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HUMAN-COMPUTER INTERACTION USING DYNAMIC HAND GESTURE RECOGNITION TO CONVENIENTLY CONTROL THE SYSTEM

Smit Parikh, Srikar Banka, Isha Lautrey, Isha Gupta, Prof Dhanalekshmi Yedurkar
MIT School of Engineering, MIT-ADT University
Pune, India

Abstract— **The use of a physical controller such as a mouse, a keyboard for human computer interaction hinders the natural interface since the user and computer have a high barrier. Our aim is to create an application that controls some basic features of computers using hand gestures through an integrated webcam to resolve this issue. A Hand Gesture Recognition system detects gestures and translates them into specific actions to make our work easier. This can be pursued using OpenCV to capture the gestures which will be interfaced using Django, React.Js and Electron. An algorithm named YOLO is used to train the system accordingly. The gestures will get saved inside the DBMS. The main result expected is that the user will be able to control the basic functions of the system using his/her hand gestures and hence providing them utmost comfort.**

Keywords— **Hand Gestures Recognition, Deep Learning, Security, Windows Applications, OpenCV.**

I. INTRODUCTION

In computer science and language technology, gesture recognition is a subject with the objective of interpreting human gestures through mathematical algorithms. Gestures may originate from any movement or condition of the body, but they typically originate from the face or hand. Emotion recognition from face and hand gesture recognition is the current emphasis in the field. In order to control or communicate with devices without physically touching them, users may use small actions. Many approaches have been made in order to decode sign language using cameras and computer vision algorithms.

However, it is also the topic of gesture recognition strategies to recognise and recognize stance, gait, proxemics, and human behaviors. Recognition of gestures can be seen as a way for machines to start learning the language of the human body, providing a richer bridge between computers and humans than primitive text user interfaces or even GUIs (graphical user interfaces), That still restricts the majority of keyboard and mouse inputs and interacts naturally without any mechanical devices. At this point, it is possible to point a finger and shift accordingly, using the principle of gesture recognition. This could make it redundant to conventional input on computers.

In the present scenario, the main application fields of gesture recognition are:

- Automotive sector
- Consumer electronics sector
- Transit sector
- Gaming sector
- To unlock smartphones
- Defence
- Home automation
- Automated sign language translation.

With techniques such as computer vision and image processing, gesture recognition can be carried out. Two kinds of movements in computer interfaces are distinguished:

- Offline gestures: Offline gestures are those gestures which are processed after the user interacts with the object. The gesture for triggering a menu is a case.
- Online Gestures: These are direct gestures of coercion. They are used to scale a physical object, or rotate it.

There are different algorithm for gesture recognition:

1. 3d Model Based Algorithm:- In the 3D mesh version (right), a real hand (left) is represented as a set of vertices and lines, and the program uses their relative location and interaction to deduce the gesture.
2. Skeletal Dependent Algorithm:- The (right) skeletal version successfully models the hand (left). This has less parameters and is simpler to calculate than the volumetric version, making it ideal for systems for real-time gesture analysis.
3. Appearance Based Algorithm:- For appearance-based algorithms, these binary silhouette(left) or contour(right) images represent typical inputs. They are compared with various hand models and the correspondent gesture is inferred when they match.

There are different uses for gesture recognition such as:

1. Socially Assistive Robotics

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2. Virtual Control
3. Remote Control
4. Control through facial gesture
5. Aid to Physically challenged
6. Immersive Game Technology
7. Sign Language Recognition .

The hand gesture recognition device is used to use hand gestures to communicate between a machine and a person. For live motion gesture recognition using a webcam, a windows-based application is created. This project is a mixture of detection of live motion and recognition of the gesture. The webcam is used by this program to detect a motion made by the user and perform fundamental operations accordingly.

A clear gesture has to be carried out by the person. The webcam then records the motion of the user and recognizes the gesture. It then acknowledges the gesture of the user (comparison takes place against a collection of predefined gestures), and performs the corresponding action. While the user runs other programs and software, this application can be rendered to run in the background. This is very useful for a hands-free approach.

However, for searching the web or writing a text document, it may not be of great use, it is very helpful in media players and even when reading documents or files. Even when sitting away from the computer screen, a simple gesture may pause or play the film or raise the volume. And when having lunch, one could quickly scroll through an eBook or a presentation.

II. LITERATURE REVIEW

In 2020, Munir Oudah [1] has focused on a review on Hand gesture methods and, in various conditions, introduce their merits and limitations. In addition, the performance of these techniques was also tabulated, focusing on computer vision techniques that deal with similarities and difference points, hand segmentation technique used, classification algorithms and disadvantages, number and types of gestures, dataset used, range of detection (distance) and camera form used. Different approaches have been reviewed, such as the Instrumented Glove approach, the Computer Vision approach, Glove Marker color-based recognition, Depth-Based Recognition, and many more. With a quick discussion of some potential implementations, this paper is a detailed description of hand gesture methods.

In 2020, Alvin Sarraga Alon [2] has aimed To generate a powered fan with a wireless hand gesture. The key feature used for transmitting and receiving information is the Bluetooth module. The research used a gyro sensor to calculate the shift in hand coordinates depending on the speed of the fan's rotation. A microcontroller is attached to it, In fact, it was an Arduino in which coded functions were used. Using the coordinates provided by the Bluetooth and gyroscope axis, the wireless hand gesture fan speed control system was successful and feasible. With an overall test accuracy of 98.61 percent, hand gesture recognition was carried out.

In 2020, Chia-Chun Tsai [3] has utilized The Leap Motion gesture-sensing system for controlling a drone in the Unity game engine's virtual world. There are four swiping gestures and two static gestures tested, like face up, face down. To use two eye gesture recognition and unity to create a game, they have used leap motion. Among various users, drones respond to gesture control with an average of more than 90% accuracy.

In 2020, Vaidyanath Areyur Shanthakumar [4] has worked on a The motion control device mounted on the sensor is used to record 3D hand and finger movements. To detect and accept hand movements. A novel angular velocity approach has been proposed that is directly applied to real-time 3D motion data streamed by the sensor-based device. The method can identify both static and dynamic gestures in real time.. With two interactive applications that involve gesture input to communicate with the virtual world, they have assessed the accuracy of recognition and execution efficiency. Their experimental findings showed high accuracy of identification, high efficiency of execution, and high usability levels.

In 2020, Dinh-Son Tran [5] has proposed a novel method for Detection of fingertips and real-time hand motion recognition with an RGB-D camera and a 3D convolution neural network (3DCNN). The scheme will extract fingertip positions accurately and robustly and recognize movements in real-time. By assessing hand gesture recognition through a range of movements, they have shown the accuracy and robustness of the interface. In addition to this, a method for manipulating computer programs was developed to demonstrate the possibility of using hand gesture recognition. Experimental studies have shown that their device has a high degree of hand gesture recognition accuracy.

In 2019, Bin Hu [6] has presented A hand gesture recognition device developed for unmanned aerial vehicle flight control (UAV). Skeleton data obtained from a Leap Motion Controller is transferred to two separate data models in order to train the device to recognize the programmed movements. The three deep learning neural networks proposed, which are a 2-layer fully connected neural network, a 5-layer fully connected neural network and an 8-layer convolutional neural network, were tested. The static test results have shown that on normalized datasets and 11 percent on raw datasets, the 2-layer

fully linked neural network achieves an average accuracy of 98.2 percent. On normalized datasets and 45 percent on raw datasets, the 5-layer fully connected neural network achieved an average precision of 95.2 percent. On normalized datasets and raw datasets, the 8-layer convolutional neural network achieved an average accuracy of 96.2 percent. Testing on a drone kit simulator and a real drone has shown that drone flight controls are feasible for this device.

In 2019, Okan Köpüklü [7] has proposed an The architecture consists of two models: (1) a detector that is a lightweight gesture detection CNN architecture and (2) a deep CNN classifier to classify the gestures detected. In order to determine the detected gestures' single-time activations, As it can calculate misclassifications, multiple detections, and missing detections at the same time, they have suggested using Levenshtein distance as an assessment metric. Two publicly accessible datasets, EgoGesture and NVIDIA Dynamic Hand Gesture Datasets, which require temporal identification and classification of the hand gestures performed, evaluate our architecture. Model ResNeXt-101, The state-of-the-art offline classification accuracy of 94.04 percent and 83.82 percent for depth modality on EgoGesture and NVIDIA benchmarks, respectively, is used as a classifier. They have obtained important early detections in real-time detection and classification thus achieving outputs similar to offline service.

In 2019, P. Sai Prasanth [8] has recognized As a way of differentiation between the movements, live hand gestures use color signs. To map out the points of cardinality and functions of interest, they used ROI (Region of Interest). This was achieved by itself in good lighting and can be used in different applications. Used in this project, the Global thresholding algorithm helps to analyze the captured image quickly and effectively.

In 2018, Shining Song [9] has designed a dynamic gesture recognition control system based on a USB single camera. After obtaining the image through the camera, the original image is binarized, eroded, smoothed and filled with holes, then the circumscribed rectangles and the centroid points of the gesture image are tracked and ultimately, the movement direction of the gesture is determined according to the motion track. Finally, through the gesture control movement, the mouse pointer moves and simulates the left-click operation. The test results have shown that the system recognition rate is high, therefore the research has some practical values.

Year[Citation]	**Methodology**	**Features**	**Challenges**
2020 [1]	Hand gestures using hand segmentation techniques, classification algorithms using data glove sensors.	Data glove sensors to capture hand motion.	Designing a robust system that overcomes, with less constraints, the most common problems.
2020 [2]	It aims to create a powered fan with wireless hand movements.	Using the Bluetooth and Gyroscope axis, successful machine-to-machine wireless communication results are possible..	Due to the complex body structure, it takes a lot of time to set the goniometer.
2020 [3]	To practice the manipulation of glove puppets, Leap Motion is used in combination with the Unity method.	As opposed to dynamic, leap motion has strong success rates for gesture recognition in static gestures.	Leap Motion in multiple locations to examine variations in the success rate of recognition of gestures.
2020 [4]	To detect and recognize hand movements, a novel angular velocity method is directly applied to real-time 3D motion data.	Experimental findings indicate high accuracy of recognition of 97.3 percent, high efficiency of execution	The future aim is to implement an automated way to calculate parameter threshold values..
2020 [5]	A novel technique for real-time fingertip detection and hand motion	This approach gives highly accurate gesture estimates, and also suitability for practical applications.	It is limited to few applications for now.

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	recognition using an RGB-D camera and 3DCNN.		
2019 [6]	A hand gesture recognition device developed for unmanned aerial vehicle flight control (UAV).	98.2% accuracy at 2 layer, 95.2% accuracy at 4 layer and 96.2% accuracy at 8 layer CNN.	The system can handle upto 10 simple dynamic gestures.
2019 [7]	A deep CNN for the observed gesture to identify.	94.04 percent of offline classification accuracy and 83.82 percent on EgoGesture and NVIDIA benchmarks for depth modality.	More investigation on the statistical hypothesis testing and to utilize different weighting approaches.
2018 [9]	A dynamic gesture recognition control system based on a USB single camera.	Using gestures, cursor motions and other simulated operations instead of pressing the mouse.	Less accurate and not suitable for disabled users.
2018 [10]	YOLO for hand gesture recognition is used to improve accuracy, speed, and model size.	Light YOLO greatly enhances the accuracy, pace from 40PFS to 125FPS, and size from 250M to 4MB, from 96.80 percent to 98.06 percent.	Struggles to detect tiny objects.
2017[11]	A real time gesture recognition and fingertip detection algorithm is proposed.	Mouse Control using hand gesture and fingertip detection	Does not support real time mouse control operations.

III. PROPOSED SYSTEM

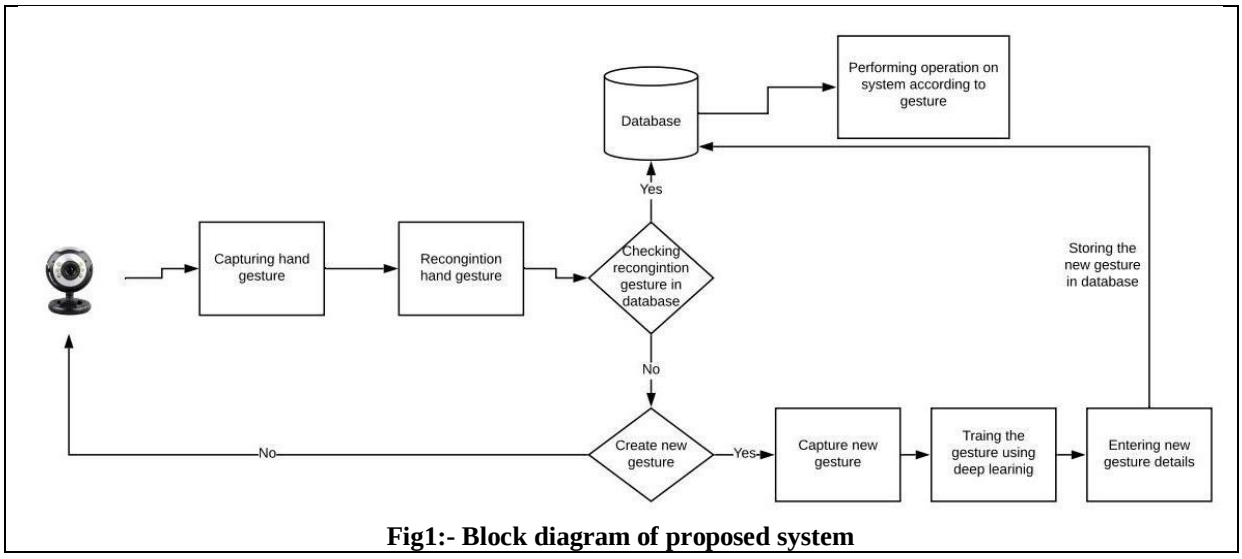

Fig1:- Block diagram of proposed system

- In the existing systems, the users face some discomfort in controlling their laptops or desktops when they are in the middle of their activity.
- So we have proposed a method where specific functionalities of the systems can be controlled by the use of hand gestures. The above block diagram is the workflow of our proposed system. Most gesture recognition methods usually contain three major stages and so does our proposed method.
- The first stage of this proposed solution demonstrates the creation of a software application with 2 factor

authentication for security reasons. Then, the hand gesture is captured from the user. There will be a few predefined hand-gestures so that the user can get the idea of how to control the system.

- At this stage, differentiated features and effective classifiers selection are a major issue in most researches. To prevent this issue, YOLO has been used, a Deep Learning algorithm which is used for real-time detection and works extremely fast [10].
- OpenCV has also been used for capturing the gestures and for processing them. These captured gestures are stored in a database (PostgreSQL/MongoDB) for the latter usage.
- The second stage recognizes the type of the user's hand gesture that is captured. A check is performed if the hand gesture exists in the database. If it doesn't exist, then a message will get displayed to create a new hand gesture for that particular function. Once the hand gesture gets created by the user, the hand gesture gets stored in the database.
- The third stage is introduced after the addition of the new hand gesture. Now, the user can perform the operation that he/she created and hence, he/she will be able to control the system without physically making contact. (For example - play, pause, mute or open an application).
- The user can also edit the predefined hand gestures according to his/her choice. Here, the user can store hand gestures as static and dynamic hand gestures too.

IV. CONCLUSION

Technology is advancing every day to make man's life and work more easier and more comfortable. We have taken this into consideration and we have done research based on hand gesture recognition for controlling specific functionalities of the computer system. This paper has portrayed the survey related to hand gesture recognition, using it in different application areas and also studying existing solutions. Based on the study that we have performed, we have proposed a different solution to control our systems using hand gesture recognition which will provide the user, ease and comfort.

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