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Human Computer Interaction Based on Hand Gesture

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Abstract: ***Many hand-controlled robots are developed for visually impaired people in order to make them live confidently. This project work proposes a Human Computer Interactions with the help of gestures recognition wireless to help physically handicapped persons to move robot in desired direction lives. The project work is framed into three stages. First, gesture capturing and recognition – gesture capturing uses a laptop or pc camera that takes input from our hands and gesture recognition based on the finger count algorithm. Secondly, Transmission of data wireless – ZigBEE Module is used for serial transmission of data, Finally, Movement of Robot - The robot will move based on the fingers opened or fingers closed and displays the direction in laptop or pc in which direction the robot is moving. This project work can be able to insist the physically enabled people in their daily life. The entire process will run on Arduino Uno, ZigBEE Module, L293D Motor Driver***

Keywords: Arduino Uno, Human Computer Interaction, Gesture Recognition, ZigBEE Module, L293D Motor Driver.

I. INTRODUCTION

According to 2001 census India has a population of 21 million people which are physically handicapped out of which 7% people can't hear properly and 28% of the people can't move from their respective places. 75% of the cases can be avoidable with the help of technologies. In this modern era computers are being used by many people and its demand is still growing. The computing industry went through lot of advancements in the recent years. The modern systems can handle with more interface devices than mouse & keyboards. The use of hand gestures in Human Computer Interactions (HCI) was implemented in many studies. However, such implementations mainly require the use of specific hardware such as special gloves, helmet and other equipment with sensors such as accelerometer, gyroscope. Recently, with the increase in the computational capacity of computers, there are many studies which implements gesture recognitions methods based on computer vision techniques [1,2]. Most of these methods require lot of memory space to operate. This study also implements a computer vision based gesture recognition method to operate robot. This paper provides details about controlling of robot wireless by using XBEE module so that the transmission distance is also high, and we can operate the robot properly from anywhere in the straight lands.

A. Existing System

The most and widely used method of controlling the robot are with the help of Bluetooth, WIFI, RF Transmitter and Receiver. The use of special devices to aid the interaction between humans and computers has been implemented in multiple studies. The earlier studies report implementation of gesture based interaction method using either computer vision techniques or using sensors such as accelerometer [3,4]. The addition of these devices and sensors have contributed in developing systems such as Virtual or Augmented reality, voice or gesture based control systems in cars, music players, mobile phones etc. One of the major issue in detecting hand gesture is the adaptive color segmentation due to the color of the background, finding hand location and effects of morphological filtering. There are some devices such as Microsoft Kinect which can detect the gestures for the purpose of playing the video games. However, this device can only detect general hand movements but not the specific movements of wrist or fingers. Some studies also employ algorithms such as scale invariance feature transform (SIFT) along with machine learning algorithms such as support vector machine (SVM) to detect or classify the gestures from images [4]. A 3-D gesture interaction technique based on single camera is also implemented by Rodriguez et al. [6]. The hand gloves equipped with analog flex sensors to measure the finger bending for controlling robot is difficult to operate because of glove can be operated only by specific person if anyone else want to operate robot it is difficult to operate, and it is expensive. The accelerometer is also used to control the robot wireless, but expensive calibration is difficult. Controlling the robot using WIFI is complex because if we can operate the bot in nearby surroundings where the modem is installed. Human Computer interactions based on gesture recognition with the help of Bluetooth is complicated because its transmission distance is only 100 meters.

II. METHODOLOGY

The aim of this study is to implement a system which can be used to operate a robot wirelessly using hand gesture in the natural environment. A video camera or webcam will be used to capture video stream of hand gestures and the computer system will process it order to identify the gesture type. Based on the gesture type, the commands such as moving left, right, backward and forward will be sent to robot wirelessly. The robot will receive these commands and perform operations accordingly. The present system can be divided into two parts.

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A. Process Flow

The system is divided into two parts; on the server side, the image will be captured and the gesture is identified and the respective command will be sent to the client side wirelessly via ZigBee module. On the client side, the Zigbee module will receive the command and the robot will execute the received command. The server side and client side process flow is depicted in the Fig. 1 & 2 respectively.

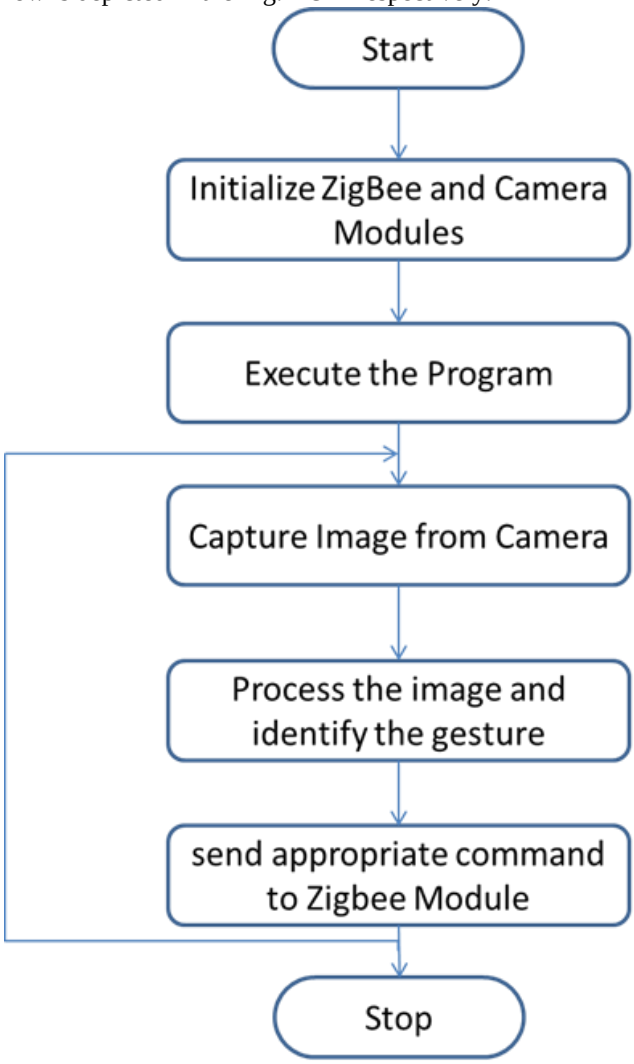

Fig. 1. Server-Side Process

B. Implementation

The main motto of choosing Image processing technique is because of its advantages and it can be implemented very easily with the help of image processing we can control a robot wireless by giving hand gestures. In transmitter section Universal Serial Bus interface, XBEE transmitter, RS232 Cable is employed together. Firstly, we should initialize the RS232 cable and USB to laptop and check the COM number in device manager, the XBEE must be in vice versa connection to USB i.e., transmitter of XBEE is connected to receiver of USB and receiver of XBEE is connected to transmitter of USB followed by running a python code. OpenCV is a library of Python which was used for numerical calculations of dots between the fingers. Threshold is used to display grey scale images of gestures and Contour is used for labeling and blocking the fingers outside the margin which is used for morphological operations. Python prompt is used to display the directions in which the robot is moving. The camera captures the image, which then be transmitted via ZigBee module. The image is processed and the command based on the classification is transmitted to the robot. The baud rate for the data transmission is set to 9600.

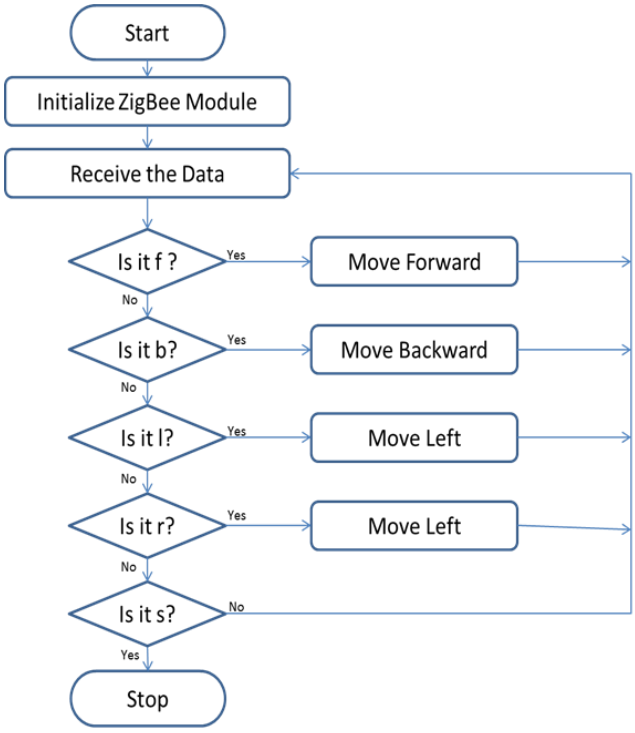

Fig. 2. Client-Side Process

Fig. 3 & 4 depicts the transmitter side and receiver side implementation respectively

Fig. 3. Transmitter

In Receiver section Arduino Uno, L293D Motor Driver, DC Motors, Rechargeable Battery ZigBEE Module Receiver, Robot Chassis are incorporated. The command data is received by ZigBEE receiver module and transmitted to the L293D Motor Driver module. The motor driver IC will drive the motors based on the command received from the ZigBEE receiver module, and hence the movement of the robot is defined.

If an entire palm is shown in front of camera, the robots will start moving in forward Direction and if the palm is closed completely the robot will stop moving If the hand with four fingers open is displayed to camera, the robot will start moving backward, similarly, the hand with three fingers open will result in the robot moving in right side direction, and hand with two fingers open will result in robot moving left side direction The predefined gestures are the principle parts of the recognition system. These gestures are stored by Gesture Manager. The Gesture Manager is a library which maintains the list of the gestures. In order to detect the gesture in an image, the system compares it with the data in the Gesture Manager. The first step in the detection is to measure the similarity between each fingers constellation. The bend values of the fingers are presented by a five dimensional vectors and the similarity is calculated by measuring the distance with the stores gesture postures. Similarly, the position or the orientation is also calculated. This process will continue until the stop command or the fist gesture is shown to the camera.

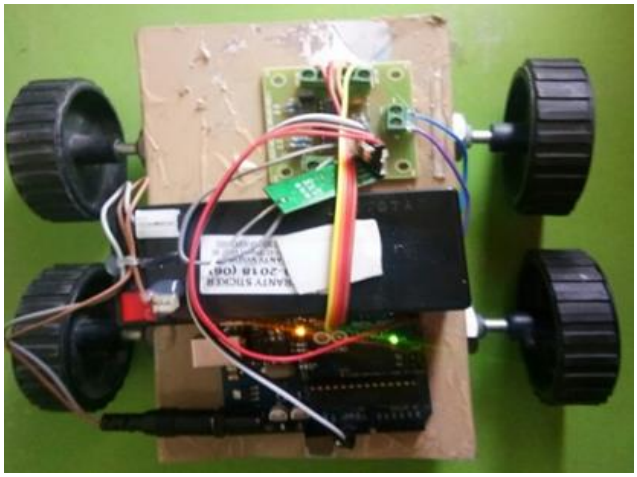

Fig. 4 Receiver Robot

III. RESULTS AND DISCUSSION

The different modes of operating the robot depicted in fig. 5,6,7,8 and 9. When a particular gesture is shown to the camera, the algorithm will detect the appropriate command which will then transmit to the robot via XBee module

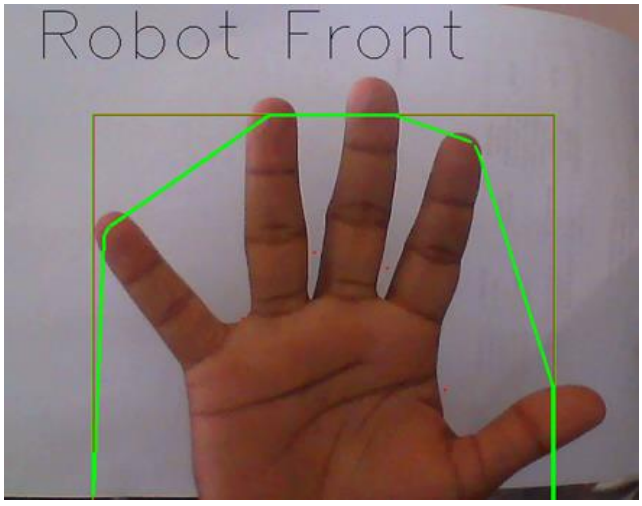

Fig. 4. Five dots to move forward

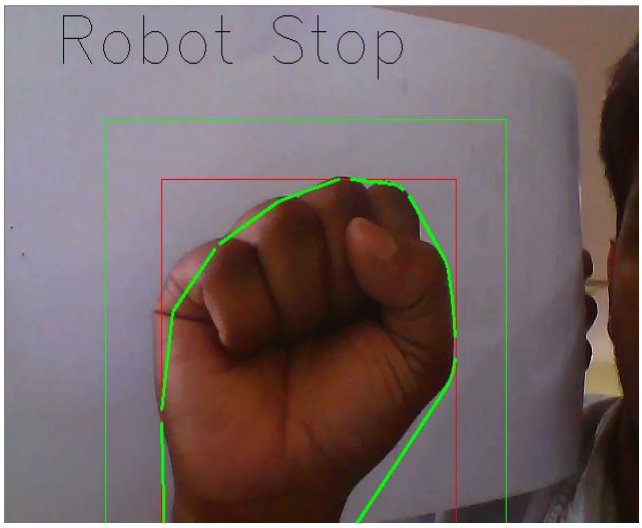

Fig. 5. No dots to stop the robot

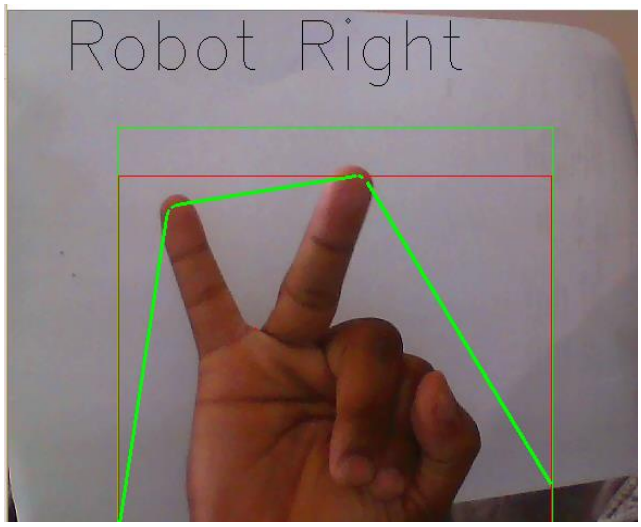

Fig. 6. Two dots to turn the robot right

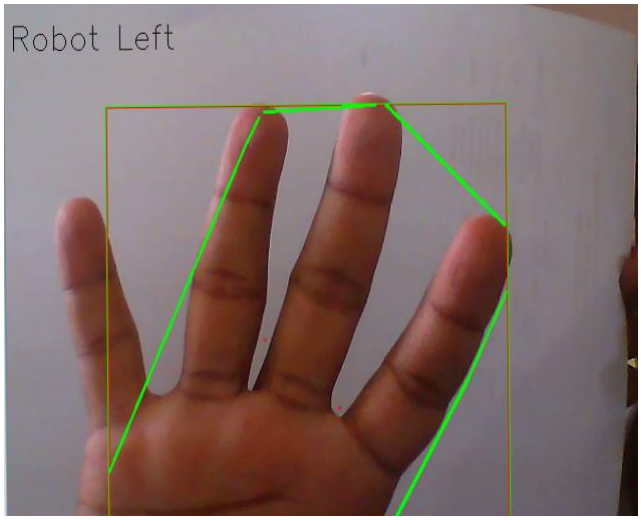

Fig. 7. Four dots to turn the robot Left

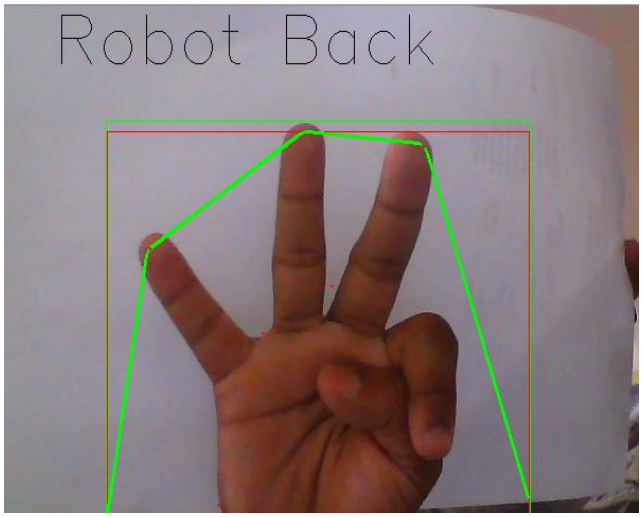

Fig. 8. Three dots to move robot backwards

From repeated experiments it was observed that the system is reasonably quick (approx. 500 ms) to detect the gesture. The process of detecting the gesture, transmitting to robot, being received at robot side and the execution of command took less than one second. While, the system was observed to be performing well, however, in order to capture better imaged it was required that the background was static and preferably of single color. The system was struggling to identify correct gestures when displayed without any clear background.

IV. CONCLUSION

In this paper, the human computer interface based on hand gestures was implemented to control a robot. The robot can be operated using simple hand signs and can be easily operated by young or elderly without any overt training. The system is able to perform adequately in real-time scenarios. The system does not require any special gloves or sensors to control the robot which makes it more cost efficient. The feedback from test subjects who controlled the robot in the real-time was mostly positive. The only complaint by users that sometimes, the background effects the detection of the correct hand gesture. The detection speed and the reaction of the robot was deemed to be reasonably fast. The current setup can only handle five types of hand signs. The future implementations can include detection of more types of hand signs and addition of more components in the robot such as robotic arm so that a robot can be used to perform simple tasks remotely.

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