Motion Controlled Face Recognition Enabled by Authentication Robot

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***Abstract*- This paper is based on the development of an affordable gesture control with authentication via face-recognition mechanism using image processing technique and its implementation in a robot. The current gesture-tracking techniques involve the usage of expensive devices which dramatically increase the production and maintenance cost. This is not the case in our proposed model which incorporates cost-effective techniques to ensure the production cost is reasonably lower. The 2-D gesture-control involves the robot tracking the movements on the x-axis and y-axis and converting them into data which it can use to perform similarly related movements. The face tracking feature also involves the process of authentication .The robot can also have a chat-bot feature to improve the recreational quotient of the machine. The proposed model involves the usage of arduino for controlling the servo motors.**

***Keywords*- Face-tracking,Face Recognition, Gesture control, Face-authentication, OpenCV, image processing, Robot.**

I. INTRODUCTION

Image processing is the process of converting an image into a digital form for performing operations on it in order to obtain an enhanced image and extracting information from it. Here the image is given as the input and the output obtained tells about the characteristics of the image.

In digital image processing, computers process the image. The image to be processed is first converted into digital form by using a scanner.[1]

An image here refers to a 2D light intensity object f(x,y) where x and y are spatial co-ordinates. The value of f is proportional to the brightness of the image.

Image processing defines an existing image in terms of a new image. It involves geometric and range transformation.[2]

Various types of neighborhood is used to process an image. It involves hexagonal sampling and rectangular sampling. Hexagonal sampling where the image is sampled after adjusting a hexagonal grid

over it . Rectangular sampling is where a rectangular grid is adjusted over the image followed by the sampling process.[3]

Gesture control and face tracking is implemented by using image processing technique here. Gesture control and recognition is the interpretation of the movements of hands and converting the data obtained from it for controlling other objects without physically touching them. Gesture control and recognition is challenging because it involves complex background and various non-gesture movements which must be filtered and different illumination environments must be managed. [4]

Face tracking is the process of segmentation of an object from a particular video scene and tracking it's motion and orientation. Real-time face tracking has various computer vision applications like surveillance, driver assistance and man machine interface. OpenCV has been primarily used in this field because of its programming flexibility, easy availability and its user friendly nature. Color tracking using openCV is done by using embedded C++. [5]

Face detection here neglects unnecessary objects and movements and performs only the task of detecting facial features. Face perception is an active field of research in the current era[6].

Conversion of this low level data into a high level form involves computer vision. Useful information from the 3D world can be converted and extracted from multiple 2D images based on wavelet transformation technique.[7]

II.EXISTING MODELS

In the work named *Developing a gesture based Remote –Robot Interaction system using Kinect* which was presented by *Kun Qian, Jie Niu* and *Hong Yang* the project model uses a kinect device which considerably increases the product cost. This serves as a major hindrance for people with limited purchasing power. The proposed model eliminates this possibility because of its competitive pricing and its accuracy, reliability and user-friendliness is just as good if not better. The proposed product thus serves as a viable and cost-effective alternative.[8].

III.LITERATURE SURVEY

[9]*Kinect based Humanoid Robotic Manipulator for Human Upper Limbs Movements Tracking* by Mohammed Z Al-Faiz, Ahmed F.Shanta explains about the upper body limbs tracking by using the depth perception data available from the kinect device. The co-ordinates obtained from the data is used for 3d mapping of the movements. The primary drawback of this work is its complexity and rigid execution of the algorithms.

[10] *Kinect-based Computed Torque Control for Lynx motion Robotic arm* by Ismail Benabdallah, Yassine Bouteraa ,Rahma Boucetta describes a control system based implementation where an inverse algorithm is used capture the co-ordinates of the robotic arm . The limitation here is that the algorithm is suitable for only tracking a single moving limb and not more than which dramatically reduces the work's flexibility in use.

[11] The work named *Object Tracking Using Camshift Algorithm and Multiple Quantized Feature Spaces* by John G. Allen , Richard Y.D.Xu , Jesse S. Jin elucidates about the usage of Mean Shift Algorithm for face tracking for a perpetual user interface .Camshift algorithm is a decent option for face tracking but the tracking performed here has to done manually which makes it a tiring and cumbersome process hence making it an obsolete option in the current scenario.

IV. PROPOSED MODEL

The objectives of our proposed work are:

- To create an affordable open source multiple object tracking robot that can also be controlled via gestures.
- To provide a security feature which

enables the application software to work only when the first phase, which is the authentication is cleared.

A. Authentication using face recognition:

As mentioned above, our model implements a face recognition algorithm for authentication purpose. This involves the detection of a face in a frame, for which we use Cascade Classifier.

Once this step is over, the face which is detected is sent for further processing for validation. This is done using Fisherface algorithm.

For the detection to take place, the face recognizer should be trained with a number of faces to be recognized. Once the training process culminates, the video camera is put into work. Once the camera is started, it looks for any recognizable face in its range and detects it. The snippet for this code is:

Cascadeclassifier.detectMultiScale(gray,faces);

Once the face is detected, it is resized and a verification process is performed to validate its genuineness. The code used for this is:

int prediction = model->predict(face_resized);

If a legitimate face is recognized it allows the user to move on to controlling the robot using gestures.

To ensure a proper detection of the face within the range of the camera, a pan-tilt assembly is provided. This allows the gestures to be detected by the camera anywhere within the 270 degree range that the pan-tilt offers.

B.Gesture Control:

A web camera is used for gesture controlling the robot. This camera allows us to get 2-Dimensional gestures to be captured. 2-D gesture recognition is cost effective when compared to the technique that uses kinect or leap motion sensors which perform 3-D gesture control. The ultimate aim of the proposed work is to control a robot using gestures by keeping the expenditure to a minimum level.

OpenCV library is used for the gesture recognition of hands. These gestures are mapped to the arms of a humanoid robot. This process involves the following steps.

After the authentication is performed, the camera focuses its attention towards detection of palms. In order to identify the palm, HSV (Hue-Saturation-Value) have to be provided to filter the palms from the rest of the body.

Note: The palms must be of a different color when compared to the rest of the body(Either we need to wear gloves or we need to wear a full sleeved shirt/T-shirt in order to differentiate the palms from the forearm.)

The HSV values vary according to the lighting inside the room where the model is placed.

The algorithm tracking the palm is shown below in figures 1,2 and 3.

Figure 1: HSV Image

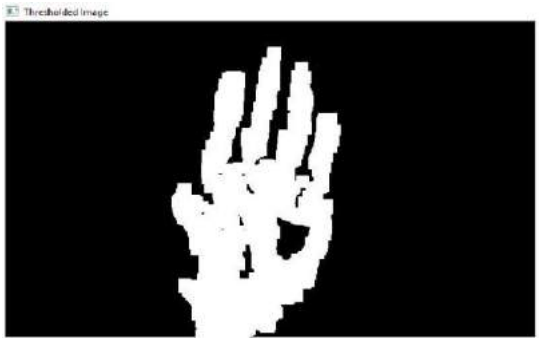


Figure 2: Threshold Image

Figure 3:Original image

Once the values are provided, it starts detecting palms ignoring all other features. When a palm is detected, the x and y co-ordinate values of the palm are obtained and these values are converted into angles and sent serially to the arduino. From the arduino, the angle values are mapped on to the servo motors of the robot, thus facilitating arm movements.

A class called body is created, which is then vectored by the code snippet given below

Vector<Body> palms;

Once we get the coordinates, we set them using the setters as follows

Palm.setXPos(moment.m10/area);
palm.setYPos(moment.m01/area);

palms.push_back(palm);

Then we can convert it into angles by using the following snippets

Servo1= (float)x/(float)FRAME_WIDTH * 180; Servo2= (float)y/(float)FRAME_WIDTH * 180;

Here, the FRAME_WIDTH is 640.

Even elbow can be detected by having a different color cloth wrapped around it and mapped to the robot.

In short, the gesture of the palm is sent as an angle to the arduino to control the servo.

The arduino code snippet for controlling the servo is

Servo1.write(Servo1);
Servo2.write(Servo2);

Thus the gestures of palm are converted to servo movements of humanoid robot.

C. Voice Recognition:

This is an added feature for controlling the robot using voice. It has its own novelty of repeating the actions once performed by the user after a voice command.

When the user says “Start recording” , the application starts recording the actions performed by the user. Again when the user commands “Stop recording”, it stops recording the actions.

In order to repeat the actions by robot, user has to say “repeat”, and it mimics the same action performed by the user.

Thus the entire process involves the face authentication phase followed by the gesture control and voice control together to control the robot and enable the robot to mimic our actions.

V.COMPARATIVE ANALYSIS

The proposed work clearly is comparatively less complex in its operations and when compared with kinect based models the components involved are less and cost efficient. Less complex components relates to ease of use and a better user experience.

VI. FLOW CHART

The overall working and operational flow is clearly depicted in the figure 4.

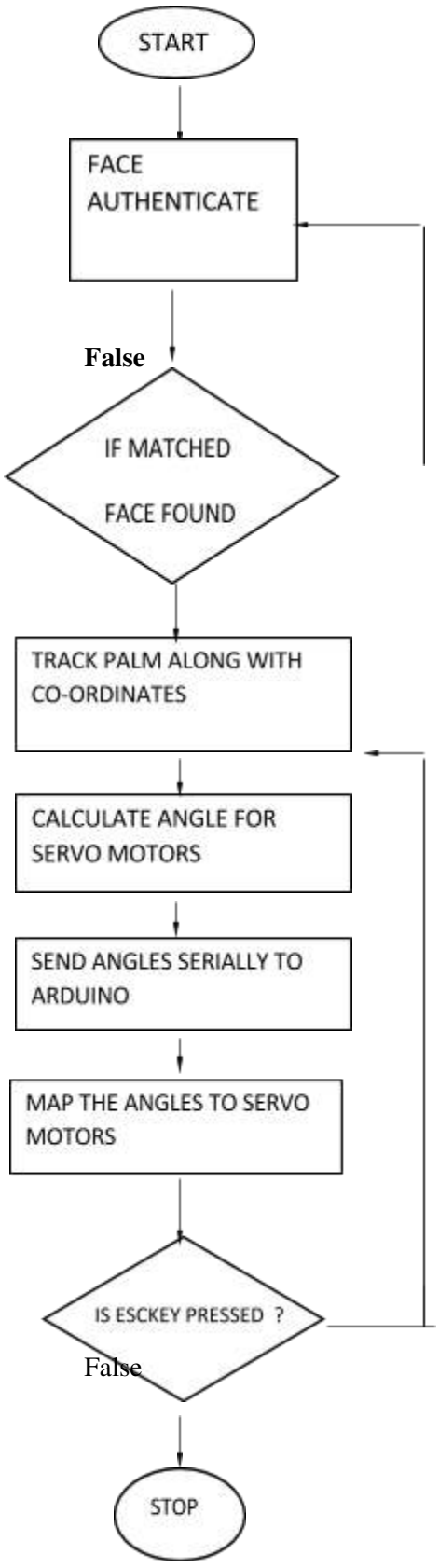


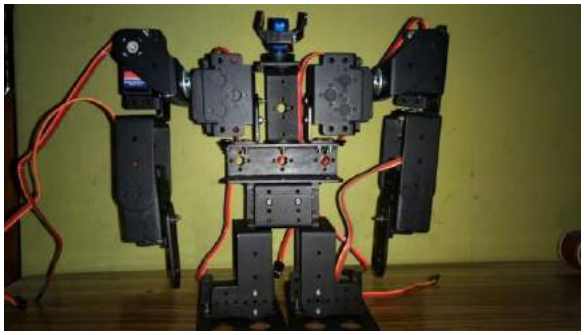
Figure 4: Flowchart for the algorithm

VII. COMPONENTS:

The following are the components of the proposed model,

- A pan tilt module to hold the camera for face tracking purpose.
- A web camera or any other camera of decent quality and small size.
- An arduino for controlling the servo motors of the robot.
- A 17DOF robot containing RKI-1211 servo motors for limb control and motion.

The robot used for this research paper is shown below.



VIII. CONCLUSION

Thus, we have presented an affordable and user friendly robot which coalesces optimal tracking performance and reduced complexity due to the non-involvement of too many devices along with a chat-bot feature.

This work has future scopes which are given below,

It is within the realms of possibility that an astro-bot can be used for space missions for performing repairs in outer space which could potentially be life threatening for humans.

The technology involved can be used in surveillance and reconnaissance missions.

The tracking feature algorithm can be optimized for use in automation and manufacturing industry.

IX. REFERENCES

[1]K.M.M Rao , *Overview of image processing ,* NRSA , Hyderabad.

[2] Steven Seitz , Aleosha et al , *Elements of image pre-processing and feature detection ,* CS4487.

[3] Ian T Young , Jan J Gerbrands et al, *Fundamentals of Image Processing, pg1995-2007.*

[4] Mohamed Alsheakhali, Ahmed Shaik, Mohammed Aldahdouh, et al, *Hand Gesture Recognition System,* 2011.

[5] M.Praveen , P. Kalpana Reddy, *Tracking of Colored Objects Using Opencv,* Volume 2, October 2013.

[6] Mamata S. Kalas, *Real time face detection and tracking using OpenCV ,* IJSCAI, Volume 2, Issue 1, May 2014.

[7] S.V Viraktamath, MukundKatti, Aditya Khatawkar et al, *Face Detection and Tracking using OpenCV,* CNCE, Vol 1, No.3, August 2013.

[8] Kun Qian, JieNiu et al , *Developing a Gesture based Remote Human-Robot Interaction System using Kinect,* IJSH,Vol.7,No.4,July 2013.

[9] Mohammed Z.Al-Faiz, Ahmed F.Shanta,*Kinect-Based Humanoid Robotic Manipulator for Human Upper Limbs Movements Tracking,* ICAA, pg.29-37, 2015.

[10] Ismail Benabdallah, Yassine Bouteraa et al , *Kinect-based Computed Torque Control for lynx motion robotic arm,* IEEE, 2015.

[11] John G Allen, Richard Y.D Xu , Jesse S.Jin , *Object Tracking Using Camshift Algorithm and Multiple Quantized Feature Spaces ,* NSW 2006.