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Hand Gesture Recognition for Robotic Car Control

[I]Abhijit Nale, [II]Ankush Barkade, [III]Pravin Ekhande, [IV]Shreyas Dayal
[I,II,III,IV]Dept. of CSE, ISB & M School of Technology, Pune, India

Abstract
Nowadays use of robots is increased in large amount. This paper presents a algorithm to control the robotic car using hand gesture recognition. This system is used for human computer interaction (HCI). The human can control the robotic car by using gesture of his/her palm. Webcam is used to capture the hand movement of the user. Image processing is used to detect the gesture perform by the user. The command signals are generated from these gestures. These signals are passed to the robotic car to move in the direction specified by the user. This way we have created a system in which user can control the robotic car by his/her hand gesture wirelessly on windows7 platform by using java and embedded C technologies.

Keywords
Hand Gesture Recognition, Human Computer Interaction (HCI), Image Processing, Robot Control, Webcam.

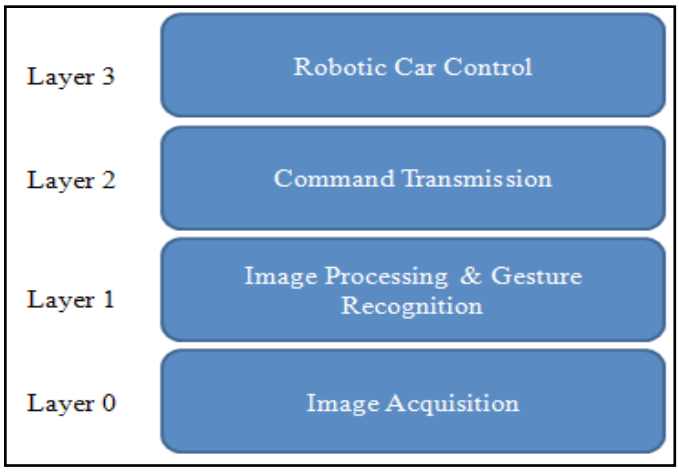
I. Introduction

Nowadays world is getting changed tremendously, new technologies emerging to reduce human efforts and gain large amount of output in short span of time. To achieve such goals the demand for indoor as well as outdoor robots is increased. But many operators fill complicated to handle those robots. There are certain options to reduce complexity, such as use of remote control. But remote controller also consist hardware as well as signal problem, command problems etc. To avoid those problems term gesture is one of the effective options to control and handle the robots using movements of palm of hands. Gesture can be produced or perform by palm of users. Gesture is one of the most powerful virtual medium for communication between human and computer. So we have proposed hand gesture recognition system to perform various functionalities of robotic cars, such as navigation of car as per the commands given by user by using hand gesture.

The techniques previously used for gesture recognition were having some limitations, such as some techniques are not user friendly and some of them having complex calculations. In our system we don't use markers, special gloves, or any other devices to recognize hand gesture such as in previous systems. Hand gesture recognition system is completely based on augmented reality. System takes 2D video as input for generating gestures to communicate with the robotic car. Hand gesture system consist of 2.4 GHz Intel (R) core 2 Duo processor, 2 GB RAM that is based on windows7 platform.

II. Proposed System

The hand gesture recognition system for robotic car control is consist of four layers such as, image acquisition, image processing and gesture recognition and command transmission, robotic car control as shown in Fig.1. In Layer 0 the user makes gesture by positioning hand parallel to webcam. Images are continuously captured and then given as input for image processing and gesture recognition. Layer 1 consist analysis phase for image processing. There are various algorithm used for image processing and hand gesture. Such as, skin detection algorithm is used that detects the skin region from the input image, the video obtain through a webcam is in RGB color model this video is converted to HSV color model because the region which belong t skin can be easily identified in HSV model, after recognition hand it is converted into a binary image. The skin region is represented using white color and all other non skin region are black. The largest connected region, which is taken as the hand region. This gives the segmented hand region and this is the region of interest. The recognition of the gesture depends on this region. In layer 2 the commands are generated from the gestures and transmitted to the robot controller that is present in layer 3.



By using the robot controller navigation of robotic car as per the commands of the user is shown in layer 3.

III. System Design

The system is designed for control of a robotic car. System consists of robotic car unit, 2D imaging system i.e webcam, control, communication unit, image processing and gesture recognition unit.

A. Imaging System

In imaging system it consist of a camera that is used to capture images of the gestures of hand performed by the user. In this system a 5 mega pixel still web cam is used to capture images of gestures performed by the user.

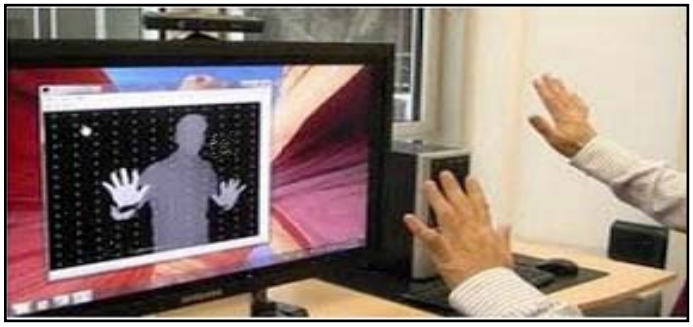


Fig. 2 : Imaging system unit

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B. Image Processing and Gesture Recognition Unit

In image processing unit various algorithms and operations are performed on the image captured by the imaging system. A gesture recognition system is developed to effectively recognize hand gestures with less computing and high accuracy. The activities performed by image processing unit are as follows:

- Image acquisition to get hand gesture.
- Enhancement of acquired image.
- Determination of the gesture.
- Generation of instruction corresponding to the gesture.

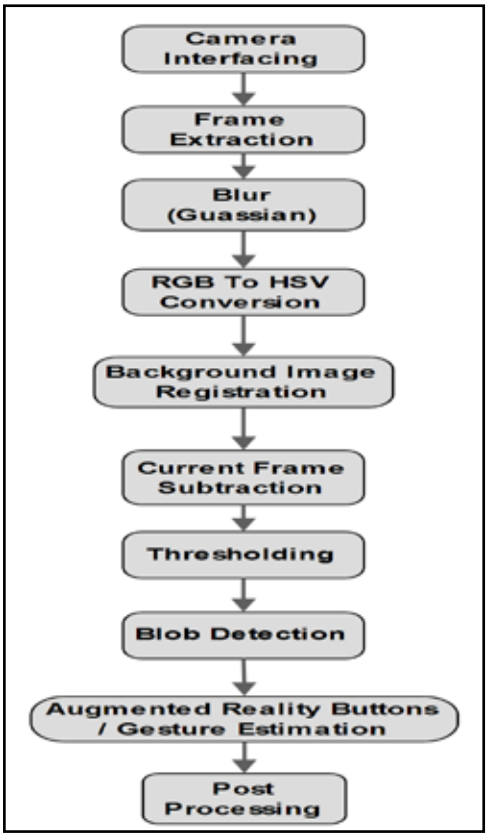

Fig. 3 : Flow diagram of gesture recognition unit

C. Communication Unit

After recognition of gesture by the gesture recognition unit communication unit is used to transmit the command to the robot car unit. A ZigBee transmitter is used to transmit the signal from the transmitting end and a ZigBee receiver is used to receive the signals.

ZigBee S1 module

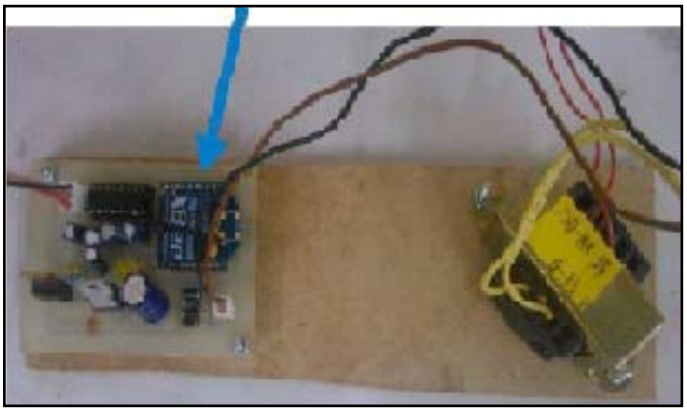

Fig. 4 : Wireless Communication Unit

D. Robotic Car Unit

The Robotic Car Unit comprises of a microcontroller (PIC16F877A) to take decisions depending on the received code. The different microcontroller interfaces implemented in the Robotic Car Unit are shown in figure 6. PIC16F877A works on 5V, while the X-Bee module works on 3.3V, so we have designed a regulated power supply for this purpose. DC motors are used to physically drive the application as per the received code. The dc motor works on 12 V. To drive a dc motor, we need a dc motor driver called L293D. This dc motor driver is capable of driving 2 dc motors at a time. In order to protect the dc motor from a back EMF generated by the dc motor while changing the direction of rotation, the dc motor driver have an internal protection suit. We have also provided the back EMF protection suit by connecting 4 diode configuration across each dc motor .

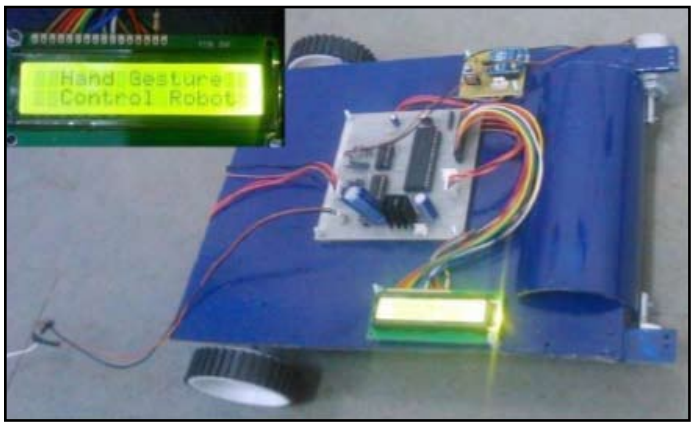

Fig. 5 : Robotic car unit

IV. Working of Robotic Car

The working of robotic car is controlled by hand gestures. After recognition of gesture the command is send to the robotic car and the car will navigate according to the user command. Movement commands are written as a function in robot specific language. We are using six predefined operations as follows “Start”, “Stop”, “Left”, “Right”, “Forward”, “Backward”.

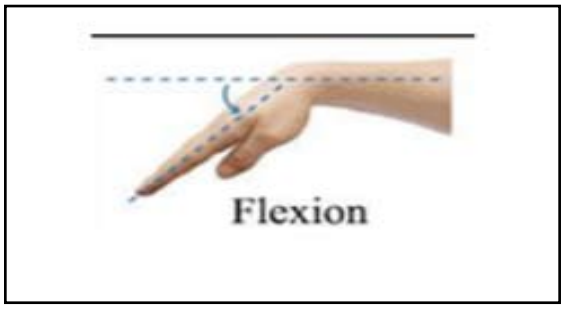

Fig. 6 : Move Forward

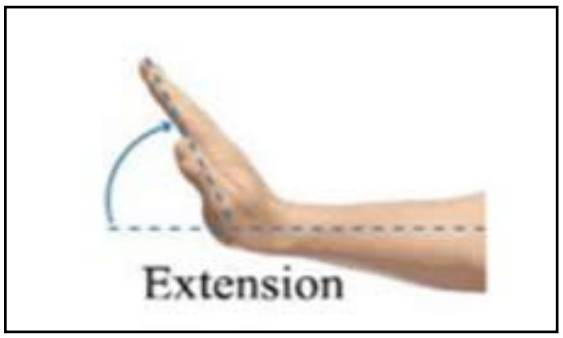

Fig. 7 : Move Backward

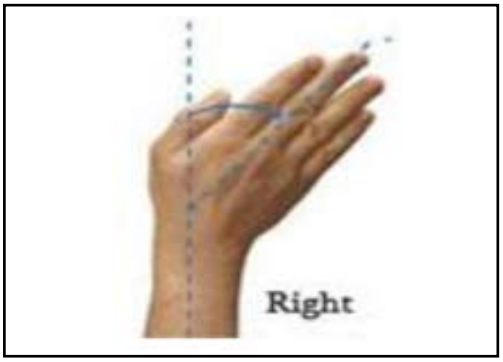

Fig. 8 : Move Right

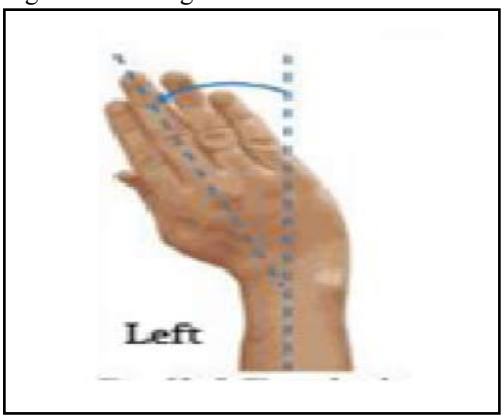

Fig. 9 : Move Left

V. Applications

As the need of robots in industry as well as in home appliances is increasing, the demand of user friendly robots is also increasing. In this system the communication with robotic car is made very simpler so this system can be used in industrial as well as home appliance to control robots. The control of robotic car by the hand gesture will lead the driver to drive car more safely. A person who is physically handicapped can also drive the car only by his/her hand gestures. This technique can also be used to drive the wheelchair by the patient himself. This way the applications of this technique are myriad.

VI. Conclusion

We proposed a system to control robotic car by using hand gestures of the user and simple algorithm for a hand gesture recognition problem. The system processes effectively on real time images captured by the camera and transmits the accurate command to the robotic car according to the gesture of the user. We have considered limited number of hand gestures and they implemented in simple conditions. Our system can be extended to recognize large and various types of gestures and to work in harder conditions. The results of the system are encouraging to do the further research in this technique.

VII. ACknowledgement

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