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RECONFIGURABLE VIRTUAL KEYBOARD BASED ON IMAGE PROCESSING

A Study on the Effectiveness of Virtual Keyboards in Technological Advancements

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Abstract: Keyboards have travelled with us for more than70 years now. From basic type writers to advanced virtual keyboards. They have gone through a lot of changes leading to evolution in the way it looks, its portability, weight, speed, size and tangibility. It saw its major turning point in 2007 with a virtual keyboard that was an addition to Apple smartphones. In recent years these virtual keyboards also saw much advancement as they were now reconfigurable. Their layouts can be changed and used according to the user's convenience with the aid of image processing powered by artificial intelligence . As this is fairly a new concept, it is being upgraded in all aspects and has its advantages and disadvantages when econometrics is overlooked. This paper has a collection of all the vital details related to a prototype of a reconfigurable virtual keyboard based on image processing that can be developed using exiting technologies.

Index Terms **- Artificial intelligence, virtual keyboard, image processing, reconfigurable,tangibility**

I. INTRODUCTION

Keyboards have a long history of drastic changes from every few years to every few months in recent times. With advancement in technology that supported these changes the keyboards took a different turn altogether. Keyboards have been dated back to 1936, the Simplified Keyboard, now better known as the Dvorak layout, is patented. It puts the most frequently used letters in the most accessible positions. In 1852, John Jones Mechanical Typographer. Then came the Remington's First Sholes & Glidden Type-Writer in1867.Then Hansen Writing Ball Created by Reverend Rasmus Malling-Hansen in 1870[1]. Then came the Selectric I Typewriter by IBM in 1961.Then in 1970s came Altair Computer with Exposed Keyboard, in 1986 came IBM Model M Keyboard. [2] Finally came the first virtual Touch-Screen Keyboards by Apple in their iPad and iPhone in 2007.This helped in reducing the size also the smart phones advanced.

II. ADVANCEMENT IN VIRTUAL KEYBOARDS

These keyboards were further developed by many other companies like Google in their android application(Gboards) which are used in smart phones with many features like floating keyboards that help reply through the notifications rather than opening the whole application itself this helped in multitasking between the apps,glide typing that helps slide through the keys rather than having to press each one of them this also helps increase typing speed and reduce strain on the fingers, spell check, 916 languages from all over the world can be typed using these keyboards which helped people speaking in different kinds of languages communicate with ease and in the language they are comfortable with , clipboards, many documents,audio and video files can be attached,Predictive typing engine, next-phrase prediction, GIFs, stickers and emojis. Gboard is a virtual keyboard app developed by Google for Android and iOS devices. It was first released on iOS in May 2016, followed by a release on Android in December 2016, as a major update to the existing Google Keyboard app on Android. Gboard passed 1 billion installs on the Google Play Store [3][4].

Most of us have already encountered a virtual keyboard but what is a reconfigurable virtual keyboard based on image processing? Firstly, there are 2 main terms i.e. virtual keyboards and image processing each one of them is a different subject altogether. And one must have a certain level of understanding in both the subjects to be able to connect the dots. Going by the definitions online and from various other sources. A reconfigurable virtual Keyboard can be broadly defined as an on-screen keyboard that replicates the hardware keyboard by means of display and functionality and can be realized with different layouts based on its application. These keyboards use Artificial intelligence mostly machine learning and image processing algorithms. Programming languages like Python and MatLab are popularly used for implementing image processing. The image processing application will then detect the key press events by user and process them accordingly. Techniques such as shadow analysis, edge detection, keyboard detection and tip detection are applied to solve the problem. These keyboards applications can range from gaming to any simple editors. It does not require any extra hardware required for connecting to the monitor. The appearance may differ based on the company that is manufacturing it or the user himself may customize the keyboard. It is not tangible as there are no push type buttons that are seen in the physical keyboard. The market presently has a projection screen. A laser beam projects a fixed keyboard pattern onto any flat and opaque surface in a safe form of laser and an added mouse feature tracks your natural movements [5]. Uses a built-in camera to capture image, projection module and sensing module which is available in compact sizes as compared to hardware keyboard. Cameras used single integrated standard two-dimensional (2D) cameras, Touch detection based on real three-dimensional (3D) models built from stereoscopic camera, CMOS camera. [6] Users can create a layout profile according to his preferences and reconfigure the keyboard. The image being displayed on the keyboard is scanned by a camera connected to the computer. An image processing application will then detect the key pressed events by the user and process them accordingly. These keyboards use Blob detection, Grayscale algorithm, Threshold algorithm[7], Object detection Keystroke detection[8], Keyboard Detection, Hand Detection Edge, Detection Tip, Detection Shadow, Extraction, Touch Detection [9] . Virtual keyboard consists of modules like, Depth map error correction, a camera dependent module based on specific models designed for the range camera, Background subtraction, Central column estimation Fingertip detection.

III. ADVANTAGES AND DISADVANTAGES

Virtual keyboards are more secure as the finger impressions cannot be traced easily and is a cheaper technology in the modern world. Bio-metrics has proven to be beneficial in security systems like ATM. Virtual keyboard ensures all different layouts can be incorporated in one.[10] The main disadvantage is that of light scattering and needs to be close to target, the image resolution becomes low which compromise on the quality of the image. These keyboards if upgraded with future technology could project on any surface, have high resolution with brighter colors which will help in improving the visual impact. The processing speed is low as it has to compare input character with database character.[11]

IV. SUGGESTIVE ALGORITHM

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4.1. A virtual keyboard layout

A virtual layout that is masked is perceived by the device internally once captured by the camera. This ensures no particles on the surface hinders with the working of the module. This can be done by filtering out background from the main image.

Boundary extraction is done to focus only on the keyboard layout. Existence of noise can result in errors like modifying pixels to unintended values in the image acquisition process. An *Averaging Filter* is used to remove noise from the image including methods like *Kernel Convolution* or *Gaussian Blur* can be used to achieve the same .These steps ensure that only the required parts of the keyboard are processed and thus eliminating the need to have a smooth surface to avoid snags.The laser is now projected on the surface. Users can optimize the layouts based on their needs.

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4.2 Preparing dataset for keys

The coordinates of keys are recorded and saved beforehand. Here, the key 2 is a matrix element represented by (1,2). The data is in the 1st row and 2nd column.Similarly, a database is created which holds all the key values and its corresponding coordinates. This database is referred in every iteration to recognize the key touched by the user in the laser projected keyboard layout.A standard layout is represented in Fig.1.

Fig 1. Image representation of the proposed configuration

4.3 Processing the keyboard input

The layout that's captured internally is expressed in terms of pixel values and assessed internally by the device. When a key is pressed, this changes the pixel value at that co- ordinate which is monitored continuously by the camera. The change in pixel is detected by Edge Detection and a Gradient Image is obtained. This change in intensity returns the pixel's coordinate values which are matched with the pre-loaded database and the function of the key is processed. This process is iterated till the user completes his task.The flowchart of the computing procedure is represented in Fig.2.

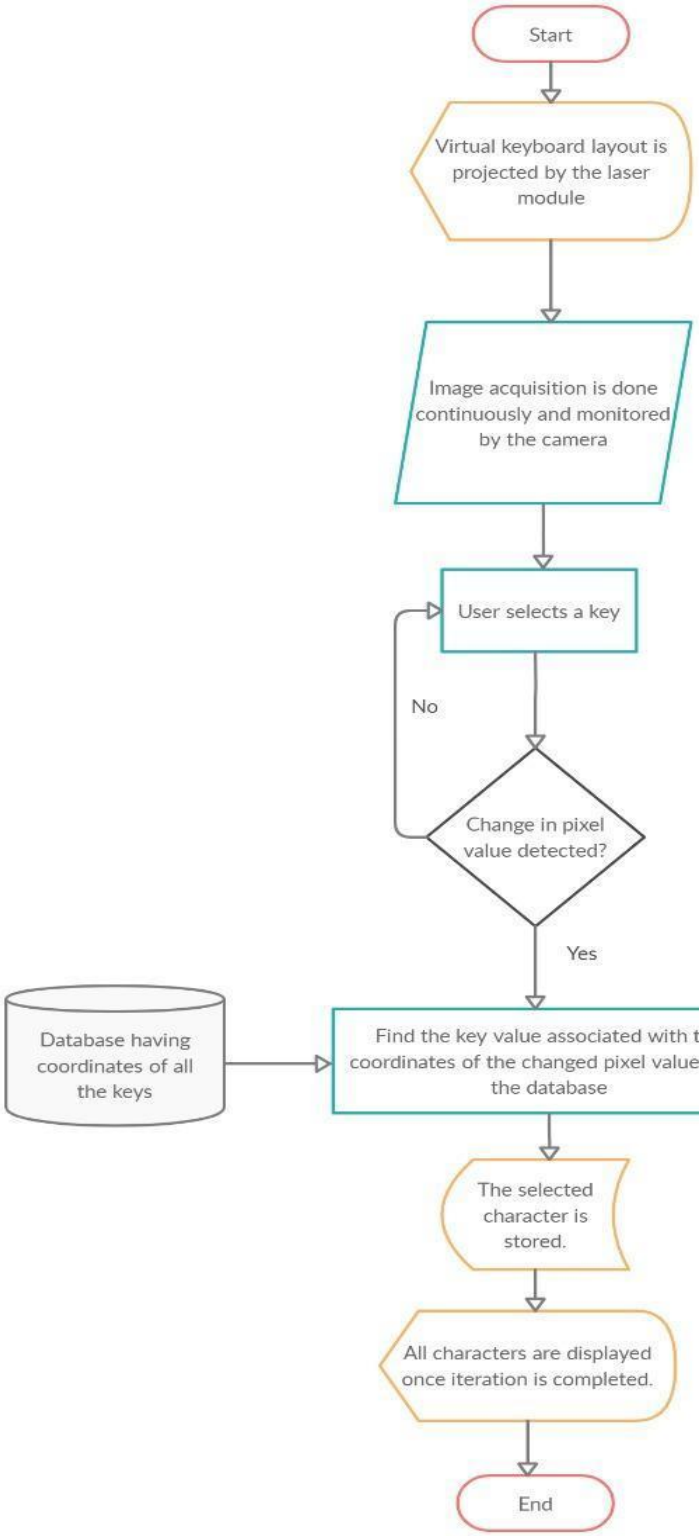

Fig 2. Flowchart representing keyboard input processing

IV. RESULTS AND DISCUSSION

With rapid technological advancements, there is a rise in the use of smart devices. Hence, virtual keyboards not only serve as a reliable input device but are also efficient and easy to use. Few virtual keyboards like True Touch Roll-up Keyboard, Mouse and Keyboard Combo (The entire keyboard moves on the desk as a mouse) already exist in the market. They can be bent without any risk of breakage or any kind of damage. Few future virtual keyboards are Laser Keyboard, Altuq Toprak's Flying Saucer keyboard.

Additional features that might be available in future are mentioned below :

1.Virtual keyboards can load user preferred layouts: Various layouts can be loaded by identifying the user once finger scan is authenticated. All these layout databases are preloaded.

2. Different laser lights: An option to change laser lights at any point of time can be implemented. This enhances eye comfort and improves readability making it easy to use for all ages.

To conclude, Virtual keyboards prove to be better than the existing physical keyboards available in the market.

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