PERFORMANCE ANALYSIS OF VIRTUAL KEYBOARD THROUGH SHADOW ANALYSIS

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ABSTRACT

Traditional QWERTY keyboards are large in size and offer little in terms of their ability to modify. A Virtual Keyboard, with slightest physical form may provide an answer to the point of time, where the size of desktops and laptops is becoming smaller, the traditional keyboard acts as a hindrance to further miniaturization. In today's world many different Virtual Keyboard exist which are using 3D cameras.

This paper involves the creation of Virtual Keyboard using the shadow analysis. The paper aimed to create such keyboard which requires no external hardware, easy to use with reconfigurable option in it. The main focus of this paper is to know the problems with current VK and how to solve these problems using novel techniques like shadow analysis. Finally this paper aimed to discuss and evaluate the working of Virtual Keyboard.

The analysis was nicely done in creating the Virtual Keyboard using shadow analysis and image processing. Also, the layout of the keyboard generated using the laser film or alphanumeric keypad. Application was successful in generating the virtual key press events done by the users. Paper also successful in allowing the users to change the layout of the keyboard based on application; hence user has the privilege to select a particular layout for gaming application.

Keywords - *Edge Detection (ED), Human-Computer Interaction (HCI), Shadow Analysis (SA), Shadow Extraction (SE), Virtual Keyboard (VK)*

I INTRODUCTION

A virtual keyboard is basically a keyboard that has no physical support and operated by the user via typing i.e. by moving fingers on it rather than typing on depressing physical keys. A VK is simply a projection keyboard projected and touched on any surface.

A virtual keyboard is one of the examples of today's fast trend. Computing is not just limited to laptops and desktops; it found the ways to enter into many devices for illustration mobile devices like cell phones and palm tops. The only thing which remains constant is old QWERTY keyboard and virtual keyboard (VK) technology is the latest development.

In paper, simple virtual keyboard has been created using shadow analysis with the help of simple 2D camera and without using any external hardware or any 3D camera.

The first biggest problem in normal QWERTY keyboards is its size, they are large in size and it is really very uncomfortable for a person to carry it from one place to the other. The chances of breaking up may also get increased.

The second problematic situation for QWERTY keyboard is its language restriction user has to install different software's to interact with the system in any other language (English language is by default).

Paper allows artificial intelligence to those people who want to work on the simple surface thinking as if it is a keyboard. Virtual keyboard lets people to have multilingual writing content or text content on existing platform. The idea behind creating this virtual keyboard is simple and understandable. A Virtual keyboard that have been created is small, well designed, handy and really very easy to operate also, which results in the perfect solution for cross multilingual text input.

The rest of the paper is organized as follows. Section 2 represents our proposed work according to the problem definition. Results and discussionshave been presented in section 3. Concluding remarks are given in section 4.

II PROPOSED WORK

Some of the very crucial points are discussed in this part regarding the implementation flow of virtual keyboard. Firstly the keyboard is detected with the help of a reference point. Once it's done, hand should be detected using the hand detection method, where colour segmentation process has been used for the detection process. It plays a crucial role in extracting the shadow of the hand. In next stage, it is very important to know how it detects it and then proposed the edge detection methodology where it detects the edges of the finger tips (top of the finger caller's finger tip).

2.1 Research background and Motivation

Turk, M and Kölsch described in [2] ,the Virtual Keyboard in different forms out of which, mostly virtual keyboards depends on CCD cameras and 3D optical ranging and significantly depends on primarily on image processing, M. and Turk, M. did a research which was focussed on various forms like rings, gloves, projection and devices based on hand gestures. A special type of 3D camera or two 2D cameras is used.

In addition to this, pattern projector has been used in this project for projecting the keyboard. Single CCD camera will be used while making the Virtual Keyboard design using high power infrared light source and a camera with the help an infrared filter. Even more meaningful is the work presented, and to get inside information from a 2D picture, shadow analysis being used.

In this paper novel technique has been used where it will use finger shadow to detect the whether the finger is touching the virtual keyboard or not. To implement devices which are highly specialized is not that practical idea. But the idea bestowed for finger, hand and fingertip detection are convincing in this changeable field or activity done under virtual human interface devices (i.e. VHID).

2.2 Proposed Solution

Firstly, this paper aims to create a Virtual keyboard using shadow analysis, using simple 2D camera and no additional hardware. Novel technologies have adopted during the development of the application. Finally, the project aims to reconfigure the keyboard, through which user can design their own keyboard layout and use it for different purposes like for gamming or choosing different languages. To implement this we introduce steps for design which are mention step by step in algorithm as described in next section.

2.3 Proposed Algorithm

In this paper a shadow based analysis is used to acquire depth information from a 2-D image. The same way in the diagram first thing is to capture the image with the help of webcam (2D camera only, no 3D camera project is using) next once the image has captured then take one reference frame. Reference frame is system coordination used to measure and represent the object and their position.

We also call it as a set of axis. Once the reference frame is set, set the required image accordingly and make it bright (image brightening). In the project some options provided through which user can easily change the saturation, brightness and make the image bright as per the requirement of the virtual keyboard software. Once the image is bright enough then it will try to detect the hand called hand detection.

The colour of the hand is black till here before detection. Now after the detection it will turn it to white colour and if it's not then it will go to image capture step. After hand detection, the system will detect the edges of the hand known as edge detection.

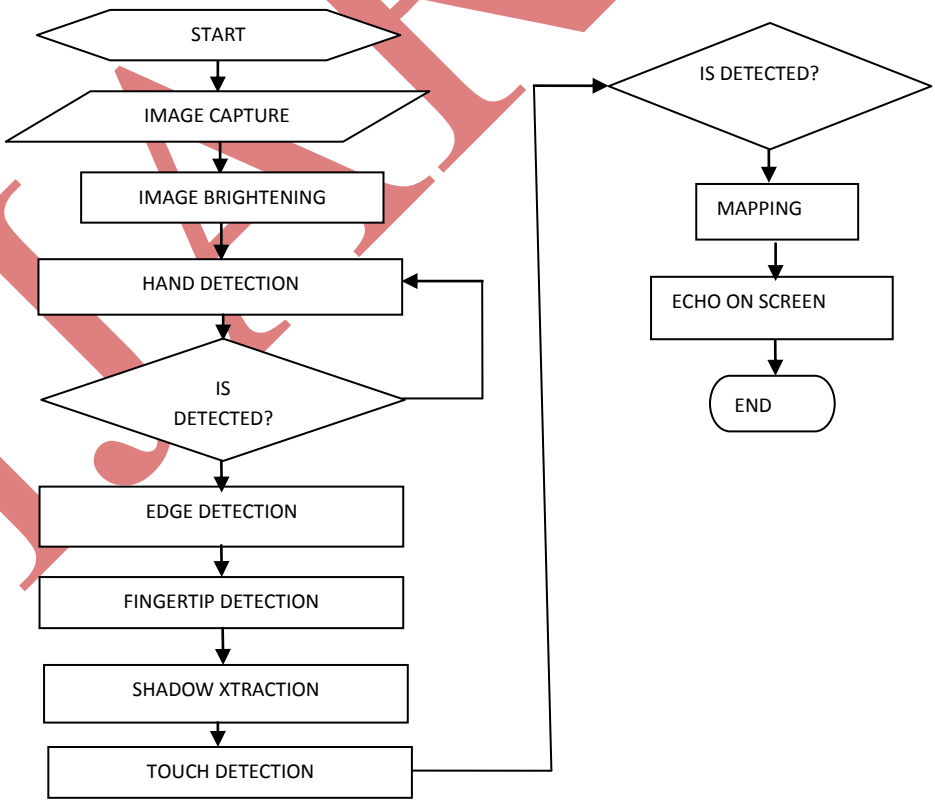


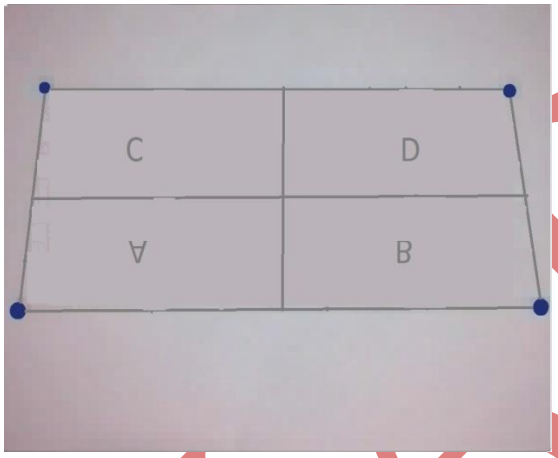
Fig. 1Flowchart For Implementation Of Virtual Keyboard

The algorithm shows the steps for design of this project. The VK implementation flow is shown in the flow graph. Initially, the keyboard is detected. Once the keyboard is detected, the user's hand is detected using color segmentation. This process is also useful in extracting the hand's shadow. If the hand is detected, the process flow moves onto edge detection which is used to identify the finger tips.

III RESULTS AND DISCUSSIONS

End to end testing took place when webcam has been used using a simple 2D Logitech camera for testing whether it's taking the image from outside world or not, this was the most crucial step. If user has virtual keyboard printed in the paper, it surely be handled carefully. Without the proper input to the application it won't results in detecting the alphabets, symbols or numbers.

The endpoints of the VK are identified using colour differentiation. The endpoints of the keyboard are colour blue, thus on thresholding, these points can be easily identified. The area of interest i.e. the location of the VK in the image is then defined. For testing we took only 4 key keyboard ABCD as shown below.



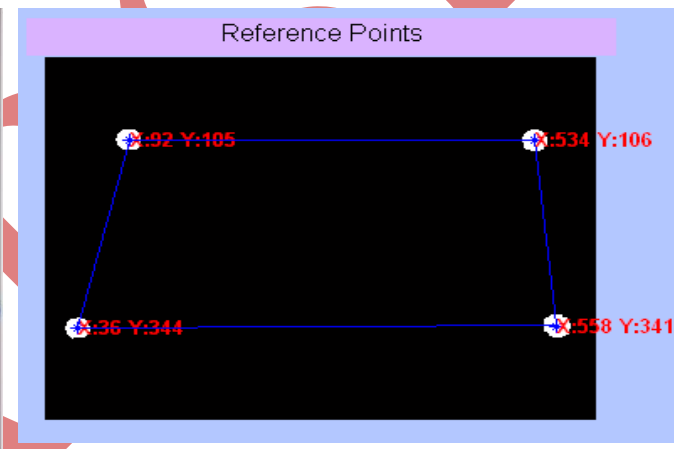
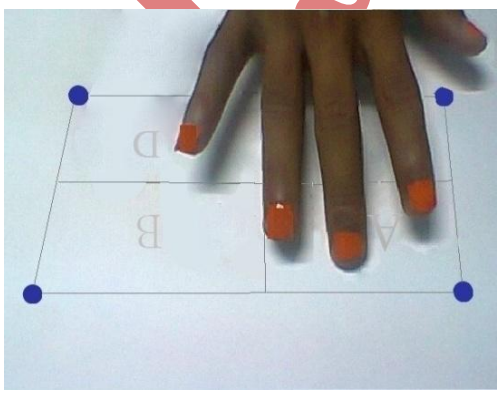


Fig.2 Virtual Keyboard with four end point **Fig.3 VK having four end point with XY coordinate**

Camera captures the image of Virtual Keyboard. Here we present the results related to touch detection of letter A.



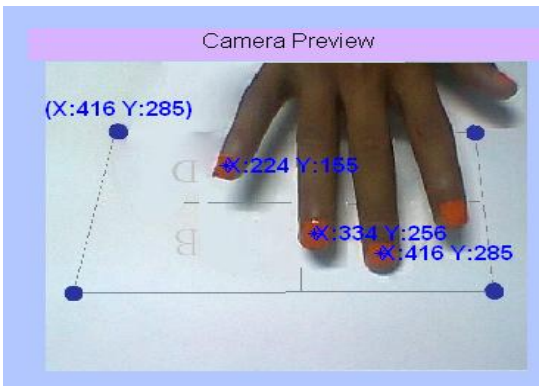


Fig. 4 Image capture by Camera **Fig. 5 Reference point of each detected point**

Initially, a large collection of hand images was created. These images were observed for their RGB (Red Green Blue) values in the area of interest, i.e. the hand. It was noted that, in these hand regions the red component was higher than the other two components. These observations were consistent across all the images that were tested. There may be certain regions on the hand such as the fingernails and/or veins where this observation might not be true. However, this does not affect the overall result as a significant portion of the hand follows the expected pattern and the hand is appropriately detected. In order to remove the abnormalities in the hand regions, we use image enhancement techniques. Finally, the detected hand regions are threshold to white, while the rest of the image is made black.

Edge detection of the hand is required in order to detect the fingertips. The edge obtained is then thickened in order to remove discontinuities [9]. Edges characterize boundaries and are therefore a problem of fundamental importance in image processing. Edges in images are areas with strong intensity contrasts a jump in intensity from one pixel to the next. Edge detecting an image significantly reduces the amount of data and filters out useless information, while preserving the important structural properties in an image. There are many ways to perform edge detection. However, the majority of different methods may be grouped into two categories, gradient and Laplacian. The gradient method detects the edges by looking for the maximum and minimum in the first derivative of the image. The Laplacian method searches for zero crossings in the second derivative of the image to find edges.

An edge has the one-dimensional shape of a ramp and calculating the derivative of the image can highlight its location. In digital image, the so-called edge is a collection of the pixels whose gray value has a step or roof change, and it also refers to the part where the brightness of the image local area changes significantly. There are an extremely large number of edge detection operators available like Sobel, Robert, Prewitt, Zero cross, Canny etc. Structure of edge, direction of edge and noise conditions are the factors which are involved in selection of different edge detection operators.

Poor concentration and refraction effects can moderately change the object boundaries which can lead to problems like noise susceptibility, false edge detection and high computational time. Here we introduce our new method for edge detection which includes mask of (1, 0) by multiplying point to point with original image using '.*' operator.

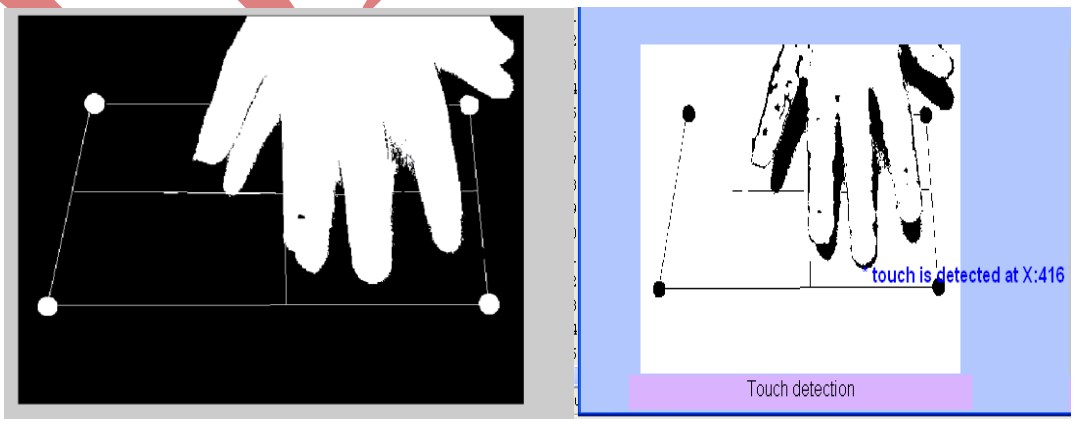


Fig.6 Hand Region Threshold to White. Fig. 7 The shadow in extracted from the original frame

To calculate touch we first calculate centroid by considering 100 pixel x 100 pixel boxes. Then we take ratio of white and black connected component by 8 neighborhoods. If the ratio of the area of non-shadow region to the area of the shadow region exceeds a particular threshold we can say that touch has occurred, finally we calculate the reference point of touch pixel. The final step involves mapping of the fingertips to actual keys. This is a simple 2D mapping based on the information available in the current frame (x, y coordinates) and relative position of the fingertip from the endpoints of the keyboard.GUI for our proposed Virtual Keyboard as shown below.

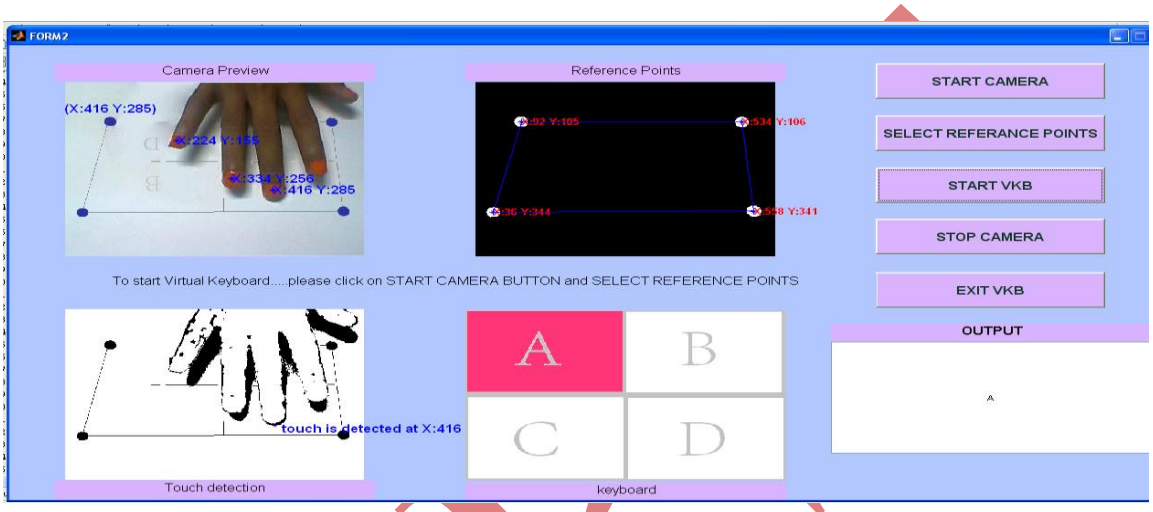


Fig. 8 GUI for our proposed Virtual Keyboard

IV CONCLUSION

This paper illustrates about the practical implementation of Virtual Keyboard (VK) which demonstrates upcoming tomorrow of human mobile devices and human computer interaction in the creation of Virtual world. With the increasing demand of small mobile devices, conventional data entry is required that are considerably flexible and easy to use without affecting portability and mobility of such devices. As different data input methods and different types of VK are available. But still, these methods have inconveniences of a normal size keyboard and lack of accuracy. The Virtual Keyboard that we propose uses only a standard web camera, with no additional hardware. This paper addresses problems with current Virtual Keyboard implementations and describes a novel technique, namely shadow Analysis to solve these problems. The objective of this paper is to develop a Virtual Keyboard (VK) using only a standard 2D camera without the need for additional specialized hardware.

A virtual keyboard for mobile devices will remove the inherent space constraints and would therefore provide for a full sized keyboard without additional hardware. In implementation, a Logitech Webcam is used and a sheet of paper with the keyboard printed on it. The only unique aspect of the keyboard is that it has four colour endpoints which are used to identify the keyboard. The implementation is based on use of image processing. We propose Shadow Analysis for detection of webcam based Virtual Keyboard (VK).

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