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Gesture Controlled Robot Using Image Processing

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Abstract-- *In today's era, robotic industry has been developing many new trends to increase the efficiency, accessibility and accuracy to the systems. . The popularly known robot in today's generation has been a gesture controlled robot. Gesture recognition has various applications like computer games, machinery control, and various types of robotic movement and through mouse replacement. In our project, we will be implementing a robot which will be controlled using gestures of the color markers. The gestures will be identified from the webcam present in the laptop through image processing. The camera will catch the live video of the gestures which will be simulated in MATLAB. The command signal is the data in the digital form. They will be generated from these gestures. These signals are serially transmitted to arduino board which will control the motor. Here we are transmitting different types of operation which will help the robot to navigate in specified direction.*

Keyword--*Gesture, Color Marker, MATLAB, Arduino, Web Camera, Image Processing.*

I. INTRODUCTION

In 21st century, the demand of robots has been increasing exponentially. Be it in military, entertainment, medical, sports, etc. The application of robots is seen widely all over the world. A robot is an electro-mechanical agent that can be guided by computer programming. It can carry out activities taking from simpler one to the most complicated one according to the computer programming installed in it[1]. The robots can work efficiently and with accuracy, thus reducing the labor work. Although robots can be controlled by physical devices, the recent method of gesture control has become very popular. Through this method, the link between the real world and digital world can be formed.

A. Gesture controlled robot

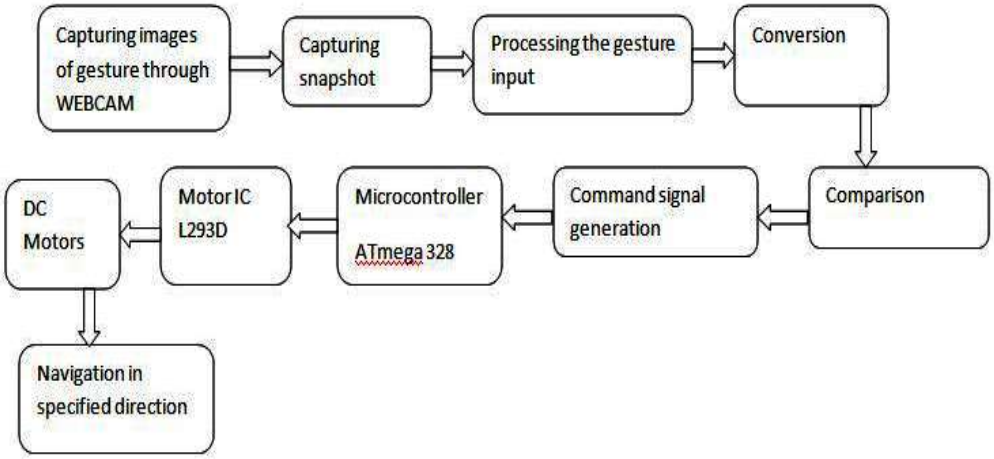
Gesture is the most expressive and natural way to communicate between humans and a robot in a real time system. Hand-gesture is one of the important methods of non verbal communication for human beings. The main purpose of using hand gestures is that it provides more natural way of controlling and a rich way of intuitive form of interaction with the robotic system[2]. Gesture controlling is very helpful for handicapped and physically disabled people to achieve certain tasks. It can be used to control interaction for entertainment purposes such as gaming to make the user's experience more interactive and immersive. Movement of the hand in specific direction will transmit a command to the robot which will then move in specified direction.

B. Existing system

Gesture only interfaces with syntax of many gestures typically require precise hand pose tracking. A common technique is to instrument the hand with a glove which is equipped with a number of sensors which provide information about hand positions, and orientation of the finger[3]. The first commercially available hand tracker, the Data Glove, was described in a video from 1987. This uses a thin fiber optic cables running down the back of each hand, each with a small crck i it.. Light

shines down the cable, so when the fingers are bent, light leaks out through te cracks. Measuring light loss gives an accurate reading of hand pose. The Data Glove could measure each joint bend to an accuracy of 5 to 10 degrees[6].

C. Proposed System



The image processing is the heart of our project. The whole controlling is done by microcontroller. The gestures will be captured in the webcam of the laptop. The camera recognizes and tracks users' hand gestures and physical objects using computer-vision based techniques. The webcam also takes the snapshots of these gestures. The software program processes the video stream data captured by the camera and tracks the locations of the colored markers at the tips of the user's fingers. Next, the RGB image in which red, green, blue color gets separated is seen. The gestures generates command signal. This signal gets simulated in MATLAB. The movements and arrangements of these fiducials are interpreted into gestures that act as interaction instructions for the projected application interfaces. The laptop is connected to the microcontroller i.e. ATmega328 using serial communication protocol. The L293D motor driver IC is connected so that it can drive the DC motors according to the program. Thus, these motors help the robot to navigate in specified direction.

II. HARDWARE COMPONENTS

A. DC Motor

An electrical machine which converts electrical energy into mechanical energy is called a DC Motor. The working principle of a DC Motor is that "whenever a current carrying conductor is placed in a magnetic field, it experiences a mechanical force". This principle of direction was given by Fleming's left hand rule. In the project, the dc motors are used to drive the robot in specified direction.

B. L293D motor driver IC

Most microprocessors operate at low voltages and require a small amount of current to operate while the motors require a relatively higher voltages and current. Thus current cannot be supplied to the motors from the microprocessor. This is the primary need for the motor driver IC. A motor driver IC is a chip which is usually used to control motors in robots. Motor driver ICs act as an interface between microprocessors i.e. Arduino and the motors present in the robot[4].

C. Arduino Uno

The Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins, 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. ATmega 328 is a 28 pin IC. There are 3 ports available on it. Port B, Port C, and Port D. Remaining pins are of VCC, ground and reference. Total 6 input/output pins of Arduino Uno are used to interface the L293D motor driver IC. One pin for power supply and another one to ground[5].

D. Camera

It captures the image of the object in view and track the user's hand gesture. The camera recognizes individuals, images, pictures, gestures that user makes with his hand.
Basically the camera forms a digital eye,which connects to the world of digital information[7].

E. Colored Marker

There are color markers placed at the tip of users finger.
Marking the user's fingers with red, yellow green and
blue colored tape helps the webcam to recognize the hand gestures.
The movements and arrangement of these markers are
interpreted into gestures that act as a interaction instruction for the projected application interfaces.

III. IMPLEMENTATION

A. Capturing images of Gesture through WEBCAM

For the system to work we need a sensor to detect the hand movements of the user. The webcam of the computer is used as a sensor. The webcam captures the real time video at a fixed frame rate and resolution which is determined by the hardware of the camera. The frame rate and resolution can be changed in the system if required.

B. Capturing snapshot

The webcam also takes the snapshots of these gestures.

C. Processing the gesture input

The software program processes the video stream data captured by the camera and tracks the locations of the colored markers at the tips of the user's fingers.

D. Conversion

Image frame taken as input from webcam is thresholded starting from minimum thresh value till single contour is formed in an image, same is in the case of intensity based thresholding[8]. In the Figure one boll is 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 ball.

E. Command signal generation

The gestures generates command signal. These signals gets simulated in MATLAB. The movements and arrangements of these fiducials are interpreted into gestures that act as interaction instructions for the projected application interfaces.

F. Microcontroller ATmega 328

The laptop is connected to the microcontroller i.e. ATmega328 using serial communication protocol.

G. Motor IC LM293D

It takes digital signal as an input from the Arduino 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.

H. DC Motors & Navigation in specified direction

The L293D motor driver IC is connected so that it can drive the DC motors according to the program. Thus, this motor helps the robot to navigate in specified direction.

(*original image)*

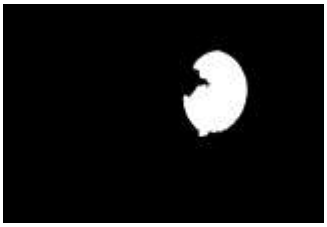
(ycbcr image)

(red reflected image)

(blue reflected image)

(green reflected image)

(final image)



(final image with white spots removed)

IV. CONCLUSION

The ultimate goal of our project is to create a link between real world and digital world. The gesture controlled robot system gives an alternative way to control robots. Gesture control, being a more natural and entertaining way of controlling devices, makes control of robot more easy and efficient. With help of a sixth sense device the user can easily access data from any machine at real time speed. The user doesn't require any machine-human interface to access the data. The data access through recognition of hand gestures is much easier and user friendlier compared to the text user interface or graphical user interface

which requires keyboard or mouse. This project is used to implement several applications that have shown the usefulness, viability and flexibility of the system.

V. FUTURE SCOPE

Our system has shown the possibility that interaction with machines through gestures is a feasible task and the set of detected gestures could be enhanced to more commands by implementing a more complex model of a advanced vehicle for not only in limited space while also in broader area as in the roads too . In the future, service robot executing many different tasks from private movement to a fully-fledged advanced automotive that can make disabled to able in all sense.

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