both a transmitter and receiver.

4. SOC Module. An SOC module is the same as transceiver module, but it is often made with an on board microcontroller.

SOFTWARE USED.

1. Arduino IDE 1.6.7

For programming the microcontrollers, the Arduino project provides an integrated development environment (IDE) based on a programming language named Processing, which also supports the languages, C and C++.The open source Arduino IDE makes it easy to write code and upload it to the board.s

IV. RESULT AND DISCUSSION

The complete setup of the gesture control was carried out in the robotics and satisfactory gesture control are obtained which are illustrated in the below table.

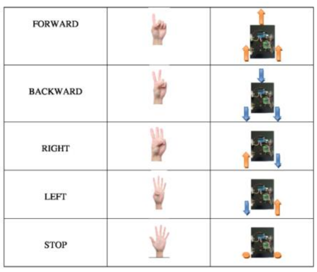

Figure. 5 Gesture control

V. CONCLUSION

We have implemented Convex-Hull detection method to recognize the gesture in raspberry-pi. There are many algorithms available to detect gesture like Haar Cascade method where we need a lot of positive and negative images to train the filter which is very time consuming and adding a new gesture would be thus very cumbersome. However, In the Convex- Hull detection algorithm we can easily add a gesture and since this algorithm uses adaptive thresholding, there is no effect of light intensity and it sets the threshold dynamically with the amount of light present. The drawback of this method is the limited number of gesture as gestures depend on the number of fingers.

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