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Hand Sign/ Gesture Recognition using Deep Learning

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Abstract: *In this paper, we focus on using pointing behavior for a natural interface, Hand gesture recognition-based human-machine interface is being developed vigorously in recent years. Due to the effect of lighting and complex background, most visual hand gesture recognition systems work only under restricted environment. To classify the dynamic hand gestures, we developed a simple and fast motion history image-based method. In recent years, the gesture control technique has become a new developmental trend for many human-based electronics products. This technique let people can control these products more naturally, intuitively, and conveniently. In this paper, a fast gesture recognition scheme is proposed to be an interface for the human-machine interaction (HMI) of systems. This paper presents some low-complexity algorithms and gestures to reduce the gesture recognition complexity and be more suitable for controlling real-time computer systems using Convolutional Neural Networks*

Keywords: Hand gesture recognition, Human computer interaction, Convolutional Neural Network, Gaussian Function

I. INTRODUCTION

The essential aim of building a hand gesture recognition system is to make a natural interaction between humans and pc wherever the recognized gestures may be used for dominant a golem or transference significant info, the way to type the resulted hand gestures to be understood and well taken by the pc thought about because of the downside of gesture interaction. Human-computer interaction (HCI) additionally named Man-Machine Interaction (MMI) refers to the relation between the human and therefore the pc or a lot of exactly the machine, and since the machine is insignificant while not appropriately utilized by the human. There square measure 2 main characteristics ought to be deemed once planning an HCI system as mentioned in functionality and usefulness. System functionality mentioned the set of functions or services that the system equips to the users, whereas system usability mentioned the amount and scope that the system will operate and perform specific user functions expeditiously. The system that attains an acceptable balance between these ideas thought about a potent performance and powerful system. Gestures used for human activity between humans and machines still as between individual's mistreatment language.

II. LITERATURE SURVEY

In [1] An efficient approach for the recognition of hand gestures from very low-resolution images. A simple and effective approach for the recognition of hand gestures from very low-resolution images is proposed. Enhancement of the low-resolution images has always been the key focus in the processing of the digital images. Images with resolution as low as [50×50 pixels] are also considered for recognition. The gestures under consideration here are the number of fingers (one, two, three, four or five) raised by the person. The low-resolution gesture image captured from web camera, mobile phone, or low-cost cameras is processed systematically to output the number of fingers raised. Simple concepts of the geometry of the hand have been used for the recognition of hand gesture from the input low resolution images. The proposed method extracts the hand gesture directly from the low-resolution image without the need of reconstruction to a high-resolution image or use of any classifier. The proposed method is based on the generation of a mask for the image which is critical in the recognition of the hand gesture. This method is tested on publicly available dataset of Marcel-Triesch. The high accuracy of the experimental results shows the superior performance of the proposed method for the recognition of hand gesture from low resolution images.

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In [2]A new hand gesture recognition algorithm based on joint color-depth super pixel earth mover's distance. A novel hand gesture recognition algorithm based on Kinect. Using the depth and skeleton from Kinect, mark-less hand extraction is achieved. The hand shapes (depth) and corresponded textures (color) are represented in the form of super pixels, which better retain the overall shapes and color of the gestures to be recognized. Based on this representation, a novel distance metric, Super pixel Earth Mover's Distance (SP-EMD), is proposed to measure the dissimilarity between the hand gestures. The effectiveness of the proposed distance metric and recognition algorithm is illustrated by experimental results and a high mean accuracy of 98.8% for hand gesture recognition is achieved based on the joint color-depth SP-EMD.

In [3] Real time sign language recognition using PCA.Sign Language Recognition system capable of recognizing 26 gestures from the Indian Sign Language by using MATLAB. The proposed system having four modules such as: pre-processing and hand segmentation, feature extraction, sign recognition and sign to text and voice conversion. Segmentation is done by using image processing. Different features are extracted such as Eigen values and Eigen vectors which are used in recognition. The Principal Component Analysis (PCA) algorithm was used for gesture recognition and recognized gesture is converted into text and voice format. The proposed system helps to minimize communication barrier between deaf-dumb people and normal people.

In [4] Depth-based hand gesture recognition for home appliance control. Dynamic hand gesture recognition system for home appliance control using only the depth camera. The dynamic hand gesture is recognized using static hand postures and hand trajectory. The proposed system can recognize seven commonly used dynamic hand gestures. Experimental results show that the system is effective for home appliance control.

In [5] Design and implementation of a 3d hand gesture architecture system under complicated environment. In this digital information explosion era, more and more products are proposed to enhance the quality and convenience of our life. However, vision-based hand gesture recognition is still a challenging problem to overcome. In this paper, an architecture system was proposed with dual camera to construct the depth map and recognize dynamic hand gesture. It contains one static and two dynamic hand gestures. This design is implemented in SMIMS development board to verify and demonstrate the whole system.

III. EXISTING SYSTEM

In recent decades, due to computer software and hardware technologies of continuous innovation and breakthroughs, social life and information technology have a very close relationship in the twenty-first century. In the future, especially the interfaces of consumer electronics products (e.g., smartphones, games, and infotainment systems) will have more and more functions and be complex. How to develop a convenient human-machine Interface (Human Machine Interaction/Interface, HMI) for each consumer electronics product has become an important issue. The traditional electronic input devices, such as a mouse, keyboard, and joystick are still the most common interaction way. However, it does not mean that these devices are the most convenient and natural input devices for most users. Since ancient times, gestures are a major way of communication and interaction between people. People can easily express ideas by gestures before the invention of language. Nowadays, gestures still are naturally used by many people and especially are the most major and natural interaction way for deaf people. In recent years, the gesture control technique has become a new developmental trend for many human-based electronics products, such as computers, televisions, and games. This technique let people can control these products more naturally, intuitively, and in the case of the existing system. The objective of this paper is to develop a real-time hand gesture recognition system based on adaptive color HSV model and motion history image (MHI). With an adaptive skin color model, the effects from lighting, environment, and camera can be greatly reduced, and the robustness of hand gesture recognition could be greatly improved.

IV. PROPOSED SYSTEM

Most gesture recognition methods usually contain three major stages. The first stage is object detection. The target of this stage is to detect hand objects in digital images or videos. Many environments and image problems are needed to solve at this stage to ensure that the hand contours or regions can be extracted precisely to enhance the recognition accuracy. Common image problems contain unstable brightness, noise, poor resolution, and contrast. A better environment and camera devices can effectively improve these problems. However, it is hard to control when the gesture recognition system is working in the real environment or is become a product. Hence, the image processing method is a better solution to solve

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these image problems to construct an adaptive and robust gesture recognition system. The second stage is object recognition. The detected hand objects are recognized to identify the gestures. At this stage, differentiated features and effective classifier selection are major issues in most research. The third stage is to analyze sequential gestures to identify users' instructs or behaviors.

V. SYSTEM ARCHITECTURE

The gesture recognition system into mainly of three steps after acquiring the input image from a camera(s), videos or even a data glove instrumented device. These steps are the Extraction Method, features estimation and extraction, and classification or recognition as illustrated in Figure 1.

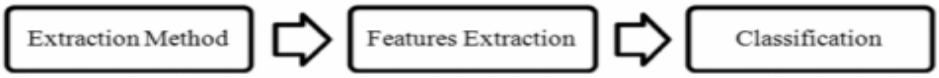

Figure 1. Gesture Recognition System Steps

5.1 Segmentation

Segmentation process is the first process for recognizing hand gestures. It is the process of dividing the input image (in this case hand gesture image) into regions

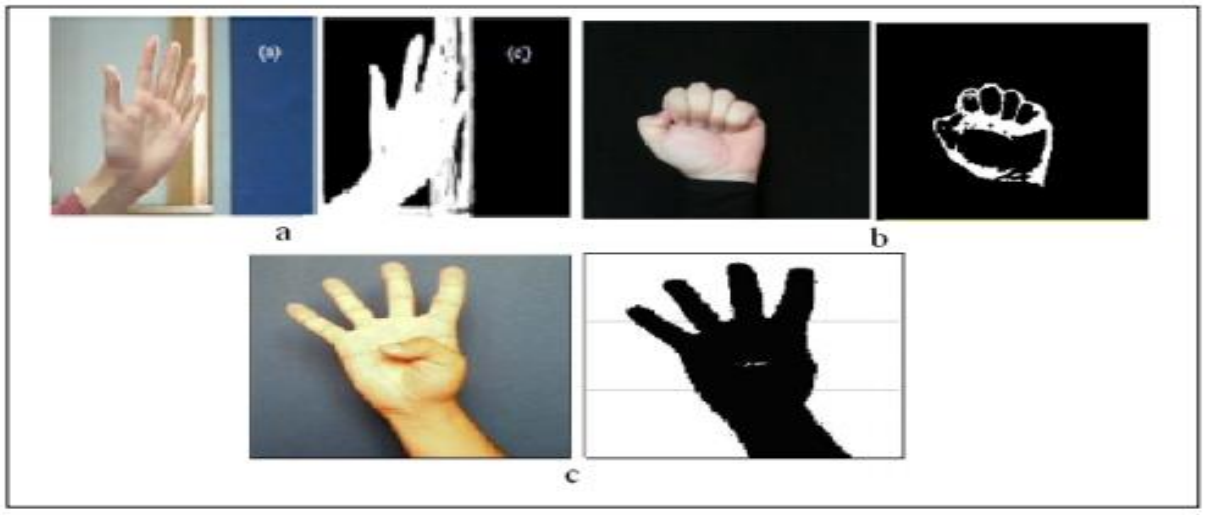

Figure 2. Segmentation method.

5.2 Feature Extraction

A good segmentation process leads to a perfect feature extraction process and the latter play an important role in a successful recognition process. Features vector of the segmented image can be extracted in different ways according to application. Various methods have been International Journal of Artificial Intelligence & Applications (IJAIA), Vol.3, No.4, July 2012 164 applied for representing the features that can be extracted. Some methods used the shape of the hand such as hand contour and silhouette while others utilized fingertips position, palm center, etc. creating 13 parameters as a feature vector, the first parameters represented the ratio aspect of the bounding box of the hand and the rest 12 parameters are mean values of brightness pixels in the image. used the Self-Growing and Self-Organized Neural Gas (SGONG) neural algorithm to capture the shape of the hand, then three features are obtained: Palm region, Palm center, and Hand slope. calculated the Centre of Gravity (COG) of the segmented hand and the distance from the COG to the farthest point in the fingers and extracted one binary signal (1D) to estimate the number of fingers in the hand region. divided the segmented image into different blocks size and each block represents the brightness measurements in the image. Many experiments were applied

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to decide the right block size that can achieve a good recognition rate. used Gaussian PDF to extract geometric central moment as local and global features. Figure 3 shows some applications of feature extraction methods

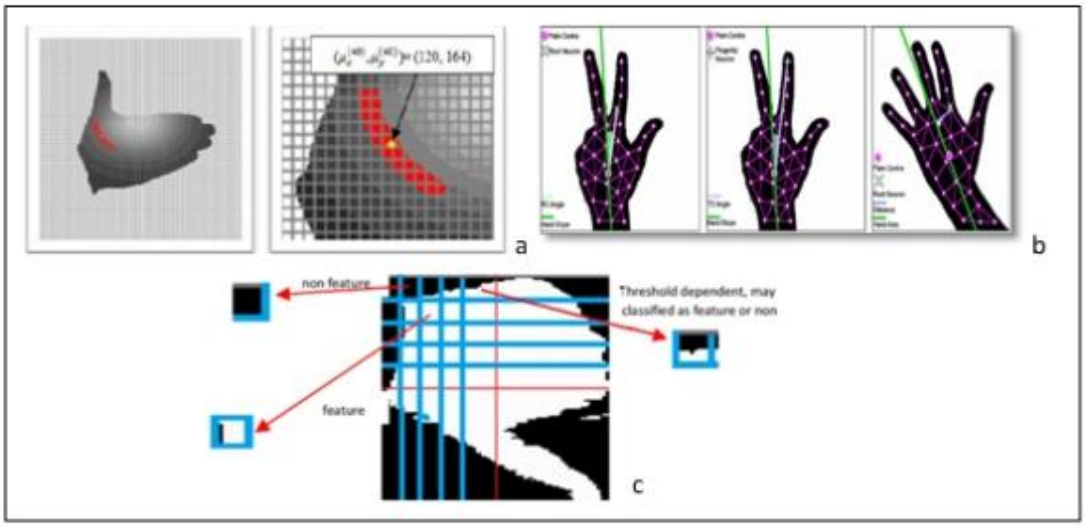

Figure 3. features representation.

a) The segmented image is partitioned into 11 terraces with 8 regions per terrace to extract local and global geometric central moment.

b) Three angles are extracted: RC angle, TC angle, and distance from the palm centre. Segmented hand divided into blocks and the brightness factor for each block represents the feature vector (blocks with black area are discarded) .

5.3 Gestures Classification

After modeling and analysis of the input hand image, the gesture classification method is used to recognize the gesture. Recognition process is affected by the proper selection of feature parameters and a suitable classification algorithm. For example, edge detection or contour operators cannot be used for gesture recognition since many hand postures are generated and could produce misclassification. Euclidean distance metric used to classify the gestures.

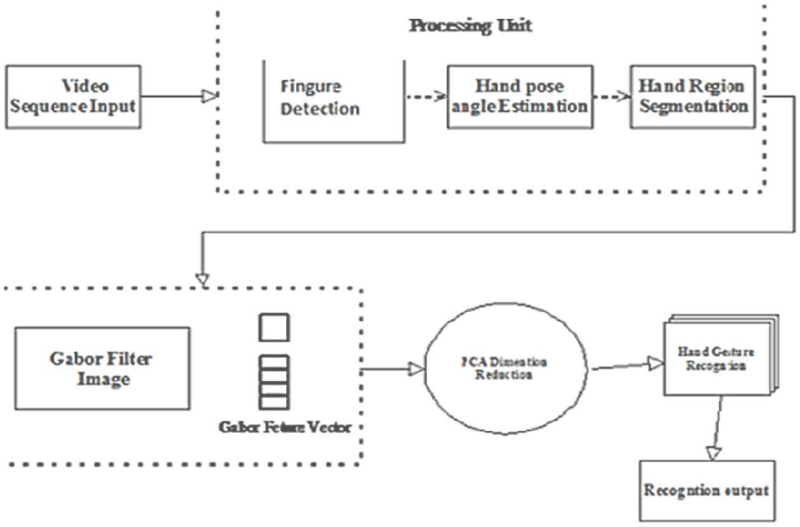

Figure 4: System Architecture

Statistical tools used for gesture classification, HMM tool has shown its ability to recognize dynamic gestures besides, Finite State Machine (FSM), Learning Vector Quantization, and Principal Component Analysis (PCA). Neural network has been

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widely applied in the field of extracted the hand shape, and for hand gesture recognition. Other soft computing tools are effective in this field as well, such as Fuzzy C- International Journal of Artificial Intelligence & Applications (IJAIA), Vol.3, No.4, July 2012 165 Means clustering (FCM), and Genetic Algorithms GAs. Figure 4 explain the architecture of classification system.

VI. ALGORITHM USED

6.1 ResNet50

ResNet-50 model is a convolutional neural network (CNN) that is 50 layers deep. A Residual Neural Network (ResNet) is an Artificial Neural Network (ANN) of a kind that stacks residual blocks on top of each other to form a network. Resnet50 is used to denote the variant that can work with 50 neural network layers. The concept of "skip connections," which lies at the core of the residual blocks, is the strength of this type of neural network. the skip connections add the outputs from previous layers to the outputs of stacked layers, making it possible to train much deeper networks than previously possible. While the Resnet50 architecture is based on the ResNet34 Architecture, there is one major difference. In this case, the building block was modified into a bottleneck design due to concerns over the time taken to train the layers. This used a stack of 3 layers instead of 2 in ResNet34.Therefore, each of the 2-layer blocks in Resnet34 was replaced with a 3-layer bottleneck block, forming the Resnet 50 architecture. This has much higher accuracy than the 34-layer ResNet model. The 50-layer ResNet achieves a performance of 3.8 bn FLOPS.

1. A convolution with a kernel size of 7 * 7 and 64 different kernels all with a stride of size 2 giving us 1 layer.
2. Next, we see max pooling with also a stride size of 2.
3. In the next convolution there is a 1 * 1,64 kernel following this a 3 * 3,64 kernel and at last a 1 * 1,256 kernel, these three layers are repeated in total 3 time so giving us 9 layers in this step.
4. Next, we see kernel of 1 * 1,128 after that a kernel of 3 * 3,128 and at last a kernel of 1 * 1,512 this step was repeated 4 time so giving us 12 layers in this step.
5. After that there is a kernel of 1 * 1,256 and two more kernels with 3 * 3,256 and 1 * 1,1024 and this is repeated 6 time giving us a total of 18 layers.
6. And then again, a 1 * 1,512 kernel with two more of 3 * 3,512 and 1 * 1,2048 and this was repeated 3 times giving us a total of 9 layers.
7. After that we do a average pool and end it with a fully connected layer containing 1000 nodes and at the end a SoftMax function so this gives us 1 layer.

So, totalling this it gives us a 1 + 9 + 12 + 18 + 9 + 1 = 50 layers Deep Convolutional network.

VII. CONCLUSION

Various methods are discussed for gesture recognition, these methods include from Convolutional Neural Network, HMM, fuzzy c-means clustering, besides using orientation histogram for features representation. For dynamic gestures HMM tools are perfect and have shown its efficiency especially for robot control. NNs are used as classifier and for capturing hand shape in. For features extraction, some methods and algorithms are required even to capture the shape of the hand as in, applied Gaussian bivariate function for fitting the segmented hand which is used to minimize the rotation affection. The selection of ResNet architecture have helped a lot to increase the performance of the neural network with large number of layers. In this work application areas for the gestures system are presented. Explanation of gesture recognition issues, detail discussion of recent recognition systems is given as well.

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