VIRTUAL KEYBOARD USING IMAGE PROCESSING

A

PROJECT REPORT

Submitted in partial fulfilment of the requirements for the award of the degree of

BACHELOR OF TECHNOLOGY

IN

ELECTRONICS AND COMMUNICATION ENGINEERING

Under the supervision of

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STUDENT'S DECLARATION

We hereby declare that the work presented in the Project report entitled **"Virtual Keyboard using Image Processing"** submitted for partial fulfilment of the requirements for the degree of Bachelor of Technology in Electronics and Communication Engineering at **Jaypee University of Information Technology, Waknaghat** is an authentic record of our work carried out under the supervision of **Dr. Nishant Jain**. This work has not been submitted elsewhere for the reward of any other degree/diploma. We are fully responsible for the contents of our project report.

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Date:

CERTIFICATE

This is to certify that the work which is being presented in the project report titled **"Virtual Keyboard using Image Processing"** in partial fulfilment of the requirements for the award of the degree of Bachelor of Technology in Electronics and Communication Engineering submitted to the Department of Electronics and Communication Engineering, **Jaypee University of Information Technology, Waknaghat** is an authentic record of work carried out by **Sahil Singla (151001)** and **Kartik Banta (151010)** during a period from August 2018 to May 2019 under the supervision of **Dr. Nishant Jain** Department of Electronics and Communication Engineering, Jaypee University of Information Technology, Waknaghat.

The above statement is correct to the best of our knowledge.

Date: ……

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ABSTRACT

Recent years have denoted a major increase inside the range of the path in which users can interact with PC's. The keyboard and mouse are the primary interfaces for a pc, clients at present use touchscreens, infrared cameras (like Microsoft's Kinect). In relation of those progressions and furthermore the multiplication of minor cameras in PC's and tablets, human pc interface analysts have examined the chance of executing a keyboard style interface using a camera as a substitute for genuine keyboard equipment.

A camera watches the client's hands, that lay on a flat surface. The camera may watch the hands from over the surface, or at partner degree point. The virtual keyboard's bundle investigations those photos in period to see the succession of keystrokes picked by the client.

In a few nations (for instance, India), clients communicate in different dialects, that makes fabricating physical keyboards for different languages expensive. A camera-based console will help for this problem, Smart-phone clients may at times wish to utilize a full-sized console with their gadget, but are reluctant to hold a physical console. Since most cell phones are provided with a camera, a camera-based keyboard may be an alternate in order to avoid this drawback.

The goal of this project was to actualize a virtual keyboard exploiting the picture inspection systems in order to create it for security purposes. We already have security lock systems present for domestic and commercial use. But the issue is that these systems are not secure enough as there can be breakage through key stroke logging, so in order to ensure more stealth and security we can replace the normal password typing keypads introduced in these systems by this virtual keyboard application which can be implemented using the regular security camera present in the security lock room, very less additions would be required to make the system work.

Inside the framework we tend to authorize, one high-quality camera which catches RGB photos of a user's hands, that bit a freckled surface, or console tangle, in order to

choose keystrokes and further using image processing techniques, these touch made by the user are monitored and output keystrokes are generated accordingly.

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CHAPTER-1

INTRODUCTION

Virtual keyboard is just another example of innovation in field of computer technology. Nowadays computing is not just limited to the desktops but can also be seen in our mobiles. But one thing that has not changed since the beginning is the keyboard interface i.e. QWERTY keyboard. Virtual keyboard is the new innovation in this field.

The virtual keyboard technology makes use of camera and image processing techniques enabling user to work on any flat surface using paper keyboard. Virtual keyboard lets us create a keyboard in any of the preferred language on almost every existing platform. The properties of virtual keyboard being small and easy to use application make it a good solution for text input across different platforms.

The virtual keyboard we are presenting is specially reserved within the security field, the application can be additionally installed along with the security lock systems already present for the domestic and commercial use without the requirement of major changes as the camera used to monitor the security place can be used for getting live feed of the paper keyboard. We are thereby not trying to replace the physical QWERTY keyboard itself. Key features of the virtual keyboard are: support multiple text languages, smaller in size, supports every text operation defined in system language settings, user friendly.

This report will firstly give an overview of QWERTY keyboards. It then emphasizes on virtual keyboard, its working, advantages, disadvantages and its applications.

CHAPTER-2

LITERATURE REVIEW

The new technological improvements are surprising us every day. The computers and their technologies have revolutionized the world and way of life. As the technology advances new innovations are being carried out in almost every field in order to take care of user's comfort and their needs, similar is the case with computers and keyboards.

ENIAC the first computer was huge in proportions, than the technology came up with microchips i.e. tiny devices having huge memory. The evolution of microchips opened new opportunities to create smaller devices like CPU's, integrated circuits and microcontrollers.

Coming over to keyboards, first of all exhausting switches were used as keys than QWERTY keyboards came into action which often result in lost or damaged keys. Nowadays dupe keypads are well liked within the market due to their sublime look and user friendly interface, these keypads are mostly used for specific application based machines e.g. ATM.

The Virtual Keyboard has been enforced during a variety of various forms, one those supported 3-D optical go and CCD cameras are most important as they're based mostly on image processing. A range of virtual keyboards in numerous forms are present like gloves, rings, hand gestures and projection based devices. Also, people have tried building up these virtual keyboards using laser holograph creating technology where they tried creating a holographic image of the keyboard.

The virtual keyboard that we are proposing uses solely a camera, keyboard layout sketched on a sheet of paper with no extra hardware requirements and makes use of hand driven gestures and basic tools of image processing like threshold, segmentation, gray scale conversions, enhancement filters, edge detection.

Gade et.al. [1] implemented a virtual keyboard using the image processing techniques. Within the system one low-quality camera is present which seizures RGB pictures of a user's fingers on a flat surface in order to extract out keystrokes. Firstly, based

upon this info associate degreed an initial standardization image of the paper keyboard, the system thus produces a distinct sequence of keystrokes. The performance of every of the 3 main phases of image analysis is examined and then the either of 2 techniques for locating the user's fingertips in a picture is compared. Then the degree to that the system is sensitive to changes in lighting and frame rate is analyzed later providing the user with the output.

Zhang, Y. et.al. [2] implemented a virtual keyboard application which further consists of two subsystems. These two subsystems are liable for processing of input custom keyboard and videos. These subsystems are fingertip recognition system and recognition system of custom keyboard.

In the fingertip recognition subsystem a Gaussian filter is used to smooth the picture. This filtered image is further divided into RGB channels and binarized. The BWMORP algorithm is used to extract user's hand and then farthest point of the hand is used to extract fingertip end. The fingertip end is always detected in the application at any point of time i.e. the program keep on searching for the fingertip at every point. Than the character recognition uses feature extraction system and tries remembering each of the characters and their immediate location on the paper keyboard. Basically the motive of their research was how accurate a virtual paper keyboard system can work in different conditions such as under lamplight, office lights, shady rooms, flat surface and elevated surface.

Zhang, Z. et.al. [3] implemented a vision-based interface system, VISUALPANEL, which employs an arbitrary quadrangle-shaped panel i.e. a regular piece of paper and a tip pointer i.e. fingertip, wireless and mobile input device. The system monitors the console and the fingertip precisely and constantly. The projective mapping between the keyboard at the current position of the fingertip and the display is determined by panel tracker endlessly, which then maps the tip position to the corresponding position on the display. The system can fulfill many tasks such as controlling a remote large display, and simulating a physical keyboard by detecting the clicking and dragging tasks,. Users can naturally use their fingers to issue commands and type texts. Furthermore, the system can also provide 3D information, serving as a virtual joystick, to control 3D virtual objects by tracking the 3D position and orientation of the visual panel.

Yousaf et.al. [4] presented a virtual keyboard that used finger joints tracking-based keystroke detection and recognition approach. For the finger joints localization and tracking, activities of user's hands are captured in a video sequence. For hands region detection and finger joints localization, averaging background subtraction, linked component classification and contour analysis are performed. Finger joint trajectories are estimated by probabilistic regional density-based kernel tracking. Based on spatial and pathic information, the estimated trajectories are further inferred into respective feature vectors. For the classification of feature vectors leading towards the detection and recognition of keystrokes, these feature vectors are fed into logic-based technique and Dynamic Bayesian Network. Experimentation results demonstrate accurate keystroke detection and recognition for 28 keys using actual video data set and real-time implementation. Successful research results encourage for the accumulation of non-intrusive vision-based virtual keyboard in mobile devices in addition to existing tiny keypads for facilitation of the users.

Kölsch, M. et.al. [5] and Sarcar et.al. [14] analyzed different virtual keyboards present, testing them and checking their accuracy in different conditions such as using them under lamp lights, office lights, shady rooms. The different virtual keyboard technologies they analysed are:

- Visual panel
- Finger joint gesture wearable keypad
- Thumbcode
- Chording glove
- Finger ring
- Touch stream
- Multi-Point touchpad
- V type
- V key
- Virtual keyboard projection
- Scurry
- Senseboard

H. Du et.al. [6] proposed a system that consisted of 3 major hardware modules:

- 3D optical range camera
- visual feedback
- processing platform

The range camera is connected to the processing platform with help of a USB2.0 interface. The visual feedback module communicates with the PC by help of a serial port. The Swissranger SR-2 3D optical range camera is used that continuously measures gray-scale and depth map of image. It supplies gray-scale and depth measurements based on the time-of-flight (TOF) measurement principle with a spatial resolution of 160 × 124 pixels. The depth information delivered by the range camera is used to develop simple and effective algorithms to guess the position of fingertips and to trace the matching stricken key. The visual feedback module is built using projection of a vigorously generated image based on a mini LCD. Whenever the processing algorithm detects a key-striking or key-bouncing event, it sends an inform command to the visual feedback module with precise key info. The feedback module fill in the produced display according to the command. Additional audio feedback is used to help the user recognize positive keystrokes.

The processing algorithm they used comprises of 5 modules:

- Depth map error correction, a camera dependent module based on specific models created for the range camera
- Background subtraction
- Central column estimation
- Fingertip detection
- Keystroke detection

Matsui et.al. [7] presented a virtual keyboard which comprises of three processing stages The first stage is fingertip detection, which displays a list of fingertips 2-D coordination only if fingertips are detected. The second stage is Stroke Detection, which looks at the deviation of vectors of each fingertip in motion. In the final stage, Keyboard Checker translates fingertip's coordinates sensed as stroke to user-defined key character.

Wijewantha N. S. et.al. [8] presented a virtual keyboard that uses a novel approach in order to detect letters according to touch movements made by the user. The keyboard presented in this paper uses digital image capturing and image processing techniques along with the normal projection techniques. The virtual image of the QWERTY keyboard is projected by help of a sliding projector which is compact enough. A LED centered light pen is used for selection of characters. Whenever the user uses the LED based light pen for

selecting a character, a blue light illuminates at the LED pen signaling the touch typing. These touching events are then captured by image capturing module in real time and further sent to character identification module with the use of web camera. The character identification module thus identifies the characters according to touch events made by the user with help of LED pen. Lastly the character typed by the user are identified and presented on the display screen with the help of a signal which is sent by device emulation module to the electronic device.

Adajania et.al. [9], Yin et.al. [10], Hagara et.al. [11] and Thati et.al. [12] proposed a virtual keyboard that uses a regular web camera and shadow analysis method to extract the fingertips of user and to detect whether the touch with the keyboard has been made or not.

Zhao et.al. [13] implemented a virtual keyboard application that uses 2-3 motion detecting rings per hand that are used to recognize user's fingertip position and touch sensitivities and output is generated accordingly.

X. Su et.al. [14] implemented a virtual keyboard that makes use of laser and image processing techniques. The virtual keyboard they proposed consists of 1 infrared laser module, keyboard pattern projector, embedded system and a single image sensor. The keyboard pattern is implemented with help of projector. Each and every keystroke is detected precisely by image processing including morphology principle and ellipse fitting.

CHAPTER-3

QWERTY KEYBOARD

3.1 Introduction

The QWERTY design is based on the layout created for the Sholes and Glidden typewriter and sold to E. Remington and Sons in1873. The QWERTY keyboard just came as random alignment of keys not it was pre-decided.

The word QWERTY in QWERTY keyboard comes from the first six characters from the left of the top most row. It is the most common keyboard layout used worldwide in desktops, typewriters, mobile phones or any sort of keyboard using devices. The keyboards are designed with QWERTY layout just in order to slow down the typing speed and prevent key jams.

3.1.1 Internal Structure of Keyboard

The keyboard uses its own processor and circuit design that helps to carry the information to and from the computer. A large part of circuit in keyboard constitute towards key matrix i.e. grid of circuits beneath the keys.

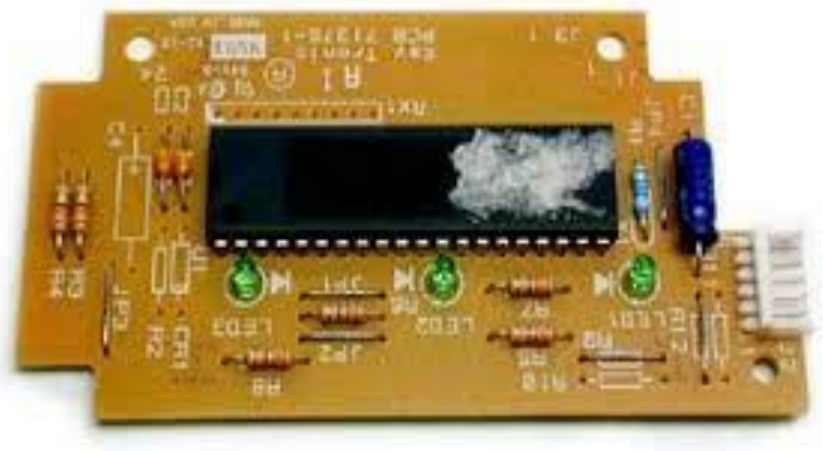

Figure 3.1: Internal circuitry of keyboard [16]

The key matrix is the grid of circuits underneath the keys. Each circuit is wrecked at the point below a specific key in all the keyboards except for capacitive ones. Pressing the key, links the gap in the circuit, permitting a little amount of current to run through. The key matrix is observed by the processor for signs of consistency at any point on the grid. When a closed circuit is found, it relates the position of that circuit on the key matrix to the character map in its ROM.

The character map is fundamentally a contrast chart for the processor that tells it what the key at x, y coordinates in the key matrix represents. The processor checks to see if the mixture of keys has a description in the character map or not if more than one key is pressed at the same time. For example, if we press the key ‘a’ by itself, it would result in a small letter "a" being sent to the computer. The processor compares the combination with the character map and produces a capital letter "A", if we press and hold down the Shift key while pressing the key ‘a’.

A different character map provided by the computer can overtake the character map in the keyboard. This is done very often in dialects whose characters do not have English equivalents. Also, there are efficacies for altering the character map from the traditional QWERTY to any other custom version.

A change in the current flowing through the circuits in the keyboard takes place as keyboards rely on switches. When the key presses, the key switch against the circuit activates, there is usually a small amount of vibration between the surfaces, known as bounce. The processor in a keyboard recognizes the pressing of the key repeatedly and do not cause this very rapid switching on and off. Therefore, it filters all of the tiny variations out of the signal and treats it as a single key press.

If the key is hold down for a little longer, the processor estimates that we wish to send that character repetitively to the computer which is known as typemastics. In this method, the delay between each and every instance of a character can generally be set in software, usually ranging from thirty characters per second (cps) to as limited as 2 cps.

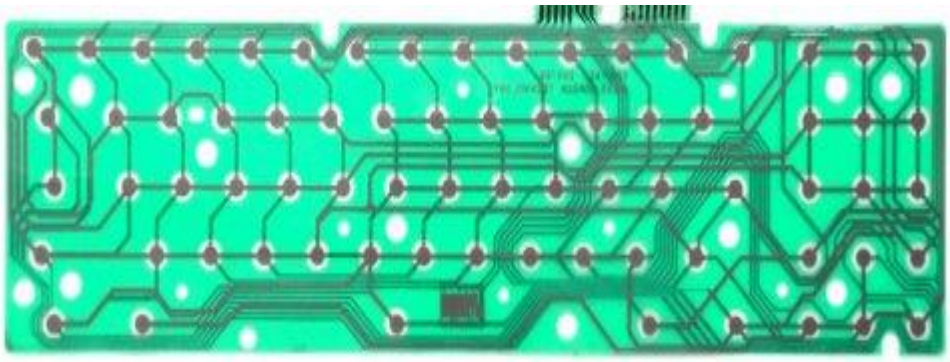

Figure 3.2: Key matrix [17]

3.1.2 Working

The operation of a QWERTY console is as per the following:

- At the point when a key is squeezed, it shoves down on an elastic arch laying underneath the key. A conductive touch on the underside of the vault contacts (and thus associates) a couple of conductive lines on the circuit underneath.
- This overcomes any issues among them and enables electrical flow to stream (the open circuit is shut).
- A checking signal is discharged by the chip along the sets of lines to all the keys. At the point when the flag in one sets ends up various, the chip creates a "make code" comparing to the key associated with that match of lines.
- The code created is delivered to the PC either by means of a console link (utilizing on-off electronic heartbeats to speak to bits) or over a remote association. It might be rehashed.
- A chip within the PC gets the flag bits and decodes them into the proper key press. The PC at that point chooses what to do based on the key squeezed (e.g. show a character on the display device, or play out some activity).
- At the point when the key is discharged, a break code (unique in relation to the make code) is sent to demonstrate the key is never again squeezed. In the event that the break code is missed (e.g. because of a console switch) it is workable for the console controller to trust the key is pushed down when it isn't, which is the reason

squeezing at that point discharging the key again will discharge the key (since another break code is sent).

Figure 3.3: Rubber domes positioned over a keyboard matrix PCB [17]

3.1.3 Keyboard Switching Technologies

- Rubber dome mechanical: It uses flexible rubber domes to provide resistance and tactility to keys.
- Capacitive non-mechanical: It comprises of 2 “D-shaped” capacitor pads for every switch and is enclosed by a skinny insulating film of solder mask which act as a dielectric. Its working is totally different than rest of the technologies, when a key is pressed, capacitance of pattern of capacitor pads changes and the key pressed is recognized accordingly.

- Metal contact mechanical: In this technology, the electrical current is switched for a short period of time during key strokes. Gold is the most commonly selected contact material for this technology as it prevents switch failure due to oxidization.
- Membrane mechanical: It comprise of three different layers in its design recognized as top membrane layer as first, holes at the middle layer and conductive trace layer a at the bottom.
- Foam element mechanical: Similar to metal contact but uses a small piece of spongy foam between the bottom of plunger and metal strip in order to provide better tactile response.

3.1.4 Keyboard to Computer

The processor present in the keyboard analyzes the key matrix when a user is typing, determining the characters to be sent to the computer. Firstly, these characters are stored in a buffer of memory and then the data is sent in a stream to the computer with help of some type of connection.

The most commonly used connections for streaming data from keyboard to computer are:

- 5-pin DIN (Dutch Industries Norm) connector.
- 6-pin IBM PS/2 mini-DIN connector.
- 4-pin USB connector.
- Internal connector.

Mostly mini-DIN connectors are used but new systems prefer USB connectors but it doesn't matter what type of connector is used. An integrated circuit is present that helps processing all the data that comes from the keyboard to the operating system.

3.2 Types of Keyboard

3.2.1 Based on total number of keys:

- Original PC keyboard with 84 keys.
- AT keyboard with 84 keys.
- Enhanced keyboard with 101 keys.

3.2.2 Based on connectivity:

- Wired.
- Wireless.

Versatile PCs, for example, laptops frequently have custom consoles that have somewhat unexpected key courses of action in comparison to a standard console.

Basic keys in a keyboard are:

- Typing keys
- Numeric keypad
- Function keys
- Control keys

The typing keys are the segment of the console that holds the letter keys, for the most part spread out in a similar style as that of typewriters. The numeric keypad is a piece of the normal advancement. Since a substantial piece of the information was numbers, an arrangement of 17 keys was added to the console. These keys are spread out in a similar design utilized by most calculators and mini-computers.

In 1986, IBM broadened the keyboard with the expansion of function and control keys. The function keys, placed in an order in a line over the highest point of the keyboard, could be allocated explicit directions by the present application or the operating system. Control keys gave cursor and display control. 4 keys masterminded in an altered T development between the composing keys and numeric keypad enables the operator to move the cursor on the screen in little time with accuracy.

3.5 Disadvantages

- Key stroke logging:

  Keystroke logging, regularly alluded to as key logging or console catching, is the activity of recording the keys struck on a console, usually with the objective that the user is uninformed that their activities are being detected. Information would then be able to be recovered by the individual working the logging program. A key logger can be either programmer itself or software.

  While the projects themselves are legal, with a large number of them being intended to enable managers to direct the utilization of their PCs, key loggers are frequently utilized to steal passwords and other private information. Key logging can likewise be utilized to contemplate human– PC cooperation. Various key logging strategies exist: they run from equipment and programming based ways to deal with acoustic investigation.

- More hardware requirement:

  Physical keyboards needs large hardware requirement to be designed. Switches, metal, plastic, processors, IC's and many other materials are required to make a typical keyboard.

- Language barrier:

  The typical keyboards are mostly designed in english language including native language of the country produced for in some of the models which are difficult to use for a user who don't understand both the languages and also for the user who needs to type in some other preferable language.

- Damaged or lost keys:

  Damaged or lost keys are the most common issues regarding the typical keyboards. Often due to rough and tough use or due to falling of keyboard, the keys along with the processors and IC's are damaged.

CHAPTER-4

VIRTUAL KEYBOARD

4.1 Introduction

As the interest for registering surroundings develops, new human-PC interfaces are authorized to supply various co-operations among clients and machines. In any case, introduce for some human-to-PC collaborations remains the binomial console/mouse. We tend to are exhibiting here a cutting edge innovation, that will be that the Virtual information gadget. Since the name proposes the virtual keyboard has no physical look. Virtual keyboard is an application that virtualizes equipment console with very surprising formats along these lines allowing user to modify the design in application. E.g. user will pick very surprising dialect for proofreader or pick a specific format for bad habit applications. User will even style his very own design in equipment variant

Virtual keyboard is simply one more case of advancement in field of PC innovation. These days registering isn't simply constrained to the work areas yet can likewise be found in our mobiles. In any case, one thing that has not changed since the start is the console interface i.e. QWERTY console. Virtual keyboard is the new development in this field.

The virtual keyboard innovation makes utilization of camera and picture handling (image processing) procedures empowering client to use it away at any level surface utilizing paper console. Virtual keyboard gives us a chance to make a console in any of the favored dialect on pretty much every current stage. The properties of virtual console being little and simple to utilize application make it a decent answer for content contribution crosswise over various stages.

Virtual keyboard is superior to QWERTY console as old QWERTY consoles are unit expansive and serve little as far as improvement while virtual keyboard are littler in size and convenient. Key highlights of the virtual keyboard are: security lock systems is the prime application, it supports numerous content dialects, is little in size, underpins each content activity characterized in framework dialect settings, easy to use.

4.2 Working

The camera will capture the live video feedback of the user using the keyboard and will transfer it in the program which at that point will pre-process the picture i.e. either blur or sharpen it as indicated by need of the circumstance and afterward actualize different picture handling strategies, for example, threshold, segmentation and yield what the user has composed and create it on the display.

PYTHON programming will be utilized in the picture preparing segment. Steps like converting image into binary format, applying edge detection algorithms will be followed in this specific arrangement.

Steps pursued during image processing are:

- Detection of Keyboard:

  Color differentiation is used to detect the endpoints of the virtual keyboard. The endpoints of the paper keyboard are colored black, these points can be easily recognized as we threshold the image. The area of interest i.e. the location of the virtual keyboard in the image is then defined.

- Detection of Hand:

  Initially, a large collection of hand pictures are created. These pictures are then observed for user's RGB (Red Green Blue) values within the space of interest, i.e. the hand. It was noted that, in these hand regions the red part was above the opposite 2 parts. These observations were constant across all the images that were verified. Bound regions such as fingernails and veins are also present on the hand wherever this observation may not be true. However, this doesn't have an effect on the general result as a major part of the hand follows the predictable pattern and also the hand is befittingly detected. So as to get rid of the irregularities within the hand regions, we tend to use image improvement techniques. Finally, the identified hand regions square measure threshold to white, whereas the remainder of the image is formed black.

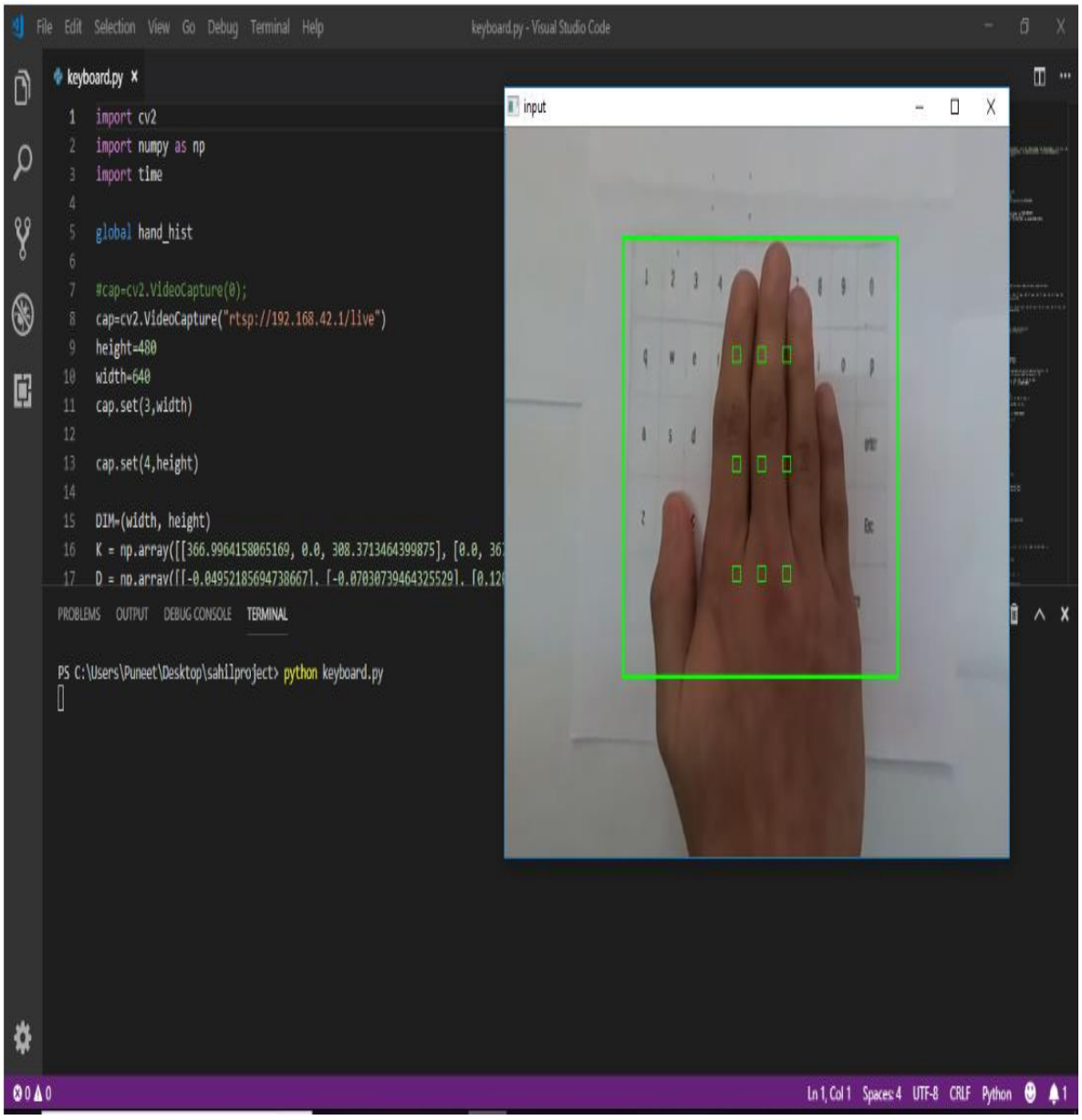

Figure 4.1: Detection of hand as well as the keyboard layout.

- Detection of Edge:

For edge detection we have a tendency to use the Sobel technique that offers superior results paralleled to Prewitt and Zero-Cross. Edge observation of the hand is needed so as to identify the fingertips.

There are major 2 ways to detect edges, gradient and Laplacian. We use the gradient technique to detects the sides by longing for the utmost and least within the

differential of the image. The Laplacian technique searches for zero crossings within the second by-product of the image to seek out edges.

Extra alterations are required because of the way that the shake obtained isn't consistent and to make it so we use eight point associated part investigation neighborhood framework that delivers a lot of counter clockwise edge facilitates which follow the layout of the hand. This empowers a total traversal of the hands edge utilized and little knocks that may have remained.

So as to evacuate the rest of the knocks we limit the picture under the suspicion that there ought to be just a single huge item in casing the hand. The region of each remained item is determined and the biggest one is resolved to be the hand. To minimize the unpredictability, the ceaseless form is changed into a discrete one.

- Detection of Tip:

In this stage we tend to recognize the finger tip of the user within the picture captured by the digital camera. The hand edge obtained is better than a skinny single lined edge that has variant breakdowns. These breakdowns build it troublesome to traverse on the sting of the hand.

To beat this drawback, the skinny single lined edge is expanded employing a structuring part to convey a thick edge.

On this thickened edge our algorithmic program is run to seek out the finger tips. we tend to use the subsequent priority structure as given in reference paper whereas traversing the sting to see successive picture element to be tested for bit. Edge thickening is crucial because the edge obtained victimization Sobel might not invariably be good and continuous.

- Detection of Touch:

A minor region round the fingertips is analyzed for shadow; the ideas area unit white whereas the shadow regions area unit black. The magnitude relation of the white to black pixels is set.

If the magnitude relation of the realm of non-shadow region to the realm of the shadow region surpasses a specific threshold we are able to say that bit has befallen.

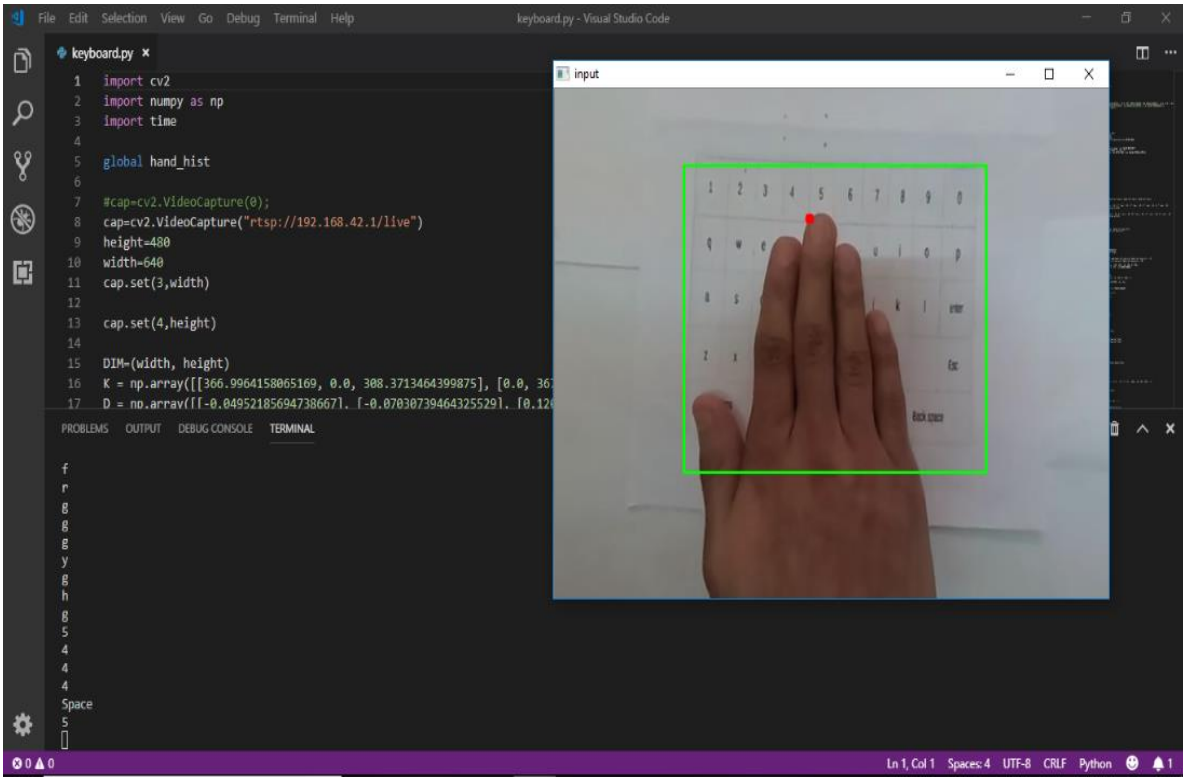

Figure 4.2: Detection of user's fingertip

- Mapping:

The last step includes mapping of the fingertips of the user to actual keys. This is a simple 2D mapping based on the data presented in the current frame (x, y coordinates) and comparative location of the fingertip from the endpoints of the keyboard.

The button coordinates are known, making the mapping very straight forward: when a touch is distinguished, its arrange is known and is contrasted with the catch reaches to get the mentioned key and include client input. The keybooard's language was executed in English.

4.3 Image processing techniques

4.3.1 Threshold

Threshold is the way toward concentrating on the required information and disregarding the entire foundation. Threshold is a non-direct activity that changes over a gray scale picture into a binary picture where the two dimensions are assigned out to pixels that are beneath or over the predetermined threshold esteem.

For thresholding, typically a mean 8-bit value is taken from the original image. Now, the original image is divided into two portions. Pixel esteems that are not exactly or equivalent to the edge; foundation. Pixels esteem is more prominent than the edge; frontal area.

4.3.2 Segmentation

Picture segmentation is the way toward dividing a computerized picture into numerous sections (sets of pixels). Picture segmentation is ordinarily used to find objects and their limits in pictures. A compelling way to deal with performing picture division incorporates utilizing calculations, apparatuses, and a far reaching condition for information investigation, representation, and calculation advancement.

The objective of segmentation is to improve as well as change the portrayal of an image into something that is increasingly important and simpler to dissect. The consequence of picture segmentation is a lot of fragments that all things considered spread the whole picture, or a lot of shapes removed from the picture. Every one of the pixel in a locales are comparable as for some trademark or processed property, for example, color, intensity, or texture nearby locales are all together extra ordinary as for similar trademark.

4.3.3 Image Enhancement

Image enhancement means enhancing and emphasizing an image’s features such as edges, contrast, sharpness and so on. Therefore, changing the dynamic ranges of these features

improves the graphic effect of the image and help in extraction of important information easily.

There are two methods for enhancing an image:

- Spatial domain method: spatial domain refers to the plane of the image and is based on direct processing of the image pixel.
- Frequency domain method: processing technologies like Fourier transform, wavelet transform are based on modifying frequencies of transformed images.

Image enhancement generally stretches the gray value range of an image i.e. 0-255 which helps in boosting the contrast of an image along with its quality. The concept of image enhancement is generally based on histogram.

4.3.4 Image Binarization

Image binarization is the conversion of image from RGB to binary image. It plays an important role in digital image processing as most of the image processing systems are based on binary images.

Firstly, the image will be transformed into gray scale image than we apply threshold to it. This threshold might be fixed or adaptive. Adaptive image binarization is required wherever an optimal threshold is selected for the image.

Conversion of colored images to gray scale generally uses 3 methods.

- Maximum method:

  The RGB value of each pixel is equal to maximum of its RGB values.
- Averaging method:

  The RGB value of each pixel is equal to average of its RGB values.
- Weighted averaging method:

  The RGB value of each pixel is equal to average of the weighted RGB values of every pixel.

4.3.5 Image Smoothing

As we know that there are many types of noises in an image which can influence the amplitude of the image thus image smoothing is used in order to remove these noises. If improper smoothing is done it may result in blurring of image. Thus it is essential to adopt an appropriate smoothing technique.

Image smoothing can be done both in spatial as well as frequency domain:

- In spatial domain we use methods of neighborhood averaging, median filtering, multiple images averaging and so on.
- In frequency domain ideal low pass filter, butter worth low pass filter are used.

4.3.6 Pre- Processing

The picture captured by the camera may not be clear so as to improve the quality of the image for further processing, an image processing filter is applied to the input image. Here we tend to either blur the image or sharpen it according to needs of the situation. We will blur the image in case its too sharp or sharp it in case its too blur. Hence either sharpening or Gaussian blur filter is used based on quality of feed**.**

4.3.7 Selective RGB

Based on the color components (R, G and B values), the picture pixels are filtered. User initially stipulates the threshold ranges for these colors. The ranges are to be listed based on the color of the symbols**.**

4.3.8 RGB to HSV Conversion

HSV model stands Hue, Saturation and value. Hue represents color type. Saturation represents vibrancy of color. Intensity scale represents brightness of color.

4.3.9 Histogram

We construct a binary histogram for individual characters. It is a plot which helps us determine the frequency distribution of a constant data. While constructing a histogram, the data is fragmented into intervals known as bins. A picture histogram is a kind of histogram that goes about as a graphical portrayal of the tonal dispersal in a digital image.

Image histogram is helpful device for thresholding. Data enclosed in the graph is a depiction of pixel appropriation as a component of tonal variability, image histograms might be dissected for peaks. This limit esteem would then be able to be applied for edge detection, image segmentation and co-occurrence matrices.

4.3.10 Pattern Matching and Pattern Recognition

In pattern matching, we look to find the most alike pattern or object by equating it to an example of that pattern in a scene image. The most unique features are paralleled from the query pattern and needed to be examined in the scene image in order to address the issue of locating an object in the target image proficiently.

In pattern recognition, based on the unique features, the input data is classified into objects or classes.

4.4 Algorithm

- The keyboard layout print is taken on a blank paper. A camera is used to capture live feed of fingers typewriting on keyboard layout.
- Video Input a continuing video feed is obtained from the digital camera connected to the computer.
- Frames are grabbed at regular intervals. The present frame from video is derived as image to another image management where we are able to scan or manipulate pixels.
- For pre-processing a picture, process filter is applied to the input image to boost it for more process. Here we tend to either blur the image or sharpen it according to our needs.
- Hence with image process, the real time written words on keyboard are detected and screened on desktop.

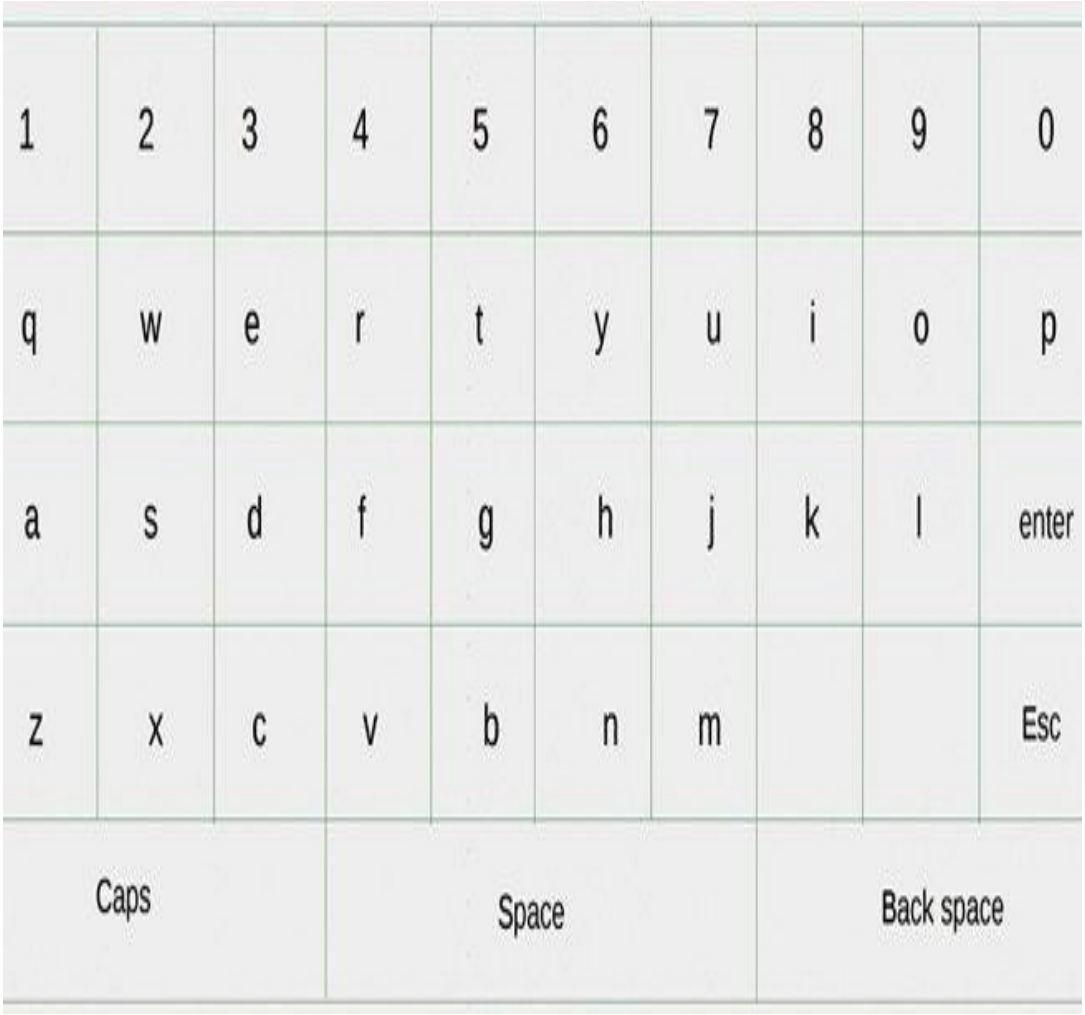

Figure 4.3: Keyboard layout

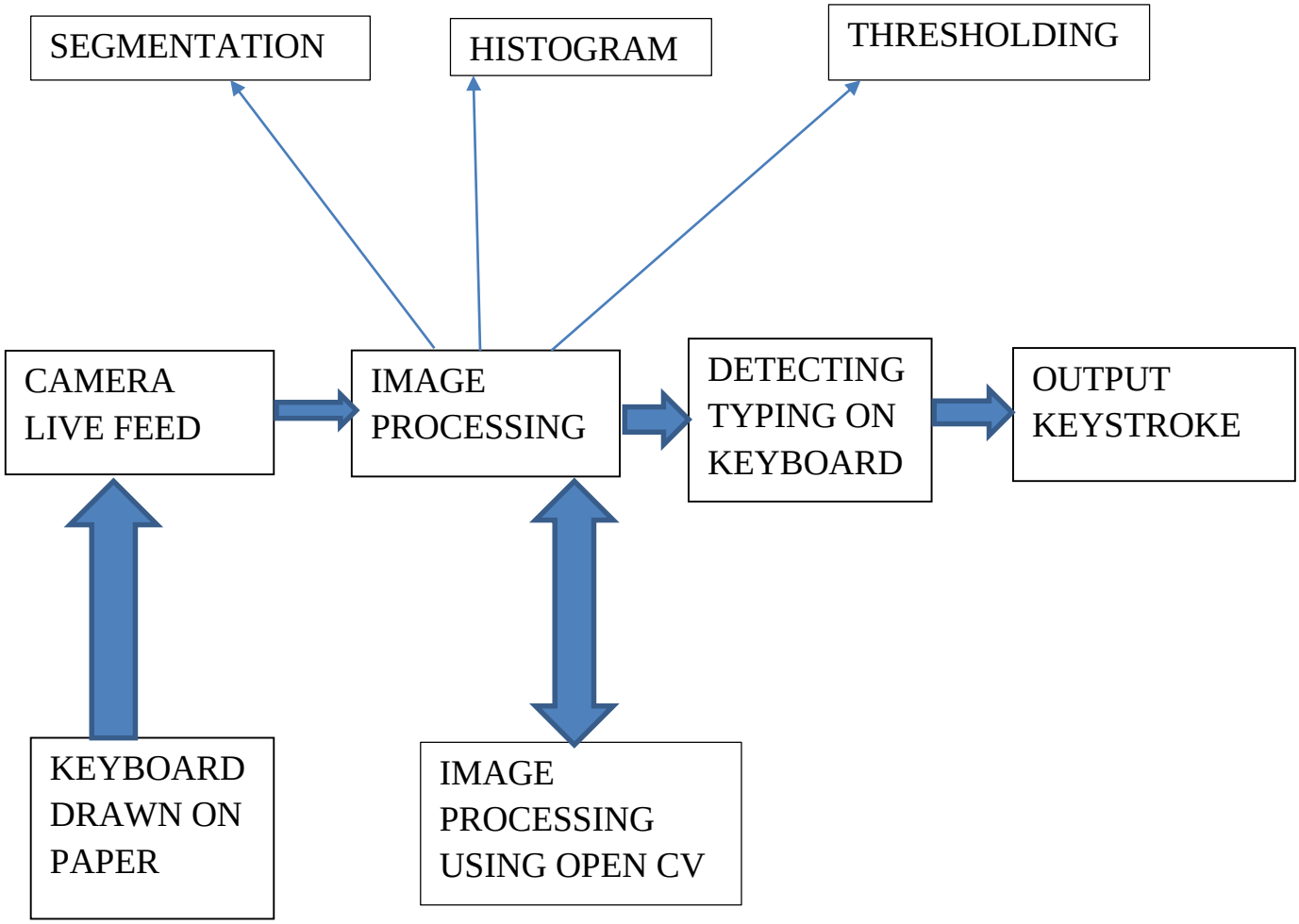

Figure 4.4: System architecture of virtual keyboard

4.4 System Design and Analysis

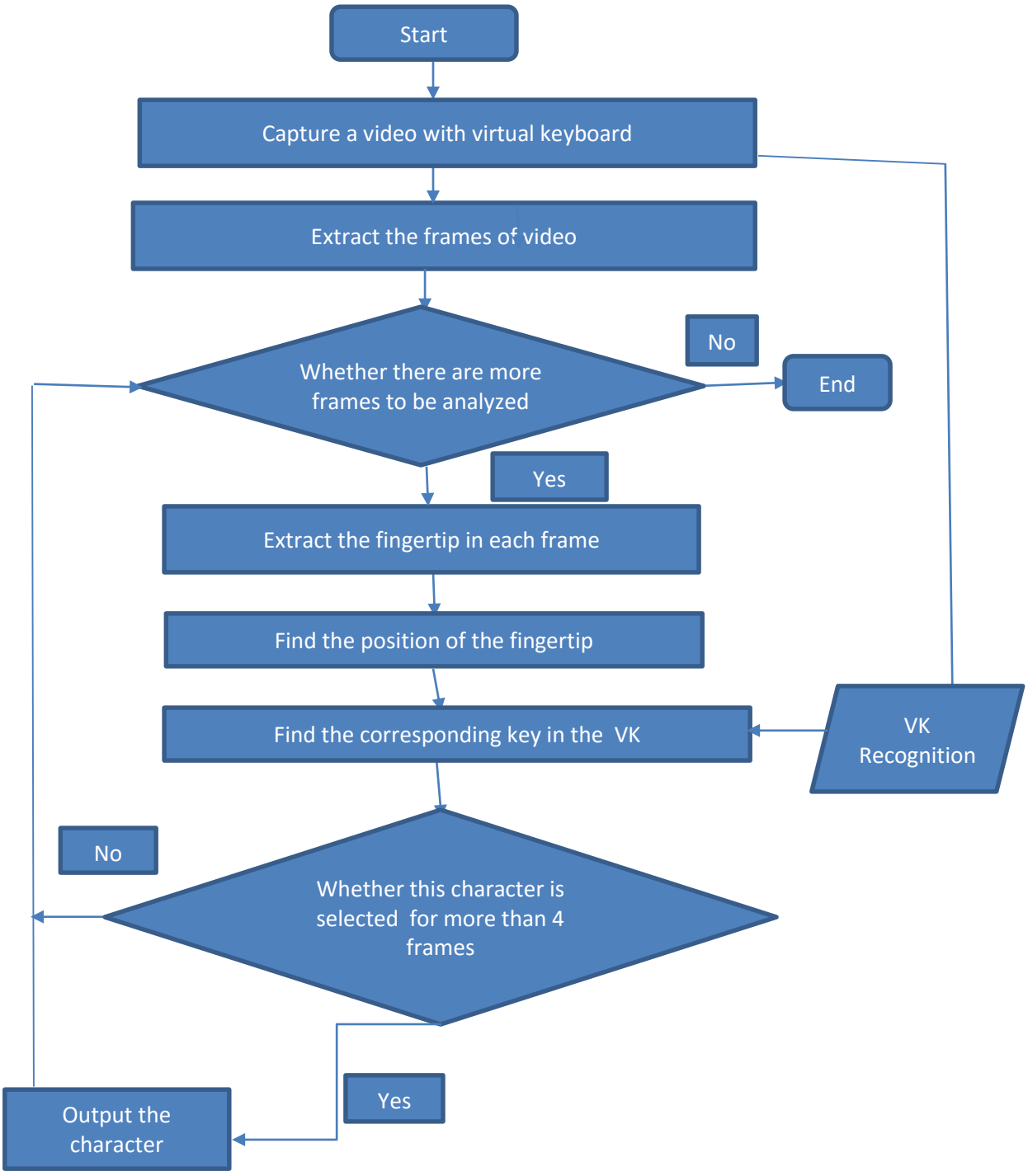

Figure 4.5: Flowchart of the virtual keyboard application

Code: Functional Details

- Hand Histogram:

  Histogram is considered as a graph related to pixel frequencies in a gray scale image. The pixel values range from 0-255. This function is used to convert the RGB to HSV in order to concentrate the histograms in the particular region. The obtained histogram is normalized to compensate few errors.

- Hist Masking:

  The obtained frame is first converted to HSV and Structural element is obtained using MORPH_ELLIPSE. The Image is thresholded based on back project and Bitwise AND is performed.

- Contours:

  The image(frame) passed is first converted to grey and then thresholding is applied to identify different objects followed by contours to return the boundaries.

- Max Contour:

  Out of all Contours obtained this function helps in obtaining the contour with maximum area.

- Centroid:

  For the Max Contour obtained the centroid finds the moments, means centroid of the contour area.

- Farthest point:

  This function helps in finding the Farthest point from centroid by obtained max contour.

- Printwordxy:

  This function gets the image of keyboard and helps in identifying which button corresponds to what pixel of image and thereby prints them when a finger is hovered over it.

4.6 Advantages

- Worked in to the gadget no wires or separate gadget with additional batteries:

  Since, the virtual keyboard is software based application using very less hardware (just a sheet of paper and a high quality camera) thus doesn't require any separate connections to be made as the camera of the laptop can be used or a separate camera can be connected by help of Bluetooth.

- Spares additional weight on a compact gadget:

  The virtual keyboard setup is very light as compared to the typical physical keyboards as unless physical keyboards they comprise just of a keyboard layout drawn on a paper sheet which help user to use it on any plane surface and are highly durable.

- Programming, so extra capacities can be included later:

  Virtual keyboard is a software based application so any changes or additions can be made easily. For example, if the user wants to add a new character or symbol in the keyboard setup it can be made by just doing some changes in the software and keyboard layout.

- Various dialects can be upheld with profoundly unique key formats:

  User can setup the keyboard according to any language preferred without putting much effort as a little change in program and keyboard layout will help solving the issue.

- Prevents key stroke logging:

  Since, it is not a physical keyboard so the keys user presses while using can't be recorded or spied which makes it much safe and secure for using password operated applications as compared to physical keyboards in which our action of typing keys can be recorded.
- No damaged or lost keys:

In physical keyboards often the keys get damaged or are lost but it is not the case with virtual keyboards as it doesn't require fragile hardware which can be damaged easily.

- Environment friendly:

  The virtual keyboard is environment friendly as it comprises just of paper sheet unlike physical keyboards that use hazardous non-biodegradable material for production.

4.7 Disadvantages

- Key size little prompts composing blunders, simple to unintentionally contact neighboring keys:

  As the key sizes are constrained also a little margin between the two keys are present so, there is a fair chance that a user may accidentally touch two keys at a time or the adjacent key might get touched which can alter the output. Also it leads to slow typing speed.

- Predetermined number of keys:

  As the virtual keyboard is software based application and has very precise key layout which is already known to the program so adding any more symbol or a character will require the program to be changed accordingly the layout.

- Software so an update can break it:

  As virtual keyboard is software based application so, any virus or malware material within the system can seriously damage the application.

4.8 Other Applications

- Can be used for computer machines:

  The virtual keyboard application can be used for normal computer work. The user can carry out basic computer functions such as writing of some sort of data or entering passwords for private data using virtual keyboard application without bothering about factors such as key stroke logging.

- Can be used in ATM machines:

  The virtual keyboard application can be used for entering passwords in ATM machines. The security cam present in the ATM rooms can be used for analyzing the paper keyboard and thus with the help of the application the output digits and actions will occur in real time.

CHAPTER-5

RESULTS AND OUTPUTS

- We are able to access the keyboard layout drawn on a sheet of paper aligned same as the matrix designed for camera window.
- Further the images are preprocessed before the camera pop up window gets activated which will sharp or blur the image as per the needs of the situation.
- Than the fingertips of user are detected as soon as there is a contact made with any of the character in the keyboard.
- Red circle is pointed near the point of contact, with the help of this circle estimation is made about the position of the fingertip and the key pressed accordingly**.**

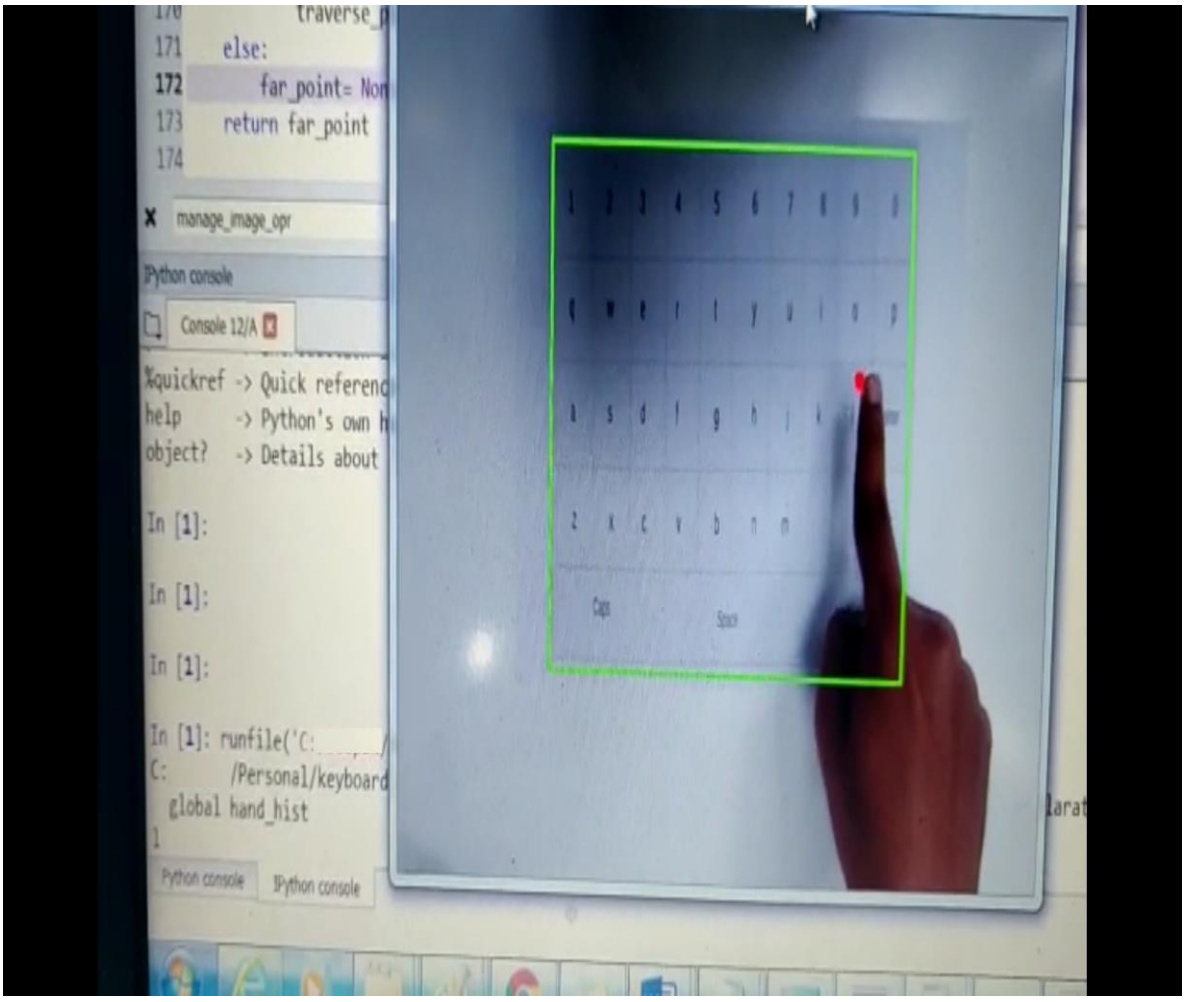

Figure 5.1: Detection of character ‘l’

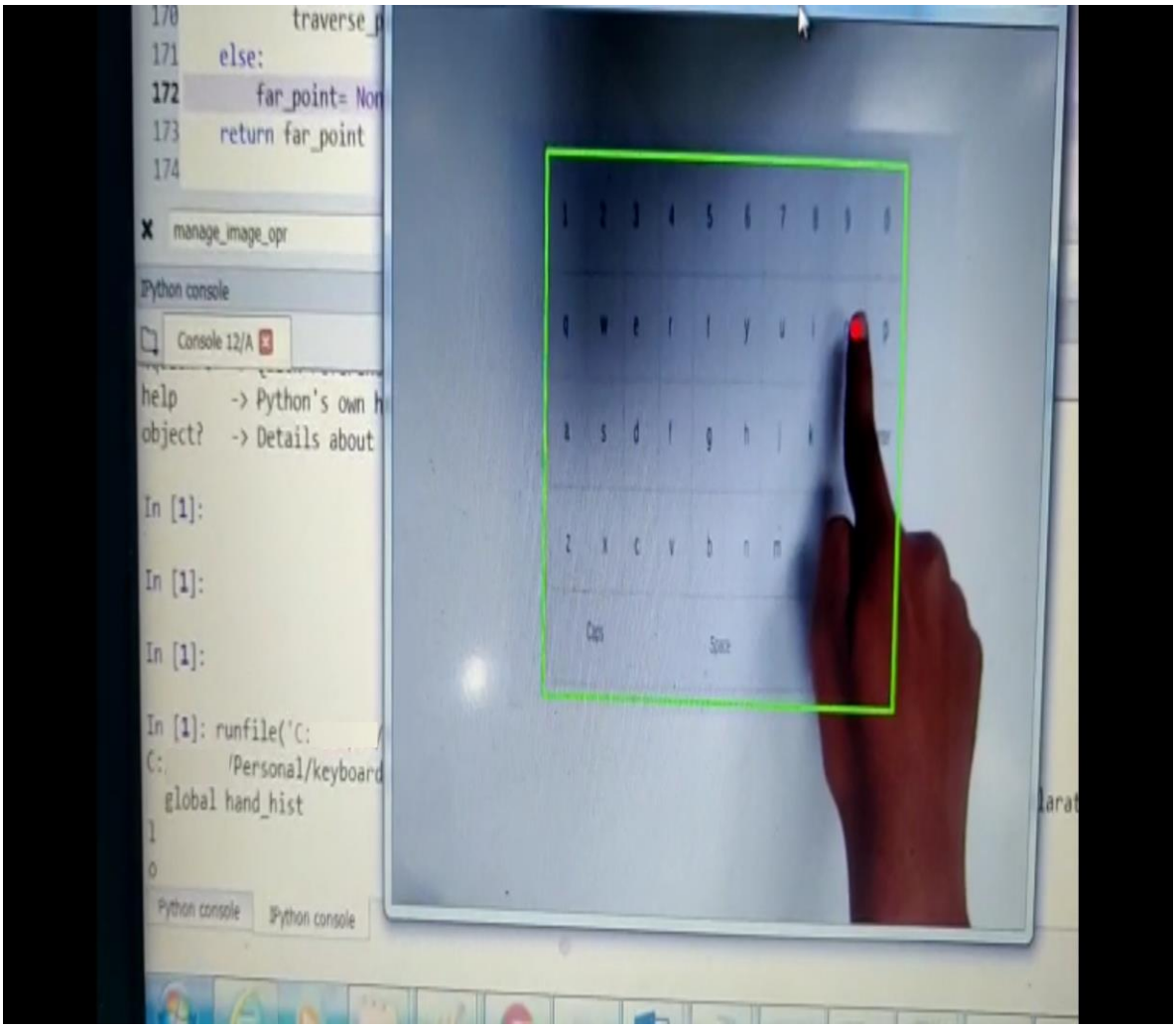

Figure 5.2: Detection of character ‘o’

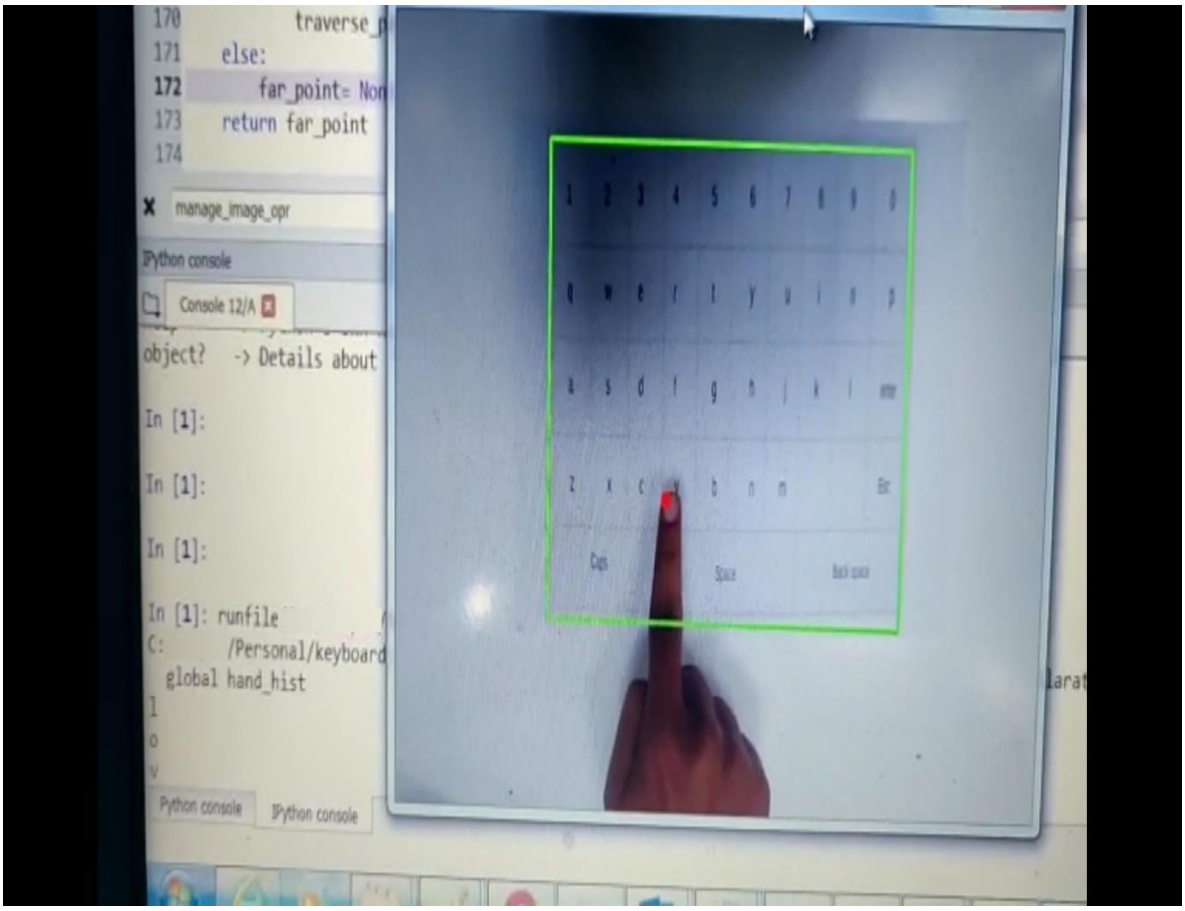

Figure 5.3: Detection of character ‘v’

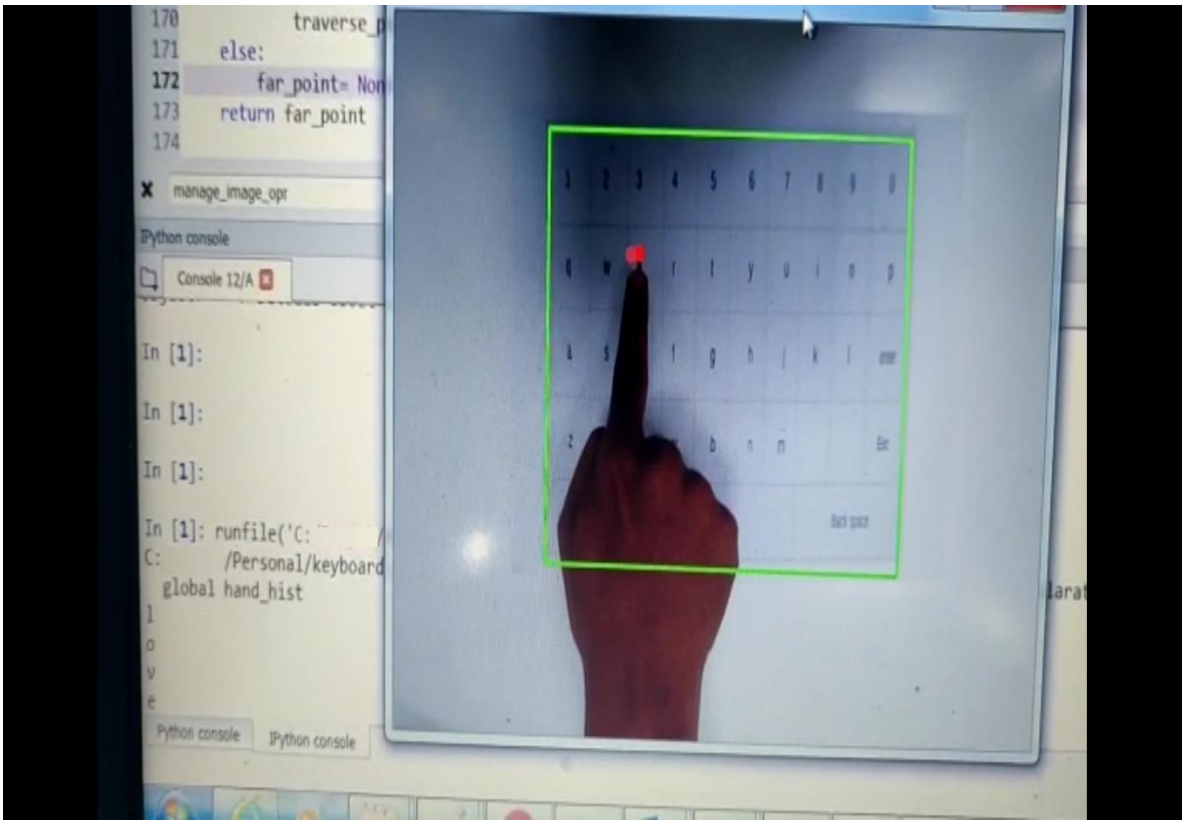

Figure 5.4: Detection of character ‘e’

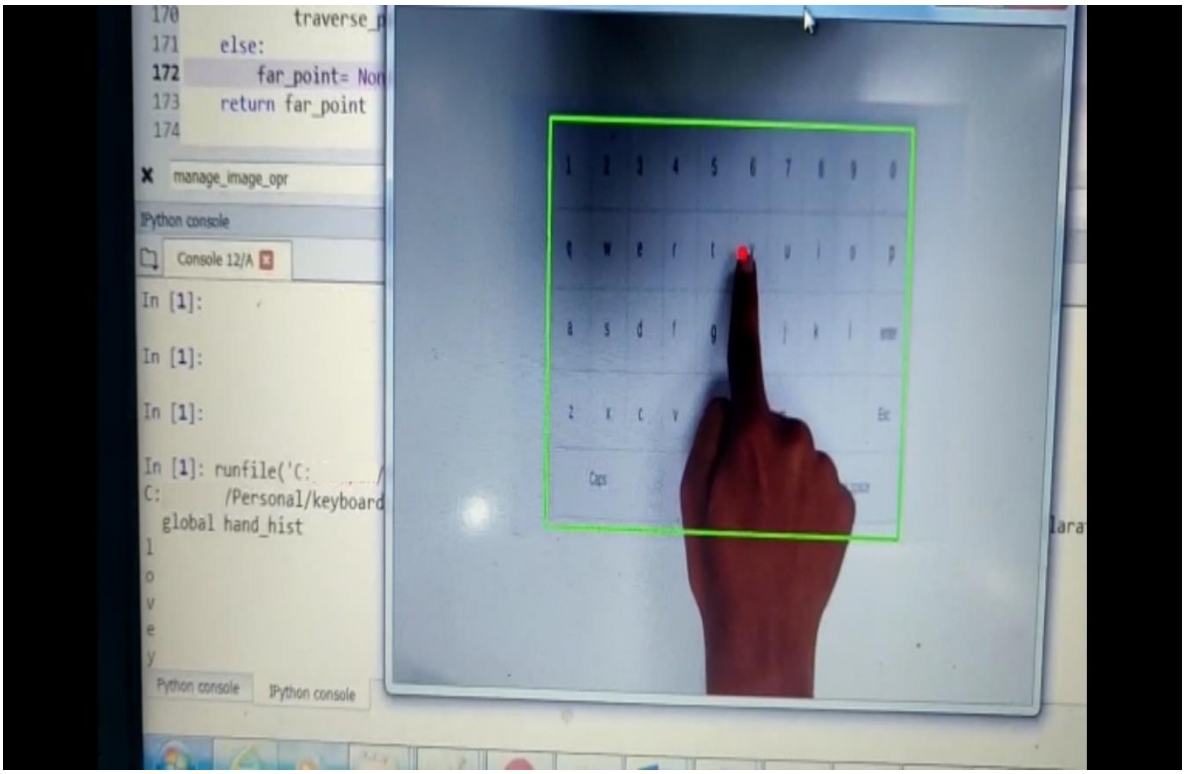

Figure 5.5: Detection of character ‘y’

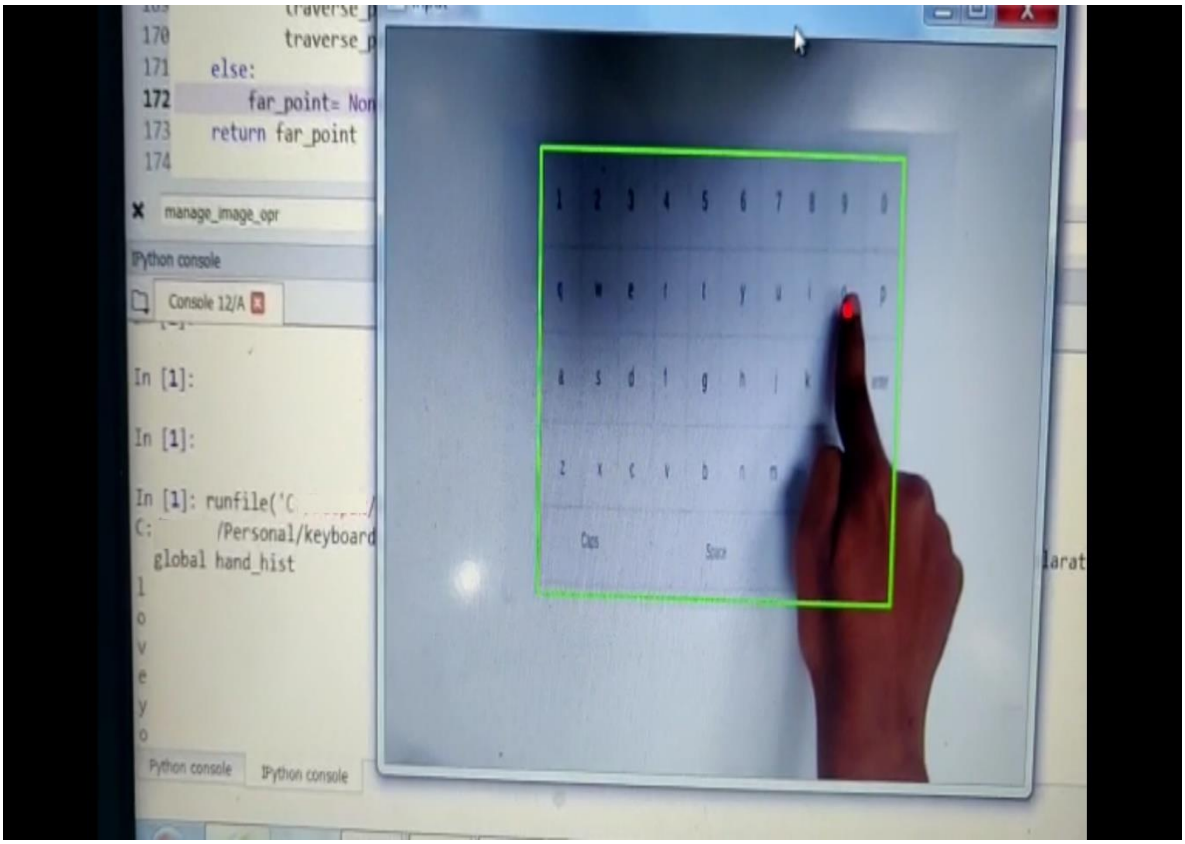

Figure 5.6: Detection of character ‘o’

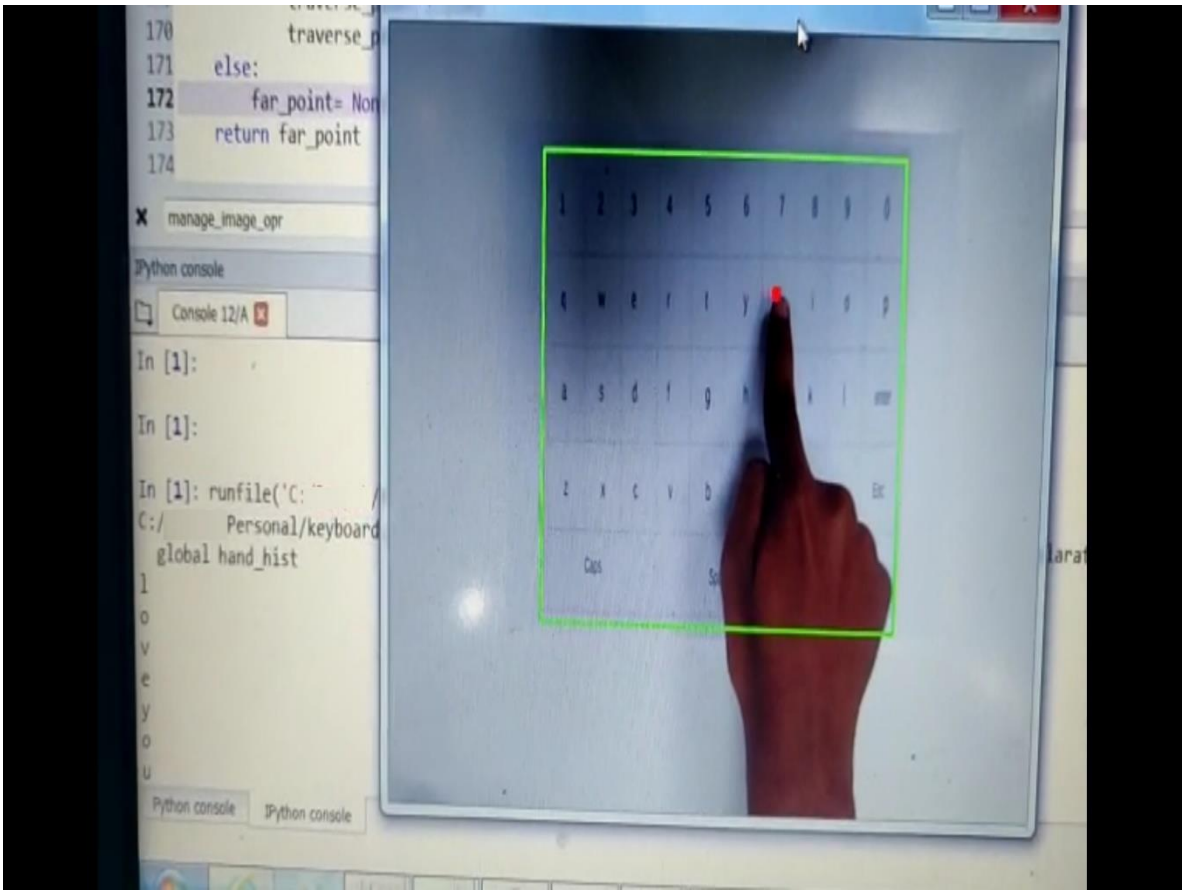

Figure 5.7: Detection of character ‘u’

Above series of figures [5.1-5.7] shows the printing of different characters of the word ‘love you’ alphabet by alphabet.

CHAPTER-6

CONCLUSION

Hereby it can be concluded it that the virtual keyboard application cannot be 100% efficient as there may be some errors occurring due to low margins between different characters which can result in typing of more than one character as output.

We are able to access the keyboard drawn on a sheet of paper using camera. Also we are able to locate the fingertip position in the paper keyboard and whether the touch has been made or not and the output is generated accordingly.

This report principally shows the practical execution of the virtual keyboard that shows the future generation of human mobile devices as well as the human computer interaction in the creation of virtual world. As the demand for tiny mobile devices is growing, conventional data entry system is required that are significantly elastic and easy to use without disturbing. The property such as lightness and flexibility of the keyboard device play an essential role here. Virtual keyboard provides a handiness of compression. User can alter the keyboard according to his/her relaxation which would require a little changes in the program. Therefore, it can be concluded that virtual keyboard application would make typing more easier, secure, reliable and more pleasurable for the user.

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