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Dsp Implementation of Gesture Recognition

Mr.P.Vijaya Kumar[1], B.Swetha Reddy[2]

[1] *Asst. Prof. (Sr.G)/E.C.E, , SRM University, Chennai.,India.*
vijayakumarp@ktr.srmuniv.ac.in.
[2] *M.tech- Embedded Systems , SRM University,Chennai,India.*
bek_swetha@yahoo.com

***Abstract*—Gesture recognition is one which enables human to interface with the machine and interact naturally without any mechanical devices. Gestures can originate from any bodily motion or state but commonly originate from the face or hand. Current field include hand gesture recognition which is useful for processing information from humans which is not conveyed through speech or type. Gesture recognition can be conducted with techniques from computer vision and image processing. Here the operation is done in 4 steps: image input, background subtraction, image processing & data extraction, and decision tree generation/parsing. This is implemented on a TMS320C6713 DSP chip. This hand gesture recognition system can be used in the field of robotics, controlling a computer, controlling interactive within video games, can be used as a controlling device in a car, controlling a television set.**

***Index Terms*—DSP, Image Capture, Thresholding, and Hand gesture Recognition.**

I. INTRODUCTION

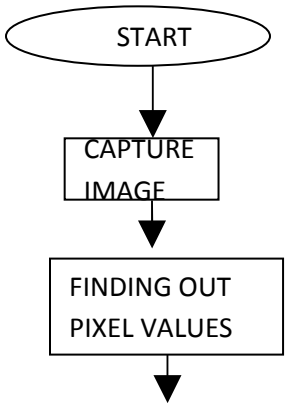
Interpretation of human gestures by a computer is used for human-machine interaction in the area of computer vision. The main purpose of gesture recognition research is to identify a particular human gesture and convey information to the user pertaining to individual gesture. The goal of this project was to build a working Gesture Recognition System. The system must be able to look at a user, and determine where they are pointing. Overall aim is to make the computer to understand human body language thereby bridging the gap between machine and human.

Hand gesture recognition can be used to enhance human– computer interaction "Ref. [2]" without depending on traditional input devices such as keyboard and mouse. This paper presents detailed description of a real-time hand gesture recognition system using embedded DSP board "Ref. [4]" and image processing approaches. Human hand tracking is the important step of human hand gesture recognition "Ref. [3]". It can be implemented by finding the location of human hand. Human detection is basically an image segmentation problem as the image is segmented into two parts: one containing hands and the other representing non-hand regions.

The performance of human-hand tracking influences the entire recognition system. A number of methods have been proposed. Generally, these methods can be classified into two groups: the first group is based on special features, and the second group is based on the hand image itself. The proposed method is based on detecting hand shape feature.

II. KEY FEATURES AND BASIC OPERATION OF 6713 PROCESSOR

This project is implemented on TMS3206713 DSK kit. A Texas Instruments TMS 320C6713 DSP operates at 225 MHz It has 16 Mbytes of synchronous DRAM and512 Kbytes of non-volatile flash memory (256 Kbytes usable in default configuration). Digital signal Processing is one of the most powerful technologies that will shape science and engineering in the twenty-first century. Revolutionary changes have already been made in a broad range of fields: communications, medical imaging, radar & sonar, high fidelity music reproduction, and oil prospecting, to name just a few. Each of these areas has developed a deep DSP technology, with its own algorithms, mathematics, and specialized techniques. The DSK is designed to work with Tl's Code Composer Studio development environment and ships with a version specifically tailored to work with the board. Code Composer communicates with the board through the on-board JTAG emulator or USB connector.



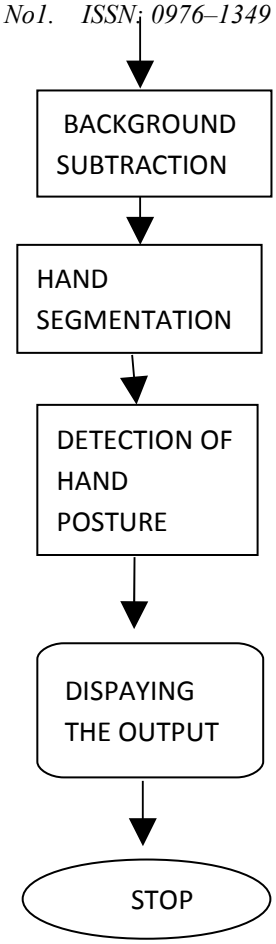


Fig.1. The flow chart of hand gesture recognition system

It takes the image from the system and after processing we get the output. We connect the C6713 DSK kit to host system through USB connector. It takes image from system so that pixels are loaded one by one and after processing we get the output the output as text indicating which hand gesture has been shown.

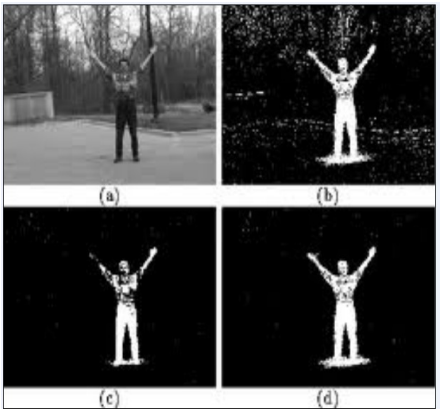


Fig.2. An original image, Background subtracted image, Image after removing noise, Feature extracted image.

III. BASIC DESIGN

The tradition method of interaction with system based on keyboards and mice will inherently limit the speed and naturalness of human's interaction with computers. So, a long-term attempt has been made that humans naturally communicate with system. In flowchart of "Fig.1" the way how this gesture can be recognized is shown in detail. First, image will be captured then corresponding pixel values for a particular respective image will be found out. Using this, background subtraction of images and then hand segmentation of image will be obtained by using binary image. The next step is the detection of hand gestures by applying some algorithms. The detected gesture will be displayed after processing has been done in DSP processor. Hand gesture recognition can be considered as a promising approach to realize this thought. This is then implemented on a TMS320C6713 DSP chip. The operation of the system proceeds in four basic steps: Image input, background subtraction, image processing "Ref. [3]" and data extraction, and finally recognition of hand gesture. The proposed method will be done with the help of 'c' programming is used to implement in DSP.

Fig.3. Hand image

Fig.4. Background of a hand image

A. Hand Segmentation

After background subtraction we need to segment the hand. This is done by removing the noise in the image, then does segmentation of hand from the image and finally recognizes the hand gesture "Ref. [1]". This is shown in (c) & (d) of "Fig.2".We can see a hand indicating gesture like stop as shown in "Fig.3". "Fig.4"shows just the background of hand image before segmentation. This looks as in "Fig.5" after applying threshold and segmenting the features.

B. Background Subtraction

Fundamentally, the objective of background subtraction algorithms is to identify interesting areas of a scene for the subsequent analysis. "Interesting" usually has a straightforward definition: objects in the scene that represent gestures. Once images are taken, the system performs a background subtraction of the image to isolate the person and create a mask.

The background subtraction proceeds in two steps. First, each pixel from the background image is channel wise subtracted from the corresponding pixel from the foreground image. This is done by choosing a threshold value. It can be seen in fig (b) of "Fig.2". The resulting channel differences are summed, and if the pixel value is above a threshold, then the corresponding image of the mask is set white, otherwise it is set black.

IV. CALCULATION OF EXECUTION TIME

The Texas Instruments TMS320C6000 DSP platform of high-performance digital signal processors (DSPs) now includes the TMS320C6713. The C6713 brings the highest level of performance in the C6000 DSP platform of floating-point DSPs. At the initial clock rate of 225 MHz, the C6713 can process information at a rate of 1.35 giga - floating-point operations per second (GFLOPS).

Total Execution time of an image by background subtraction method for different threshold values=

(Clock frequency x the number of clock cycles taken to execute an image)

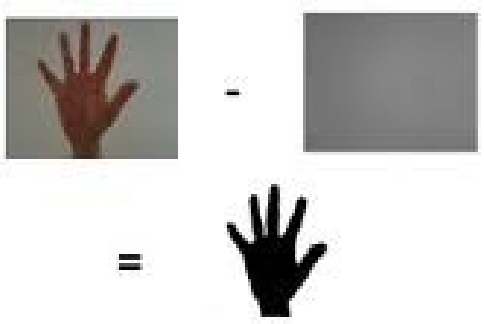


Fig.6. Back ground subtraction

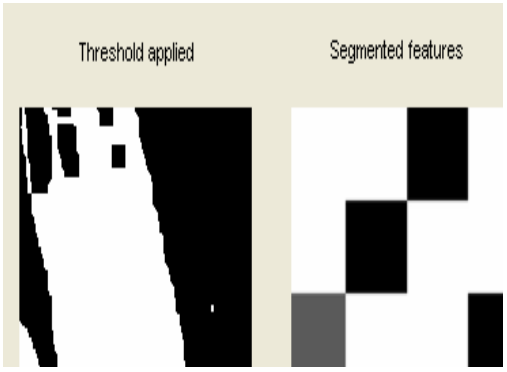


Fig.5. Image after thresholding and segmented of fig.2

Where, the clock frequency depends on the DSP board we are using. Here we are using TI-TMS320C6713. The clock frequency of this TMS320C6713 DSP processor is 1/225 MHz in Table 1 the execution time for different sizes of image have been indicated.

A. Tracing Hand

From the center of the body, horizontal rows are traced out to the left and right until the edge of the mask is reached (pixels turn from white to black). The row of pixels that extends the furthest is assumed to be the arm that is pointing. This again is a valid decision based on the assumptions about the input image. The arm is pointing in a direction (not up or down, in which case this algorithm obviously fails).This algorithm based on threshold was successful at finding the pointing arm to within a few pixels for all images tested, including those with shadows (due to the fact that the shadows are in the same direction as the pointing arm).

V. APPLICATIONS

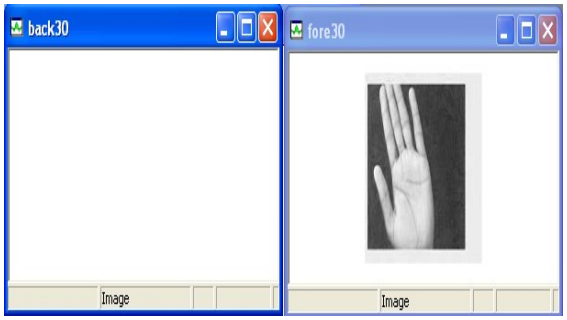
In some interactive applications, the computer needs to track the position or orientation of a hand that is prominent in the image. Relevant applications might be computer games, or interactive machine control. In such cases, a description of the overall properties of the image may be adequate. If the hand is on a uniform background, Large Object Tracking method can distinguish hand positions and simple pointing gestures.It is used in the field of robotics, controlling a computer "Ref. [7]", controlling interactive within video games, can be used as a controlling device in a car, controlling a television set.

VI. EXPERIMENTAL RESULTS

Experiments have been conducted on five to six images. For this purpose method like thresholding, feature extraction has been used. The image processing is done by using TMS320C6713 processor. Below the output of hand image for different threshold values and

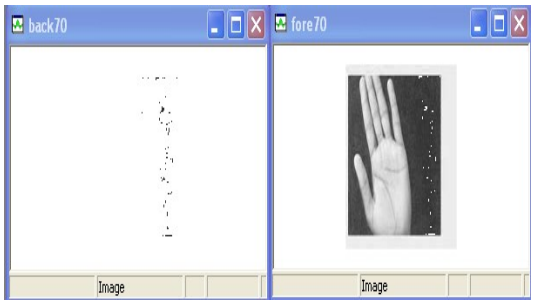
the table showing various execution times for background subtraction, hand segmentation and finally hand recognition have been shown. After processing is done, then, the text based on hand gesture will be displayed.

BACKGROUND SUBTRACTED OUTPUTS FOR HAND IMAGE ON APPLYING DIFFERENT THRESHOLD VALUES:



THRESHOLD=30

THRESHOLD=50



THRESHOLD=70

TABLE I : EXECUTION TIME OF AN IMAGE

Image Size	Back Ground Execution (us)	Hand Segmentation (us)	Gesture Recognition (us)
128x128	9202.72	6441.904	12883.808
512x512	15644.62	10951.234	21902.468

VII. CONCLUSION

In this paper, we have presented a new system for interacting with a large screen, which enables a user to interact with the system naturally. A lot of research work has been done on still hand image gestures. This paper presents a method which uses embedded DSP board and image processing techniques to recognize human's hand postures and dynamic gestures. Future work will focus on the system reaction, that is, how the system will react or function, for a particular gesture.

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