

Student Project Review and Assessment Committee

Synopsis

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Project Title		
HAND GESTURE RECOGNITION		
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Project Category		Societal and Application Project

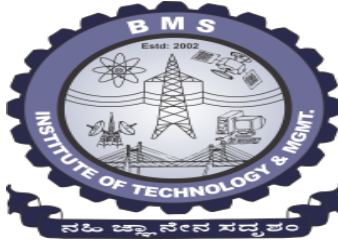
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Synopsis for the Project work

“HAND GESTURE RECOGNITION”

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ABSTRACT

Gesture recognition is a topic in computer science with the goal of interpreting human gestures via mathematical algorithms. Gestures can originate from any bodily motion or state but commonly originate from the face or hand. Gesture recognition enables humans to communicate with the machine and interact naturally without any mechanical devices. Using the concept of gesture recognition, it is possible to point a finger at the computer screen so that the cursor will move accordingly. This could make conventional input devices such as mouse, keyboards and even touch screens redundant.

In this project, we design a real-time human computer interaction system based on hand gesture. Hand gesture recognition system provides us a novel, natural, innovative user friendly way of communication with the computers. The whole system consists of three components: hand detection, gesture recognition and human-computer interaction (HCI) based on recognition; and realizes the robust control of mouse and keyboard events with a higher accuracy of gesture recognition.

INTRODUCTION

Communication in daily life is performed via the help of vocal sounds and body language. However vocal sounds are the main tool for interaction, body language and facial expressions have a serious support in the meanwhile. Even in some cases, interacting with the physical world by using those expressive movements instead of speaking is much easier. Body language has wide range of activities namely eye expressions, slight change in skin color, variation of the vibrations in vocal sounds etc. But the most important body language expressions are performed using hands.

Hand gesture recognition is identifying expressions which are meaningful of the hand or hand in motion. Hand gestures are used in our daily life as a nonverbal method of communication. Gestures are actions that contain some meaningful messages. There are number of systems used in input system for computer interaction such as mouse, keyboard. But in early years there were number of techniques for gesture recognition on tracking such as instrumental glows and optical markers etc. But the most efficient way is to identify hand gestures via webcam. This paper introduces hand gestures recognition system which uses hand gestures for computer interaction. We are using OpenCV image processing and C++ for pre-processing, hand detection, hand tracking and event triggering.

OPEN CV: Open CV (Open Source Computer Vision library) is a library which explicitly focuses on computer vision in real time. It is available free for everyone. It is compatible with C++, Python, Java and supports Windows, Linux, Mac OS and Android. Open CV was designed for relative applications. It has above 2000 optimized algorithms and comprehensive set of art CV and ML algorithms.

MOTIVATION

Coming across the various spheres of life where this wearable technology can be applied, our major motivation for this project came from one such need. Among us, there are some people who do not have the voice to express, and sometimes, the capability to hear. The deaf and dumb sign language was developed to aid the communication for such people. Our idea was to create a device which could help them communicate, to give them a voice. The idea was to create a dictionary, using Electromyography (EMG) and machine learning to recognize the sign language gestures made by them.

EXISTING SYSTEM

A hand gesture recognition system was developed to capture the hand gesture being performed by the user and to control a computer system by that incoming information. Many of such systems in literature have strict constraints like wearing special gloves, having uniform background, long-sleeved user arm, being in certain lightning conditions, using specified camera parameters etc.

LIMITATIONS OF EXISTING SYSTEM

Some of the limitations of the existing systems are that they ruin the naturalness of a hand gesture recognition system and also correct detection rates and the performances of those systems are not well enough to work on a real time HCI system.

PROPOSED SYSTEM

The system aims to design a vision-based hand gesture recognition system with a high correct detection rate along with a high-performance criterion, which can work in a real time HCI system without having any of the mentioned strict limitations (gloves, uniform background etc) on the user environment.

It is composed of a human computer interaction system which uses hand gestures as input for communication. System is initiated with acquiring an image from a web-cam or a pre-recorded video sequence. Skin color is determined by an adaptive algorithm in the first few frames. Once the skin color is fixed for the current user, lightning and camera parameter conditions, hand is localized with a histogram clustering method. Then a hand gesture recognition algorithm is applied in consecutive frames to distinguish the current gesture. Finally, the gesture is used as an input for a computer application.

SYSTEM REQUIREMENTS AND SPECIFICATIONS

- **FUNCTIONAL REQUIREMENTS :**

Functional requirements are the necessary requirements for functioning of a software or a system. Functional requirements required for this system are –

1. **Processor:** Intel Core i5 or higher
2. **Memory:** 5 GB internal memory
3. **Operating System:** Windows / Linux
4. **Graphics:** 3GB graphics or higher
5. **Web cam:** 5 MP or higher

- **NON – FUNCTIONAL REQUIREMENTS :**

Non – Functional requirements support the functioning of the system. They have a check on the entire system as a whole. Non – functional requirements of the system are -

1. **Reliability :** How reliable is the system to deliver the system its service, i.e; its ability to detect the gesture accurately.
2. **Safety :** The ability of the system to perform without failure.
3. **Availability :** The ability of the system to render its services at all times whenever requested by the user.
4. **Dependability :** This is a property of a software / system that establishes a confidence about the system to the user.
5. **Security :** The system is secure such that no outside attacker can intercept the system.

PROPOSED METHODOLOGY

In the system that we are going to develop we are making use of Open Source Computer Vision, also known as OpenCV, a real time computer vision library with many image processing functions developed by Intel for the C++ or Java programming platform. This API provides many functions to perform calculation on captured video sources and special image processing on each frame of the video to support the HGR software. The video capture and the gesture detection components of this project are heavily supported by some of the functions built into the OpenCV library along with trained machine learning models. The steps to be followed in hand gesture recognition are:

1. Hand Detection:

We need to have an input image from webcam which is fetching at the speed of 20 frames per second. The distance between hand and camera should be in the range of 30 to 100 cm. The video input is stored frame by frame into a matrix after preprocessing. For faster processing we use skin color to detect the variants and hand area. Hand gestures are meaningful continuous hand action. The image sequences captured by webcam contains garbage gestures which need to be removed by counter tracing algorithm.

2. Feature Extraction:

a) Centroid: On basis of image intensities we divide image into two parts one with hand and other with non-hand region part. The centroid divides these two halves at its geometric center. Centroid is the center of mass of an object which is calculated using image movement. Image moment, which is the weighted average of pixel's intensities of the image.

b) Thumb detection: Thumb is important in hand detection and a finger counting. The presence of thumb defines a set of gestures while absence defines other set. The thumb is on the corner of the box so we can identify which hand is there right or left-hand using thumb detection.

c) Euclidean distance: Calculate the distance between all tip of the fingers and centroid using Euclidean distance formula that is $(a, b) = \{(x(a) - x(b))^2 + (y(a) - y(b))^2\}^{1/2}$, Where a and b are the are figure tips.

This distance is used to remove redundant fingers. If there are two fingers at a closer distance they shouldn't be considered in figure count.

3. Finger Count:

In this method, the number of fingers present in the hand gesture is determined by making use of defect points present in the hand gesture.

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