



Image Processing Technique for the Gesture Controlled Robot

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Abstract:

Now these days gesture controlled robots operates with humans next to them. Whereas, this project deals with combination of robots through gesture controlled phenomenon but distance away from the user. This can be dealt through image processing technique. The command signals are developed from these gestures using image processing. These signals are then passed to the robot to operate it in the specified direction. This project presents a novel algorithm to recognize a set of static hand gestures for the Human Computer Interaction (HCI) and controlling a robotic car wirelessly after successful recognition using X-Bee module. Through this method, the user can control or navigate the robot by using gestures of his/her palm. The command signals are generated from these gestures using image processing. These signals are then passed to the robot to navigate it in the specified directions. In short we have implemented a system through which the user can give commands to a wireless robot using gestures. The application for gesture recognition has been created on MATLAB environment with operating system as windows 7. The system has been tested and verified under both incandescent and fluorescent lighting conditions. The experimental results are very encouraging as the system produces real-time responses and highly accurate recognition towards various gestures.

Keywords: Gesture controlled technique; image processing technique; navigate in specific direction; operates with humans.

Introduction:

Nowadays, automation has become a most desirable means of operating a device. The word which comes to our mind when we say “automation” is “robotics”. Robotics plays a vital role in our society. Many undergoing projects are about robotics since, they reduce man power. Some of the robotic projects are also used for even crucial tasks which may harm the life of mankind. In early days, for operation of robots a person should be physically present beside it for operation. Our paper is about to operate a bot which may not be near us and could be operated from a station. How this is made possible? This can be executed through a technique called Image Processing. That is we can operate the bot from a base station by means of hand gesture. The hand gesture is received by the robot and it operates accordingly. Recently, the demand for the indoor robots has increased tremendously. Therefore, increased opportunities for many people to operate the robots have emerged. However, for many people, it is often difficult to operate a robot using the conventional methods like remote control. The variety of physical shapes and functional commands that each remote control features also raises numerous

problems: the difficulties in locating the required remote control, the confusion with the button layout, the replacement issue and so on. A simple definition of the term gesture is suggestive movement of bodily parts such as fingers, arms etc, which convey some information. Waving the hand is a gesture that suggests “good bye”. Even though gestures can originate from any bodily movement, generally it originates from movement of face or hand. Gesture is one of the most natural and expressive ways of communications between human and computer in a real system. We naturally use various gestures to express our own intentions in everyday life. Hand gesture is one of the important methods of non-verbal communication for human beings. Hand gesture has been one of the most common and natural communication media among human being. Hand gesture recognition research has gained a lot of attention because of its applications for interactive human-machine interface and virtual environments. So, we propose a robot operation system using the hand gesture recognition. Based on one unified set of hand gestures, this system interprets the user hand gestures into pre-defined commands to control the robotic car wirelessly using X-Bee module. Unlike the conventional method for hand gesture recognition which makes use of markers, special gloves or any other devices, this method does not require any additional devices and makes the user comfortable as in the glove-based system user needs to wear burdensome accessories, which are generally connected to computer. This barehanded proposed technique uses only 2D video input. Our hand gesture recognition system was carried out on a 2.33 GHz Intel (R) Core TM 2Duo CPU 2 GB RAM on Windows 7 platform using MATLAB R2010a.

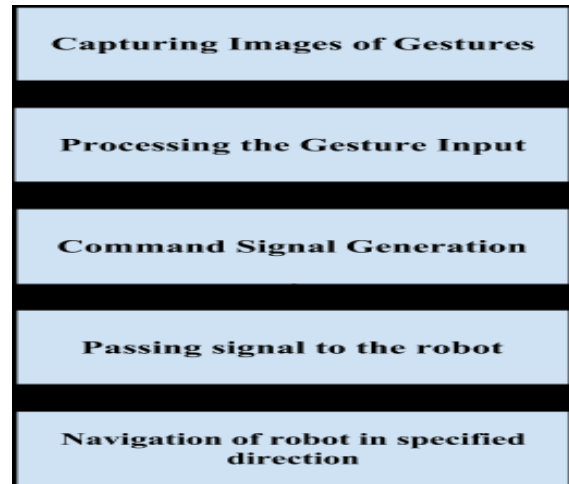


Fig.1. Basic flow of system

Technologies Used

- ❖ Halide
- ❖ PIC18 Microcontroller
- ❖ MRF24WG0MA/ MRF24WG0MB
- ❖ L293D: Motor Driver

Design:

PIC18 MICROCONTROLLER:

PIC18 Microcontroller is considered as the heart of our project. It sends various instructions to the whole system for desired action. Here we use PIC18 Microcontroller which can easily interface with the Wi-Fi module which we have chosen. The micro controller used is of 32 bit. Also the speed of the micro controller is 40MHz.



Fig.2. PIC micro-controller chip

MRF24WG0MA/ MRF24WG0MB:

The MRF Module connects to a certain number of PICmicrocontrollers via a 4-wire SPI interface and interrupt and is an ideal solution for lower-power, low data-rate Wi-Fi sensor networks, home automation, building automation and consumer applications. The combination of the module and a PIC MCU running the TCP/IP stack results in support for IEEE Standard 802.11 and IP services. This allows for the immediate implementation of a wireless web server.



Fig.3. MRF24WG0MA

HALIDE :

Halide is a new programming language designed to make it easier to write high-performance image processing code on modern machines. Its current front end is embedded in C++. Compiler targets include x86/SSE, ARM v7/NEON, Native Client, and OpenCL.

1.4. L293D: MOTOR DRIVER:

It takes digital signal as an input from the PIC Micro-controller and gives digital output to the DC motors of the robot. Power supply to the circuit is given by rechargeable batteries. In this system some rechargeable mobile batteries are used as power supply each of 3.7V. To provide more voltage to drive the motors, 2-3 such batteries are connected in

series. The fig.4. shows the structure of the L293D motor driver.

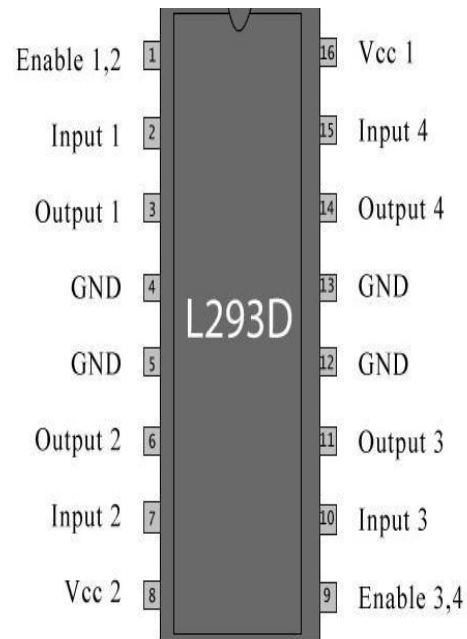


Fig.4. L293D motor driver

Implementation:

The user is present at a station far from the location of the bot from which he operates the robot. The user uses a webcam through a PC or Laptop to perform this process. He waves his hand upwards, downwards, left or right. The robot navigates following the hand gesture. This is the basic operation of our system. The detailed working of our system is discussed below. The webcam captures the video stream of the hand gestures in real time environment. The hand gestures are recorded and sent as a generated signal through a Wi-Fi from the station to the Wi-Fi module present in the robot. Therefore, Wi-Fi acts as a channel for transmission of signals.

Two ways of recording the hand gestures are followed namely,

- a) Finger Count Method
- b) Hand Palm technique

The efficiently used method is hand palm technique since; finger count method does not provide required depth in output. The Wi-Fi signal is received by the module in the system i.e., MRF24WG0MA. It works at standard IEEE range 802.11. It sends the received signal from the station to the micro-controller. The program fed to the micro-controller is HALIDE. This is the most efficiently used programming languages for image processing. The micro-controller sends the command to the whole system proportional to the signal received. The micro-controller performs image thresholding and performs the operations. Later, the signal is converted to digital signal. Finally the processed signal is sent as a command to the motor driver. The motor driver facilitates the navigation of the robot to happen. Unless, the gesture is changed by the user, the robot continues moves in the previous direction.

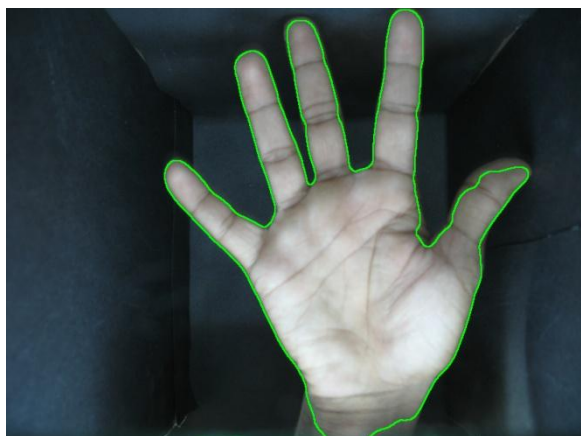


Fig.5. Input image

Here we are giving an image as an input shown in fig.5. we place our palm in front of the system and by applying image processing the picture will be shown in a different threshold image, by using this system to perform the operations by moment.



Fig.6. Thresholded image

Capturing Gesture Movements:

Image frame is taken as input from the webcam on the control station and further processing is done on each input frame to detect hand palm. Figure 7 is an example of an input frame. This involves some background constraints to identify the hand palm correctly with minimum noise in the image.

Hand Palm Detection

After capturing the image frame from the webcam, some basic operations are performed on this frame to prepare it for further processing of command detection. These operations are necessary for implementing both the techniques of gesture control, following two main processes are done to detect hand palm.

Thresholded Image:

Image frame taken as input from webcam is thresholded starting from minimum threshold value till single contour is formed in an image, same is in the case of intensity based thresholding. In the Figure 7 two fingers are

shown by the user as a gesture command having dark background. That image is thresholded so that only a single contour can be formed on it. This thresholding is done on the basis of intensity in the image, which neglects the dark background and thresholds the fingers.

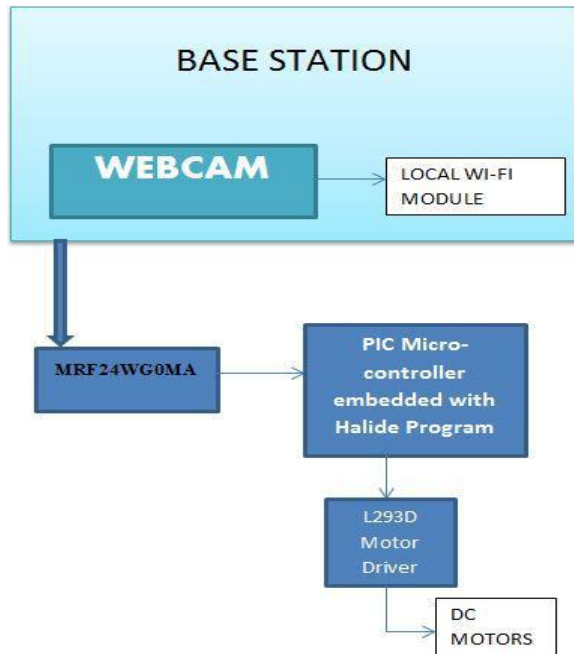


Fig.7. Block Diagram Of Working Of The System

Conclusion:

The Gesture Controlled Robot System gives an alternative way of controlling robots. Gesture control being a more natural way of controlling devices makes control of robots more efficient and easy. This project adds a special feature that this gesture controlled robot can be operated from a considerably far off place through hand gestures. Hence it reduces the chances of danger for human life in crucial areas. Application wise, this robot can be for defense purpose.

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