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High Efficient Non-Contact Hand Gesture Recognition Using Human Machine Interface

M.Suresh[1] P.S.BoomaDevi[2] S.Sivaranjani[3] B.Usha Rani[4] E.Priyadharshini[5]

***Abstract*-Man-machine interface design is about the relationship between man and machine. It aims for improving this relationship so that the user feels more comfortable while operating the device and has a good operating experience. In this paper, we propose a novel method to improve the same using Gesture Recognition. This method is more "intuitive" which makes it stand out from the rest of the methods as it follows a hands-free approach. This intuitiveness of the method makes it more user-friendly as anyone can learn to operate it without much trouble. Using gesture recognition gives a feel of "natural communication" between human communicator and software and mechanical systems.**

***Keywords*-Automation Techniques, Optical and Mechanical gesture sensors, Hands-free control**

1. INTRODUCTION

1.1 Man-Machine Interface:

An interface is a tool and concept that refers to a point of interaction between components, and is applicable at the level of both hardware and software. Similarly a Man-Machine interface is a point where we humans interact with the machines. **Human–computer Interaction** (**HCI**) involves the study, planning, and design of the interaction between people (users) and computers. It is often regarded as the intersection of science, behavioral science, design and several other fields of study. A long term goal of HCI is to design systems that minimize the barrier between the human's cognitive model of what they want to accomplish and the computer's understanding of the user's task. As an example, DOS interface has developed into windows interface and users are relieved of complex commands by a simple operating system.

1.2 Present System

The interface between the man and the machine started from being manually controlled. The user has to manually and physically operate the machine using "specific" buttons fixed/present on the device itself. The next development was to make the buttons come closer to the user by "wiring" the buttons away from the device. This was followed by the wireless revolution and the advent of remote, thus making the so-called buttons detach themselves from the device.

The current system consists of various remotes to control various devices respectively. Each remote consists of tens of buttons to provide access to all the new and added-by-the-day features of the device. All this certainly adds to the woes of the user as first he has to device which remote is appropriate for the particular device and then which button will perform the desired task.

1.3 Proposed System: Inclination towards Natural Modes of Communication.

KINESICS or body language is one of the most powerful ways through which humans can communicate nonverbally. Body language can take on many forms such as arm and hand gestures, torso movement and posturing, face movement and pose, facial expressions, and eye gaze. Nowadays, people are not merely content with simple operating interface. They want an emotional contact and equal communication with the machine. This brings in the need for an interface that takes the human body-language as the input to the machines. This need is fulfilled by using gesture recognition to bridge the gap between man and the machine.

2. GESTURE RECOGNITION SYSTEM

2.1 Architecture of GRS

A gesture recognition system (GRS) may be thought of as a pipeline of five basic systems or stages:

1) The presentation of an object of interest (the gesture);

2) A gesture-capture device (sensor);

3) A tracking algorithm (for motion capture);

4) Feature extraction; and

5) A classification algorithm.

6) Finally, some sort of external entity whose state is affected by the gesture (see Fig. 1).

2.2 Working of GRS

A gesture is a configuration and/or movement of a part of the body, expressing an emotion, intent or command. A set of gestures and their meanings form a gesture vocabulary. The purpose of a gesture-capture sensor is to convert a gesture into digital form. Segmentation is the extraction of the object of interest (e.g., the hand) from the background and the determination of its location in the scene. Tracking requires the location and/or shape of the same object in every frame of a video sequence.

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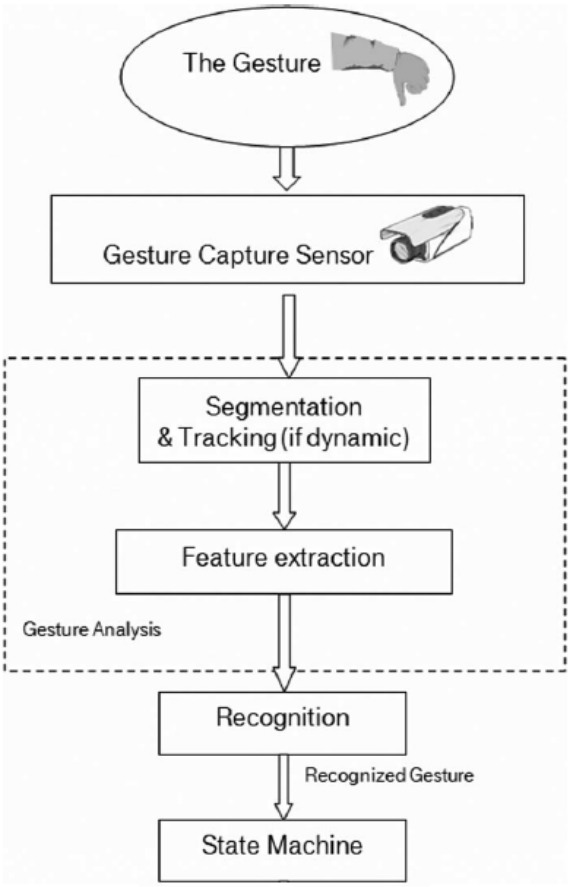

Fig.2-1. Basic architecture of a GRS controller**.**

The video stream flows from the camera to the tracking and feature extraction module. The features are then passed on to the recognition module. The recognition results are then forwarded to the state machine controlling the application logic.

Features are used both before and after object segmentation to provide statistical parameters for classification by a recognition algorithm. A classification or recognition mechanism is a computational algorithm that takes the representation of an object and classifies it as some known class type. The state machine is a mechanism that uses the classification of a recognized gesture to modify or alter the state of an electrical or mechanical apparatus. The nature of the state machine is application dependent.

2.3 Finger Gesture Recognition.

With the exception of language, the hand is most frequently used for human communication among our body parts such as hands, eyes, mouth, arms and legs. There are a number of techniques for finger recognition, which are being used in various fields. In this section, finger recognition unit is implemented using color values scheme. The finger recognition unit first converts RGB colors into gray scales and YCrCb for binary representation. Then the region inside the hand is filled by masking and noise is removed (See Figure 2). The binary image is examined in 25-pixel units, as shown in Figure 3. If sum of 1's examined is greater than ten, every digit is set to 1.

Figure 2-2. Conversion of RGB colors into gray scales and YCrCb for binary representation

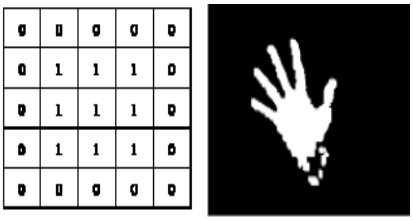

Figure 2-3. Image obtained by masking

With the image obtained by masking performed by the finger recognition unit, the center of the hand can be calculated to identify hand's location as well as the hand region furthest from the center. The center of the hand is marked with a red dot, the palm region with a red circle and the hand region with a white circle. If the number of fingers is 0 or 5, a circle image is displayed. For 1, 2 and 3 fingers, the image is shown in blue, green and red, respectively. If there are 4 fingers, the hand is shown in white on a black background (See Figure 4).

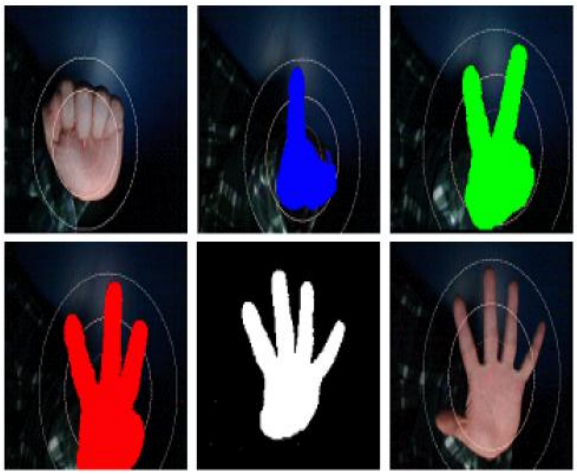

Figure 2-4. Finger recognition results

3. SYSTEM COMPONENTS

The working of a GRS system is fairly simple to understand. The GR Sensor gives its signal to the signal processor which then converts it into its equivalent digital signal. The micro-controller then based on pre-defined functions carries on the appropriate tasks required to control a device.

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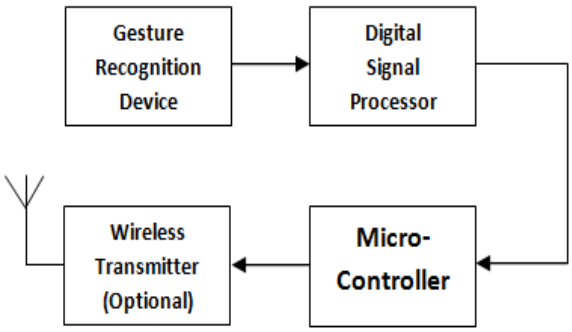

Figure 3-1. Basic Block Diagram of the Transmitter Section

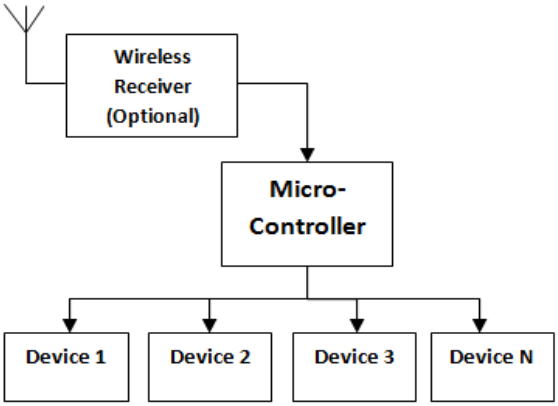

Figure 3-2. Basic Block Diagram of the Receiver Section

A Wireless Transmitter and Receiver can also be employed (as show in the above block diagram) in order to improve the flexibility of the system.

4. APPLICATIONS

A Gesture Recognition System can be used to control each and every device that can be controlled by using a micro-controller. It adds flexibility to the system as the user has to no longer remember the buttons and the remotes used to control a device.

The system needs to be programmed initially so that it can "map" the gestures to their respective tasks but once this is done, the user can easily sit back and leave the rest for the controller to do.

4.1 Future Applications

The gesture recognition technique has already been applied for military applications which include controlling the movement of a robot by using hand gestures.

We can also foresee this technology taking the pole position in home and industry automation systems.

This technology erases language barriers as gestures are mostly the same for every human irrespective of their caste, sex, culture and location. The best example being the hand gesture to ask someone to come.

5. ADVANTAGES

The first and foremost advantage of this system is its "hands-free" approach. It gives the user a natural way to communicate, which because of its intuitiveness is very easy to understand and teach. The users do not need to wear a glove and neither there is a need for a uniform background. It literally subtracts the need of skilled and trained individuals required to control a device. Gesture Recognition Systems have been tested and the experiments show that the systems can reach a accuracy of up to 98%

6. CONCLUSION

As the bridge between man and the device, the importance of the man-machine interface design becomes more prominent in the times when the device functions are becoming increasingly complex. It does not need only to clearly display control information but also to be comfortable and beautiful. This paper presents a novel technique which focuses on the way the user interacts with the devices all around. This innovative concept not only reduces the human effort but also provides us with an intuitive approach which makes our interaction with the devices more life-like.

The gesture recognition systems of future may mimic human communication. These systems are meant to be robust, fast and accurate. Implementation of such a system will give a new meaning to the phrase "Saying everything without saying anything and doing everything without doing anything."

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1. M.Suresh – Asst. Professor, Department of ECE, St. Joseph's College of Engineering and Technology, Thanjavur.

2. P.S.BoomaDevi – student, Department of ECE, St. Joseph's College of Engineering and Technology, Thanjavur.

3. S.Sivaranjani – student, Department of ECE, St. Joseph's College of Engineering and Technology, Thanjavur.

4. B.Usha Rani - student, Department of ECE, St. Joseph's College of Engineering and Technology, Thanjavur.

5. E.Priyadharshini - student, Department of ECE, St. Joseph's College of Engineering and Technology, Thanjavur.

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