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A Spectacular Technique to Deploy Virtual Keyboard in Mobile Phones

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Abstract: Targeting at more creative human interaction, this paper elaborates the innovative access towards virtual keyboard device deployed in the mobile phones. A Virtual Keyboard is a touch typing device that does not have physical manifestation in the sensing areas. It is possible by applying the image processing technique. The keyboard pattern can be projected by using the keyboard pattern projector. The CMOS camera containing Infrared light tracks the movement of the user to capture the correct keystroke. The sensor capacity of the camera can be limited to capture the finger touching. Each and every keystroke can be sensed meticulously by image processing. The Keyboard layout is reconfigurable hence allowing the user to alter the layout based on the application.

Key words: Virtual keyboard · Image processing · CMOS camera · Infrared Light · Keystrokes · Reconfigurable

INTRODUCTION

Computers have undergone rapid minimization in size and weight. Users of smart phone are more annoyed by the tiny size of the keyboard. Virtual keyboard is the most important part of virtualization as it cannot be obsolete from the computer part. Copy and paste operations, different text input keyboard support, simple and user friendly design (interface), size of file really small, test whether every part working properly, the reconfigurable keyboard are some interesting features in Virtual keyboard. A virtual keyboard is roughly in size of a fountain pen, which involves highly advanced laser technology. The virtual keyboard technology uses laser and artificial intelligence. The full sized keyboard can be displayed using infrared and laser technology. The virtual keyboard must be strictly projected on a flat surface for convenient use. Placing the Virtual keyboard device inside the mobile phone will eliminate such issues as the size of keyboard will be much large and accurate too. The CMOS camera tracks the finger movement of the typist. The software and hardware components recognize the letters and display it. Initially 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 Color segmentation process has been used for thedetection 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 tip.

Literature Survey: With an increasing demand for switching into new and virtual environment from the old physical environment where hardware ware out has been a problem due to continuous use of it. The 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). The main idea is that the device must be portable and flexible to handle. The Virtual keyboard device inside the mobile phone will eliminate such issues as the size of keyboard will be much large [6]. They are useful from security point of view in ATM's, Banks etc. They can be used in TV remote control and gaming control. They are used to make notes during smart classes, business meetings and libraries if it is inbuilt with the mobiles. This idea will be so convenient for businessmen. There is a need for upgrading the method of keystroke detection that will make it more precise and adapt to human tendency of pressing [10] Implementation techniques such as shadow analysis, edge detection, keyboard detection and tip detection are applied to solve the problem.

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Proposed Methodology: The Laser Projection Keyboard makes use of hardware components that are interfaced with the software in the system/smart device. The Laser Projection keyboard requires a calibration process before the first use for effective accuracy. The device makes use of a signal processing software which might turn the laser keyboard into a multi-touch pad. It operates by locating the user's finger 3D space and tracking intended keystrokes. Since the infra-red laser cannot emit a linear diffracted beam to cover the whole keyboard layout without diverging. Therefore we need to pass the laser light through Biconcave lens adjusted in such a distance that emerging of parallel laser beam to pass through diffraction plate which diverge the beam linearly hovering over the whole surface of keyboard layout.

Keyboard stroke information processes and can then be output to host devices. Infrared light source emits a beam of Infrared light. It helps in recognizing the hand movements and pressing of keys. Pattern projector presents the image of keyboard. The image projected on a flat surface is same as that of standard QWERTY keyboard. The virtual keyboard uses laser and infrared technology and so it can be used anywhere on a flat surface. It prevents our username and password from being stolen as the sequence in which the keys appear will change every time the page is refreshed. This keyboard is not restricted to "QWERTY" touch typing paradigm [4]. To inbuilt the Virtual keyboard device in mobiles, it is necessary to possess the following components:

- CMOS INFRARED LIGHT CAMERA
- A KEYBOARD PATTERN PROJECTOR
- LINEAR LASER DIODE

The Keyboard pattern projector displays a virtual keyboard on any surface. The user touches the virtual keys that are displayed on the surface. The Linear Laser diode sends a beam of light when a user touches or types the virtual keys and illuminates the top of user's fingers. The Linear Laser diode sends this beam of light every time when the user types or touches the virtual keys. Since infrared light is used, the user won't notice his fingers are illuminated. The Infrared CMOS camera captures the images of illuminated fingers and sends the images to signal processing software. The coordinates of the fingers P(x, y) and P`(x`, y`) are manipulated and localized by the software and that coordinates are transformed to the related key input events. In case of Smart phones, the infrared camera can be added as a feature since a lot of sensors are being used in smart phones now-a-days. Another endeavor would be using the CMOS camera as an input to capture the illuminated fingers and to send those images to the software for mapping.

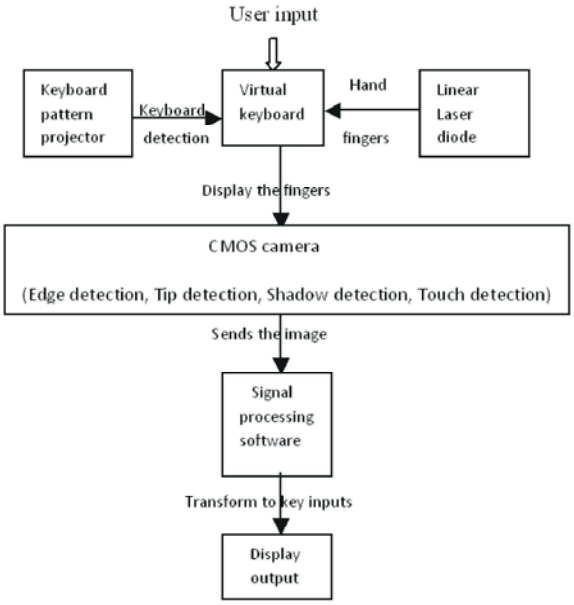

Fig. 1: Flowchart of Virtual Keyboard using Mobiles

Technical Analysis

Keyboard Detection: This is the first stage of the project where keyboard detects the virtual keyboard endpoints using color differentiation technique. Blue color has been placed at the endpoints of the keyboard, the reason for using this color idea is that, it is easily identified and also easy to identify the points, on thresholding. After this, the main step is the location of the Virtual Keyboard is to be defined.

Hand Detection: In this number of hand images has been used with three colors Red, Green and Blue called RGB values which helped in observing the images. As we all know that the value of color Red is very high as compared to the other two components. So the red component is always higher than other two. These results are consistent with every image that was tested. There are some regions where this observation doesn't works or not true like in fingernails or veins, but overall result is not get effected because hand follows some particular patterns and with that hand is properly detected. To remove some of these abnormalities image enhancement methods and techniques have been used in the project. In the end, detected regions are threshold to white color while rest black in color.

Fig. 2: Hand detection

Edge Detection: This is the third stage of the project where the edges detected with the help of a famous technique called Sobel technique. Sobel technique used in the project instead of other techniques which are Prewitt, Zero Cross and Canny because Sobel technique gives more appropriate results in better ways. The first thing is to detect the hand and then detect the fingertips. When the edge is obtained, Sobel technique will thicken it to remove the discontinuities and finally resulted in complete traversal in hand edge.

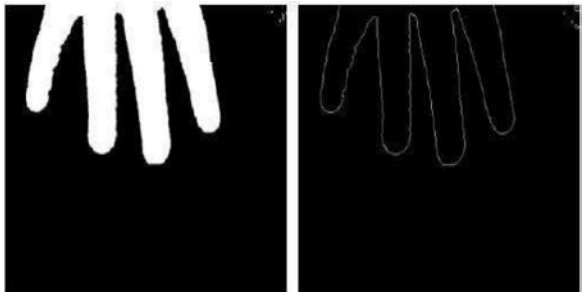

Fig. 3: Edge detection

Tip Detection: This is the fourth stage in the project, where the intention is to find the maximum finger tips where 10 finger tips taken by the CMOS camera. The CMOS camera is used in this project. Later hand detection was obtained and was a one lined edge with many discontinuities. This will result in traversing with the edges of the hand. To avoid this problematic situation, single edge was dilated with structuring the elements via giving it a thick edge. Finger tips are found with the help of thickened edge. Project used some of the priority structures in terms of finding the next pixel which is supposed to be tested for touch [2]. A tip pointer, such as a fingertip, can be represented, locally around the tip, by a conic.

$$a_1x^2 + a_2y^2 + a_3xy + a_4x + a_5y + 1 = 0$$

The variables x1, y1 corresponds to the co-ordinates of the edge pixels of the tip pointer and the variables x, y corresponds to the co-ordinates of the finger from the laser camera. This equation can be written as Ma = b. So, the least-squares solution of a is given b

$$a^* = (M^TM)^{-1}M^Tb$$

Fig. 4: Tip detection

Shadow Extraction: This is the fifth stage of the project. First the original image is captured from the camera. Then, the image will be brightened according to the lightning situations. This helps in eliminating all background noises like when shadow is coming from the multiple sources or keyboard characters or left umbra coming from the shadow. After that hand is obtained which is to be subtracted from the image. This will allow having hand shadow.

Fig. 5: Shadow Extraction

Touch Detection: This is the sixth stage of the project where project worked for how to detect the touch. It shows tips with white and shadow with black color. In project, ratio gap inserted in between non shadow and shadow region. If suppose the shadow region value gets exceeded it means threshold touch will occurred.

Mapping: This is the final stage of the project which deals with the mapping of fingertips to the original or actual keys. 2D mapping is done with the help of the information present in the current frame in the x coordinate and y coordinate and fingertip position from the keyboard endpoints.

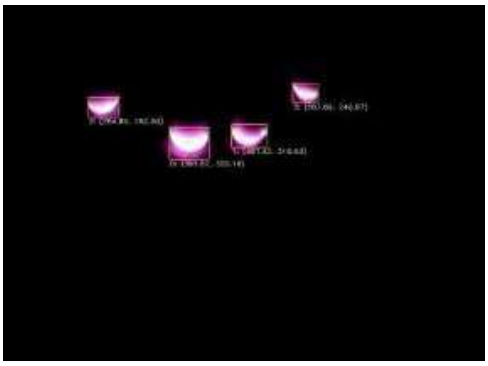

Fig. 6: Touch Detection

Fig. 7: Mapping

Evaluation: Virtual keyboards are accurate, flexible and portable. Maintenance of Virtual keyboard is much easier. The typing noise is less than conventional keyboard. Typing doesn't require lot of force as like QWERTY keyboards. But Virtual keyboards must be kept in a dark room for convenience such that the keys are properly visible. They are much costlier than the QWERTY keyboard. Most smart phone users use their thumb to type that is a slow process on a QWERTY keyboard that wastes time. As the mobile devices become more advance, the QWERTY keyboard become more awkward and difficult to manage. Typing errors can be readily minimized as the size of keyboard can be projected big. These keyboards are not portable for users and causes discomfort. To eliminate such type of problem, developers who created applications proposed virtual keyboard. The virtual keyboard is much more flexible with the hardware counterpart of the keyboard. People in these days have lots of work heavy workloads and because of that they don't have even a single minute to waste. So, they are just trying to have removed such workloads via using the computing devices like laptops, computers and desktops, which makes the life of a person easier and comfortable. Keyboard layout helped user to change it according to the application. For illustration, the user has the privilege to choose different languages and specialized layout for the gaming purpose. The user can easily reconfigure it according to user's choice and this will allow the user to choose the layout of the keyboard according to their preference or requirement. In the existing projects about virtual keyboard, external devices are used along with the mobile phones in order to use the virtual keyboard. But in our proposed idea, we have inbuilt the whole device into the mobile phone. So we need not carry the external device everywhere. This reduces the cost too. We have used optical laser which is emitted from the CMOS camera. The optical laser is used in illumination. So whenever we use the virtual keyboard, the CMOS camera identifies our fingers and whenever we type anything, it will get illuminated. We have used an app which is used in sending the pictures that are recorded by the CMOS camera. This app must be downloaded in order to use the virtual keyboard. In this app, all the images are processed and the appropriate keys that are pressed by the user are recognized efficiently. This bar chart explains the performance of our proposed idea in accordance with the existing system.

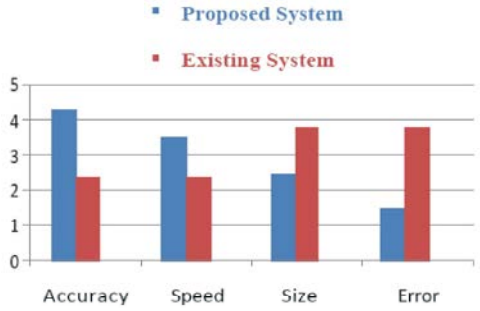

Fig. 8: Comparison via bar chart

CONCLUSION AND DISCUSSION

Since the device is portable it makes easier for user to use it anywhere and at any time. It reduces the space required by the current keyboard devices. It also reduces the cost of buying the Virtual Keyboard device and the effort to manufacture it. In the future, input to keyboard can be given without the dependency of any device. This results in a digital environment in the field of technology.

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