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Hand gesture recognition for vehicle control

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Abstract: - The rapid evolution in technology has made electronic gadgets inseparable part of our life. To access and control any device we need some interface between human and that device. To do so we have some traditional systems like key board, mouse, touch screen, joysticks etc but as the technology is advancing and we need everything so effortless and compact, but the existing system is not capable of fulfilling it because of its complex hardware, so the aim to publish this paper is to introduce a algorithm which has fast response, is less complex and has less hardware which we use for controlling certain Robotic actions by hand gestures and the system is provided with the security where human face is use as a security code. Most of the systems that use the hand gesture recognition technique have a lot of complication in it such as some hand gesture recognition robot require gloves or markers as sensing device to detect the various hand gesture command. In contrary to all the above mentioned accessories the project proposed by us will not only eliminate these unwanted burdens of carrying the gloves and markers but will also provide a great application in the field of security, as we shall be eliminating the use of these detection devices and give the commands with our bare hands and for the security purpose we are adding additional feature of face recognition.

Key words:-**Correlation, Euclidean distance, Eigen value, Eigen vector, PCA.**

I. INTRODUCTION

Hand gesture recognition is a growing very fast and it is active research topic where we have large scope of improvements and inventions. Gesture is physical action which conveys meaningful information so it is natural way of non verbal communication and is more familiar to human beings. Gesture recognition became an influencing term in some past decades. There have been many gesture recognition techniques developed for tracking and recognizing various hand gestures. Each one of them has its advantages and drawbacks as well. First is wired technology in which users need to tie up themselves in order to connect or interface with the computer system. In wired technology, the user can not freely move here and there in the room as they are limited by the length of wires to cover the distance which connect with the computer system via wire. One of the instances of wired technology is instrumented gloves also called as electronics gloves or data gloves. An instrumented glove contains some sensors which provide the information related to hand location, orientation etc. These data gloves provide results with high accuracy but they are very expensive to utilize in broad range of application. Data gloves were then replaced by optical markers. These markers project Infra-Red light and reflect this light on screen to provide the information about the exact location of hand or tips/knuckles of fingers wherever the markers are worn on hand. These systems also give good result but require very complex configuration. Then some advanced techniques were introduced like Image based techniques which require processing of image features like color, texture etc. If we work with color texture features of the image for hand gesture recognition the result may vary and would be different as skin tones changes from person to person and from one continent to other. And also under different illumination condition, color texture gets modified and leading to changes in observed results. So for adopting another alternative for the same purpose, we reach to employing different shape based features for hand gesture recognition. This is a universal truth that under normal condition every person poses almost the same hand shape with one thumb and four fingers. And to top it all, the above mentioned systems were not having any kind of security. The recognition frame rate achieved is comparable to most of the systems in existence (after allowance for processor speed) but the number of different gestures recognized and the recognition accuracy are amongst the best found. Figure 1 shows several of the existing gesture recognition systems along with recognition statistics and method. [1]

Challenging areas:-

- Human computer interaction
- Robot/vehicle control
- Sign language interpretation
- Immersive game technology

Out of these areas this paper introduces a system where we control robotic actions by using human gesture since robotics has been an important assistive technology.

Early approaches:-

- Use of markers on the finger tips [1]
- Use of hand gloves
- Use of wrist band.

An associated algorithm is used to recognize gesture have been shown in front of the camera. Carrying any of this all the time is little difficult, in this paper we have designed an algorithm which will control Robotic action without using any kind of sensors this algorithm we have design using correlation. Along with this we have provided security to the Robot so that only authorized person can access the Robot for this two steps of verifications have been provided one is the user ID and password and second is Face recognition. For the face recognition Principle Component Analysis (PCA) algorithm is used.

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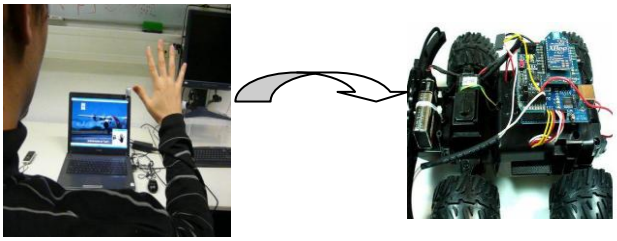
Overview of the system:-

Wireless media



Transmitter Receiver

Fig: 1 Basic blocks of a system.

This image gives clear idea about how system will work like.

Transmitter:- PC will be acting as transmitter it has three modules first two are for security and third is hand gesture recognition, in the first stage of verification user can enter allotted login ID and password if both are correct then person is considered to be authorized. In the second stage camera will turn on and it will capture image of the face, using PCA algorithm real time image and database image it will be matched if images are matching then person is considered to be authorized then again camera will turn on to accept the gesture accordingly.

Specific code word will be send to the receiver via communication media.

Different algorithms used in the system:-

1. PCA: - For face recognition we have used PCA (Principal Component Analysis) Algorithm, it is a mathematical procedure that uses orthogonal transformation to convert a set of observations of possibly correlated variables into a set of values of linearly uncorrelated variables called principal components.

PCA is the simplest of the true eigenvector-based multivariate analyses, It is a way of identifying patterns in data, and expressing the data in such a way as to highlight their similarities and differences. Since patterns in data can be hard to find in data of high dimension, where the luxury of graphical representation is not available, PCA is a powerful tool for analyzing data. The other main advantage of PCA is that once you have found these patterns in the data, and you compress the data, by reducing the number of dimensions, without much loss of information. In PCA some features of the face have taken into consideration for matching database image with the real time image:

- Mean:
- Variance:

To calculate variance following formula is used

$$s^2 = \frac{\sum_{i=1}^{n}(X_i - \bar{X})^2}{(n-1)}$$

- Co-variance:

Covariance is always measured between 2 dimensions. If we want to calculate the covariance between one dimension then we have to use following formula:

$$cov(X,Y) = \frac{\sum_{i=1}^{n}(X_i - \bar{X})(Y_i - \bar{Y})}{(n-1)}$$

Eigen value and Eigen vector:

From all these parameters Euclidean distance is found out.

2. **Correlation**:- In statistics and probability theory, correlation means how closely related two sets of data are it does not always mean that one causes the other so for finger recognition we are using correlation. Correlation usually has one of two directions. These are positive or negative. If it is positive, then the two sets go up together. If it is negative, then one goes up while the other goes down. Strong and weak are words used to describe correlation. If there is strong correlation, then the points are all close together. If there is weak correlation, then the points are all spread apart. There are ways of making numbers show how strong the correlation is. These measurements are called correlation coefficients.[2]

Communication media(x-bee):- X-Bee is the only standards-based wireless technology designed to address the unique needs of low-cost, low-power wireless sensor and control networks in the market. X-Bee can be used almost anywhere, is easy to implement and needs little power to operate. X-Bee uses the 2.4 GHz radio frequency to deliver a variety of reliable and easy-to- use standards anywhere in the world.

Receiver: - Robot will act as a receiver and it will perform actions as per the gesture have been made in front of the camera. Micro-controller is heart of the robot, for programming we are using ARM (LPC2148).

Features of ARM:

- 32-bit in QFP package.
- 8 kB-40 kB of on-chip static RAM and 32 kB-512 kB of on-chip flash memory
- ISP/IAP via on-chip boot loader software.
- Two 32-bit timers/external event counters.

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- Clock 60MHz.
- **Circuit diagram:**

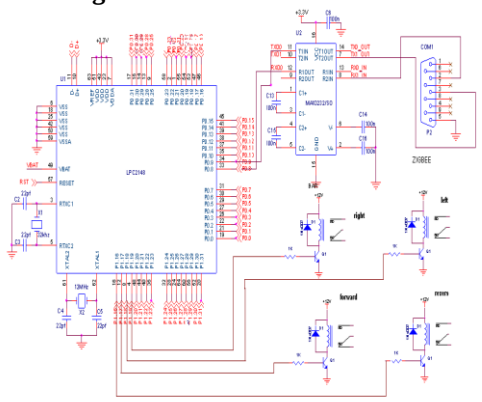

Fig: 2 Circuit Diagram

Circuit consists of X-bee module, MAX232, PIC controller, relay, DC motor. X-bee is use for the wireless communication between transmitter (PC) and receiver (ROBOT). For voltage compatibility between X-bee and controller we are using MAX232. PIC controller is heart of ROBOT which is use for programming purpose as per the executed code relay will be switched and DC motor will turn ON and ROBOT will move. As we explain above when one of specified gesture signals in front of camera, by using MATLAB we generate a code for particular gesture. That code gets transmitted by x-bee from PC to controller section. We use MAX 232 for making signal compatible for Our Microcontroller LPC2148. In uc we assign a a specific binary value for specific code from x-bee. So, that binary value comes at output port. This output port gets connected to relay driving circuit which is our final section. In relay driving circuit we use transistor BC457. So, output of controller given to base of transistor. When transistor gets base voltage it get start and energize corresponding relay. We use DPDT relay for rotating motor in clockwise and anticlockwise direction.

Some pre-defined gestures:

Table: 1 Standard gestures.

No	Gesture pattern	Action
1		Move forward
2		Move reverse
3		Move left
4		Move right
5		Stop

Our system is proposed for five gestures we have selected some pattern for the particular movement of Robot. According to the respective gesture the particular movement assigned to the gesture will takes place i.e. gesture 1 is for the forward movement of the robot, if the system recognizes the gesture 1 then according to the code, Robot will move in the Forward direction. Similarly the five movements of the robot takes place according to the Gesture.[3]

Flowchart:-

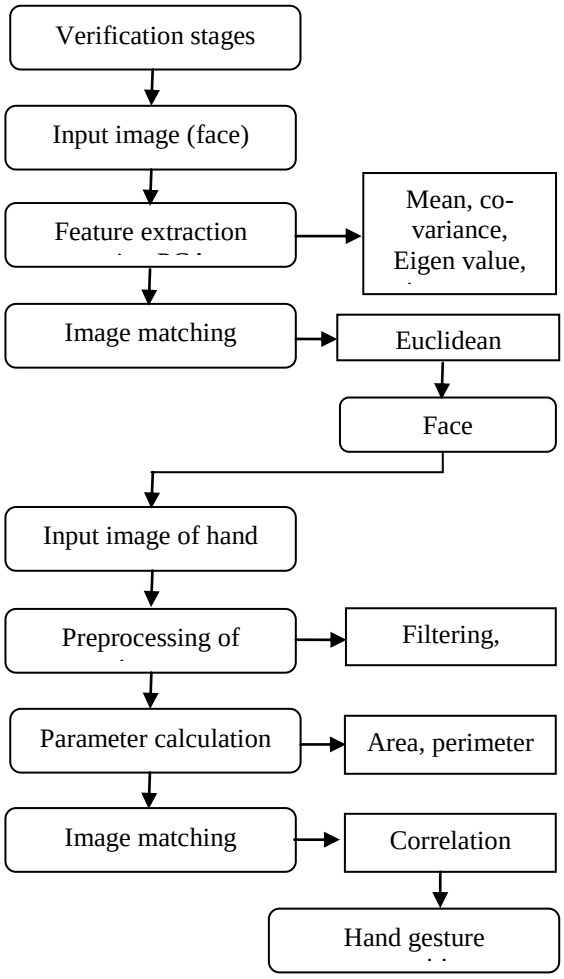

Fig: 3 Flow chart

II. SIMULATION RESULTS

Forward Movement Gesture:

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Reverse Movement Gesture:

Move Left Gesture:

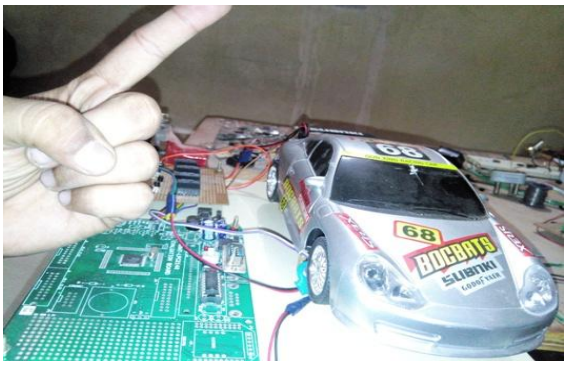
Move Right Gesture:

This type of gesture store in system so that to compare it with live gestures. We store different hand gesture of one type to neglect small difference in gesture. By using this gesture our vehicle perform accordingly.

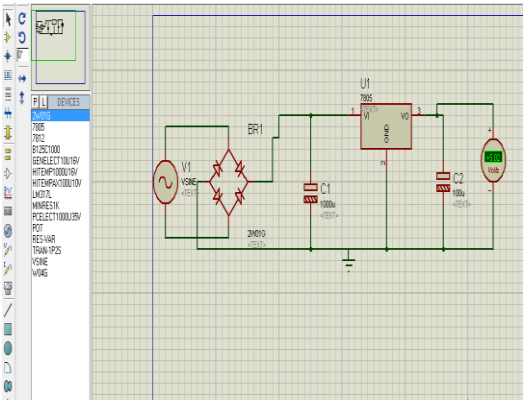
Left Movement:

Right Movement:

Forward movement:



Simulation for Power Supply:



III. CONCLUSION

In this project, a hand gesture recognition system which works under all lightning conditions with different skin colored users and with different camera parameters was aimed. It does not need any training or make the user wear a special glove etc. Also the system was aimed to work in or nearly in real time to be applicable in human computer applications. Gesture recognition can be seen as a way for computers to begin to understand human body language, thus building a richer bridge between machines and humans than primitive text user interfaces or even GUIs (graphical user interfaces), gesture recognition enables humans to interface with the machine (HMI) and interact naturally without any mechanical devices. Gesture recognition can be conducted with techniques from computer vision and image processing. Our hand gesture recognition can integrate with other application such as interactive game, smart home, auxiliary equipment and industrial control.

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IV. FUTURE WORK

Human computer interaction is still in its infancy. Visual interpretation of hand gestures today allows the development of potentially natural interfaces to computer controlled environments .Though most current system employ hand gestures for manipulation of objects the complexity of the interpretation of gesture dictates the achievable solution. Hand gestures for HCI are mostly restricted to single handed and produced by single user in the system. This consequently downgrades the effectiveness of interaction. Computer vision methods for hand gesture interfaces must surpass current performance in terms of robustness and speed to achieve interactivity and usability .considering the relative infancy of research related to vision based gesture recognition remarkable progress has been made to continue this momentum it is clear that further research in areas of feature extraction, classification methods and gesture representation are require to realize the ultimate goal of human interfacing with machine on their own natural terms.

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