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Hand Gesture Recognition Techniques- A Review

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Abstract- *Gesture recognition is the growing field of research. Hand gesture recognition system provide us natural interaction with the computer and machine. Using the hand gesture, we can easily interact with the computer without using keyboard and mouse. In this paper we have surveyed methods of hand gesture recognition like accelerometer, RGB depth sensor, heterogeneous camera, kinect sensor etc.*

Key words- Accelerometer, RGB depth sensor, Heterogeneous camera, Kinect sensor, Computer vision

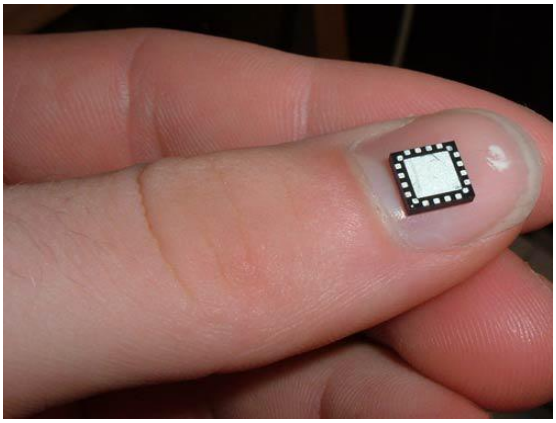
1.INTRODUCTION

Hand gesture is a powerful means of communication among humans. The gesture recognition uses computer vision, image processing and other techniques. It is useful largely because it let people communicate with a machine in a more natural manner without a mouse or other intermediate device. In technical language the gesture is spatio-temporal pattern which may be static, dynamic or both [7]. Static means hold the hand with a specific pose e.g. victory sign, thumbs up. But it requires training and it has computational complexity than dynamic hand gesture. In dynamic it recognizes the gesture dynamically. Dynamic hand gestures are more complex then static but they are more useful than static hand gesture. Hand gesture recognition techniques are mainly categorized into two parts: Glove based and Vision based method. Recently, researches using vision based method for gesture recognition. In glove based method extra devices are used to interact with machine. And in vision based method visual images are used for natural interface.

2.HAND GESTURE RECOGNITION TECHNIQUES

2.1 Accelerometer and RGB depth sensor[1]

In this gesture recognition glove have also been used with depth sensor. A hand gesture recognition system that relies on colour and depth image and on a small pose sensor on the human palm. Sensing system consist accelerometer and magnetic tracker in the sensing glove. Accelerometer and magnetic tracker are able to get the hand angular pose.



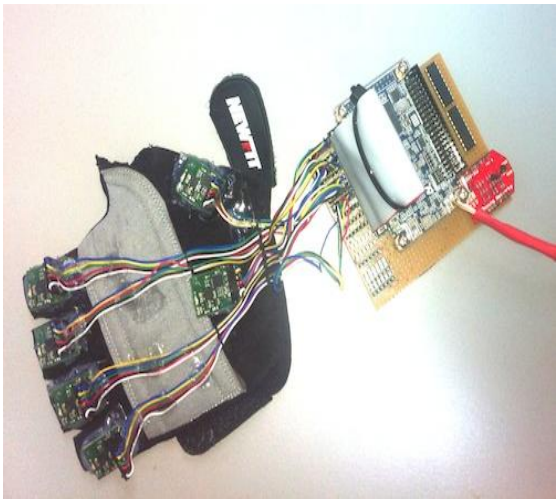


Fig -1: Accelerometer and acceleglove [1]

RGB depth sensors have overcome the limitations on texture, illumination etc. RGB sensor is used for skin colour detection. Analysis of colour information from the RGB image allow to narrow in the pixels representing the hand skin. Hand performing the gesture is near to the sensor than other body parts, and RGB depth sensor is used to recognize that hand movement.

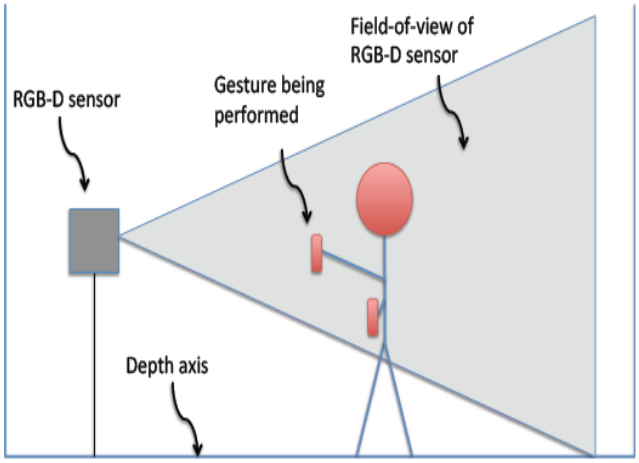


Fig -2: Scene diagram for depth position understanding between gesture and RGB-D sensor [1]

2.2 Dynamic hand gesture recognition using HMM models [2]

HMM-based method to recognize complex single hand gestures. The two features are introduced: hand size and hand shape. Gesture images are gained by a common web camera. Skin colour is used to segment hand area from the image to form a hand image sequence. Features used in the system contain hand position, velocity, size, and shape. It can define 18 different gesture. The gesture can be explained in four types: graphic gesture, figure gesture, character gesture and action gesture.

2.3 Hand gesture recognition based on shape parameters [3]

This paper aims to present a real time system for hand gesture recognition. Hand gesture recognition is totally depended on the shape parameter. Shape based features like orientation, centre of mass, status of finger, thumb in terms of hand and their respective location in image. To implement this web cam is used and it uses pre-processing steps for Hand gesture recognition. This technique does not depend on the skin colour and texture Fig 3 Shows the final image of gesture recognition process. This system is convert the gesture into five binary sequence for human computer interaction. The strength of this approach include its simplicity, ease of implementation and it does not require any significant amount of training or post processing.

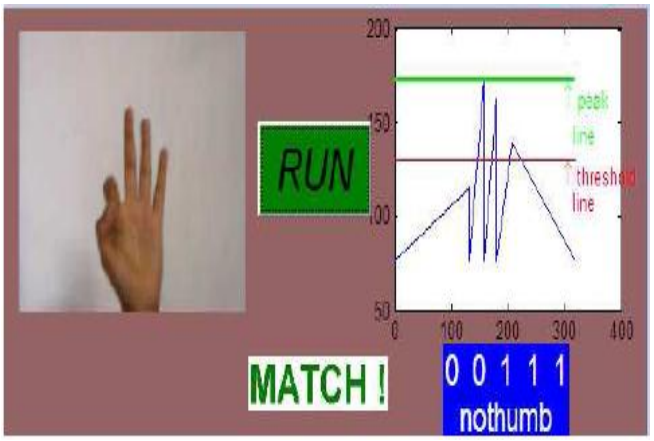


Fig 3: Hand gesture with bits code and distance plot[3]

It provides us with the higher recognition rate with minimum computation time. The weakness of this method is that we define certain parameters and threshold values experimentally since it does not follow any systematic approach for gesture recognition and maximum parameters in this approach are based on assumption made after testing number of image.

2.4 Heterogeneous cameras [4]

It provides more convenient and user-friendly interface for controlling presentation display such as page up/down control in slideshow. The system employs a thermal camera for human body segmentation to handle the complex background and varying illumination posed by the projector. A dual step calibration with the aid of common web camera is used because it is impossible as no projected contents can be viewed from thermal cameras. For gesture recognition it roughly divides the body into three parts: The head, the torso and the arm. And then recognize the hand gesture using hand segmentation and hand localization. The thermal camera detects and tracks the presenter's hand then gesture is recognize. Once the predefined gesture is recognized, the corresponding interactions are performed.

The limitation of this technique is heavy computation cost, a limited number of posture can be estimated. And it is still not fast enough and it is limited to one hand.

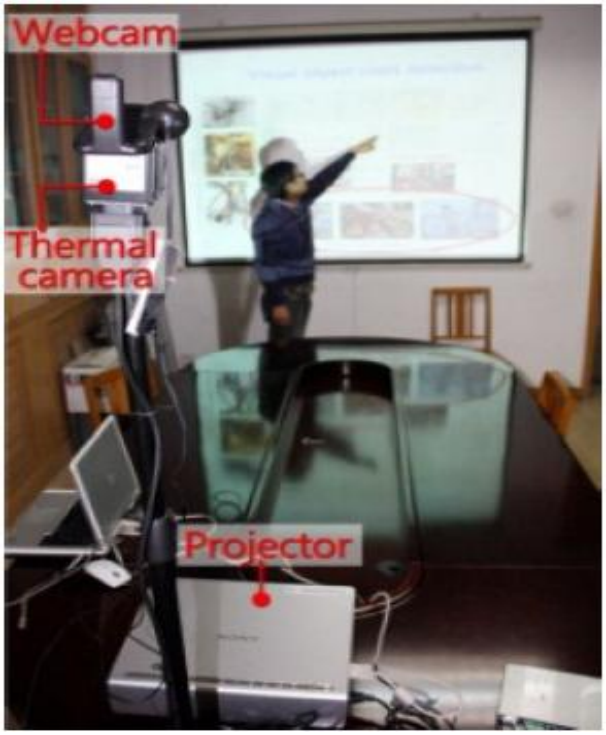


Fig -4: System Hardware setup [4]

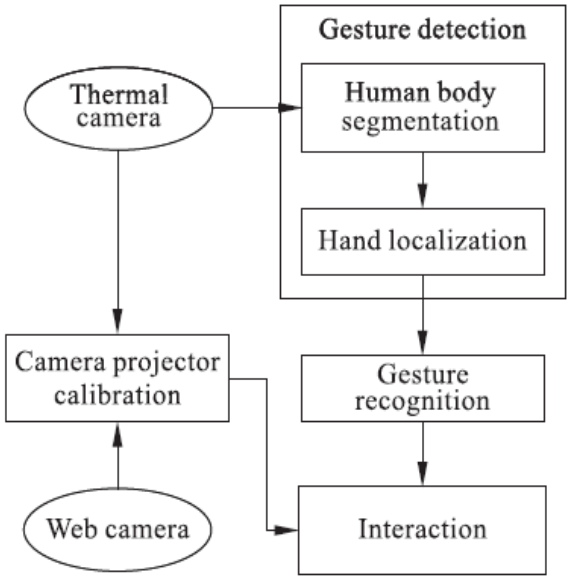


Fig -5: System flowchart[4]

2.5 Kinect sensor [5]

The Kinect sensor first detects the body movement of the user, and converts it into control commands. Then, the PC sends the commands to Arduino control panel via XBee wireless communication modules. The interface circuit is used to control movement and direction of motors, including forward and backward, left and right.

Fig -6: Kinect sensor[5]

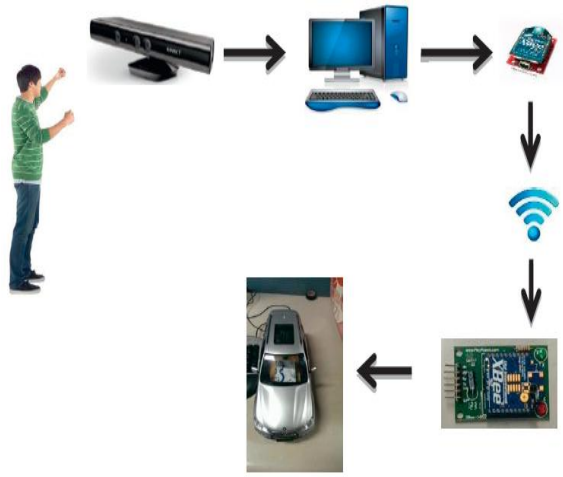


Fig -7: System architecture of Kinect remote controlled cars [5]

Application and development of kinect motion technology have been gradually penetrated into daily life and have better perspective. Kinect is used in many applications like video games, virtual reality. The cost of kinect sensor is higher than any other sensor.

2.6 HMM based hand gesture recognition system using OpenCV [5]

Hand gesture recognition is faster by using Intel's image processing library OpenCV. The whole system is divided into three stages detection and tracking, feature extraction and training and recognition. The system is Focussed on the speed of recognition as compared to better recognition rate. For continuous hand gesture HMM based algorithm comes out to be best in the lot because HMM is a statistical model and is capable of modelling spatio-temporal time series where the same gesture can differ in shape and duration. OpenCV based library makes the system easy to

create due to the large amount of inbuilt function of various image processing tasks like edge detection, feature tracking etc., also being a C++ based library the systems compatibility for real time applications is quite high with a fast processing speed. The limitation of this technique is that it suffers very much from noise.

3. CONCLUSION

Developing an efficient human machine interaction is an important task in gesture recognition system. Hand gesture can be recognized easily, and actions performed depends on gesture movement are the primary focus of many researchers. Various methods were discussed in this paper such as accelerometer, RGB depth sensor, heterogeneous camera, kinect sensor, computer vision for acquiring the input image data. And these methods have their own advantages and disadvantages. Recognition system methodology includes the pre-processing, segmentation, and recognition method. And then gesture recognition system is very useful for controlling the various hardware. This system is useful in various fields like robot control, television control, in industrial and medical area, etc.

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