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RESEARCH ARTICLE

VIRTUAL KEYBOARD.

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Abstract

This paper is about the full sized keyboard that is implemented using the image processing. In this type of keyboard the image of the keyboard is being projected on any plane surface and a pre calibrated camera tracks the movement of the fingers on the image and detects key being pressed. This keyboard uses embedded system and image processing to let the users work on any surface they want with a higher portability option. This technology has many application in various high tech and industrial sectors where the keyboards would be in sterile and low noise environments for example operation theatres.

Introduction:-

Today's computers are shrinking in size with very fast development in the VLSI sector, but the thinks which are remaining the same is the keyboards, although the input methods have changes from mechanical keyboards to touch screen still the size of the keyboards cannot be modified after some extent. Hence as an alternative virtual keyboard perfectly fills all the gaps in the traditional keyboard.Virtual Keyboards lets you easily create multilingual text content on almost any existing platform and output it directly to PDAs or even web pages. Virtual keyboard, being small and handy ,well designed and easy to use features such as platform- independent multilingual support, built in language layouts and setting.

The increased repetitive motions and awkward postures have resulted in rise of cumulative trauma disorders(CTD's) that are generally considered to be the most costly and severe disorders occurring in the office. Detailed study has led to the findings that QWERTY.

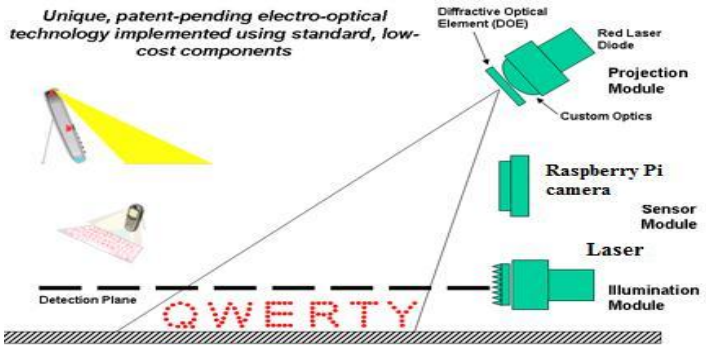

Figure 1:- Overview of keypad working.

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Selection of components raspberry Pi:-

The pragmatic thinking population of electronic designers have started to develop different computing machines with variable computing capabilities this revolution was first started by the development of the Arduino later on European researchers started working on raspberry pi which had its first inception on 2006 later on launched on 12 February 2012, with increase in the sales of the raspberry pi new model was launched in the year 2014. Powered with ARM7 machine working around at 700-900 MHz clock cycle it has got exceptional image processing capabilities. Not only that the raspberry pi has been developed to support Debian Operating systemcalled as Raspbian OS which is to install and light on the processing capabilities of the ARM7. Various other I/O ports such as HDMI, 3.5 mm audio jack, 4 USB2.0 and the most important is the it has got its own camera designed with plug and play facility.

Table 1:- Specification of Raspberry Pi Camera**.**

Still resolution	5 Megapixels
Video modes	1080p30, 720p60 and 640x480p60/90
Focal length	3.60 mm +/- 0.01
Frame rate up to 120 fps	max 90fps. Limitations on frame size for the higher frame rates (VGA only for above 47fps)
Pixel size	1.4 µm x 1.4 µm
C programming API	OpenMAX IL and others available
Picture formats	JPEG (accelerated) , JPEG + RAW , GIF , BMP , PNG , YUV420
Video formats	raw h.264 (accelerated)

Raspberry Pi Camera: - Due to the ease of the compatibility the raspberry pi and further more configuration settings that can achieved with this camera are perfectly suitable for the image processing. Thespecifications of the raspberry pi are as follows

Design and Working:-

Basic working of the virtual keyboard is that Raspberry pi camera would detect the IR rays which are being reflected from the fingers just above the keyboard layout illuminated by the projected image. The IR rays run parallel to the surface of the being used for typing.

Sensing module: -Sensing module is the core part the virtual keyboard. For sensing the key pressed, a PI CAMERAis used. This camera has the ability to capture pictures continuously at the rate of 90 frames per second. When a user places his/her finger on a certain key, the IR rays will detect the key pressing and the camera, which is programmed to capture pictures continuously and processes each picture. . The code of the project was written in PYTHON because of its capability in combining high-level languages with comprehensive math and graphics functions making a powerful image processing tool. The proximity sensing is the crucial part of the sensing the finger, as normal typing is done keeping the fingers just above the keyboard the finger. The proximity sensing is done by IR module which projects the IR rays parallel to the surface, when a finger cuts the ray the rays reflect towards the camera as per the light ray physics logic. The flow diagram is shown below.

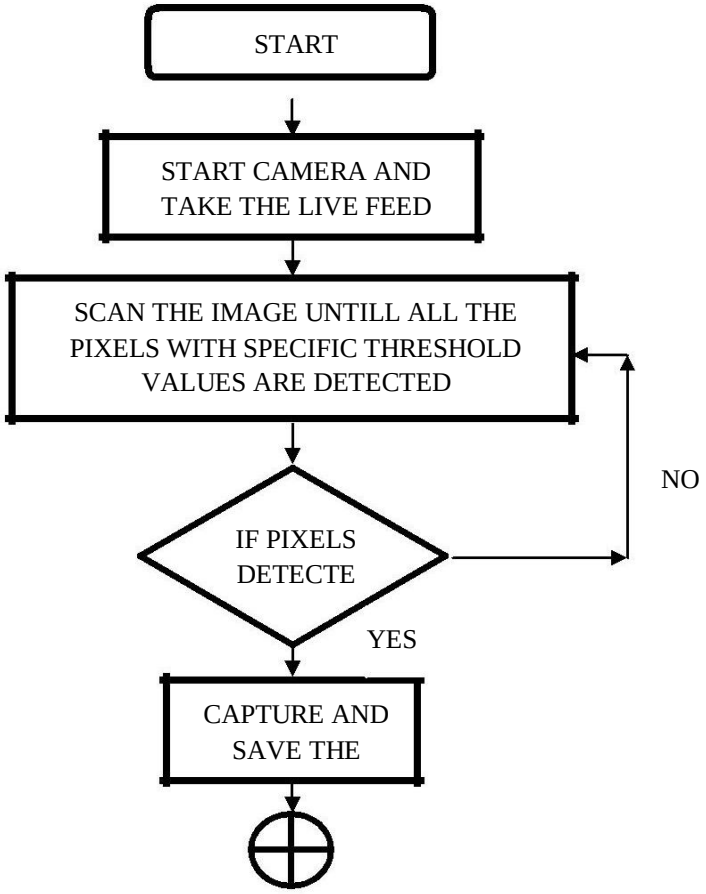


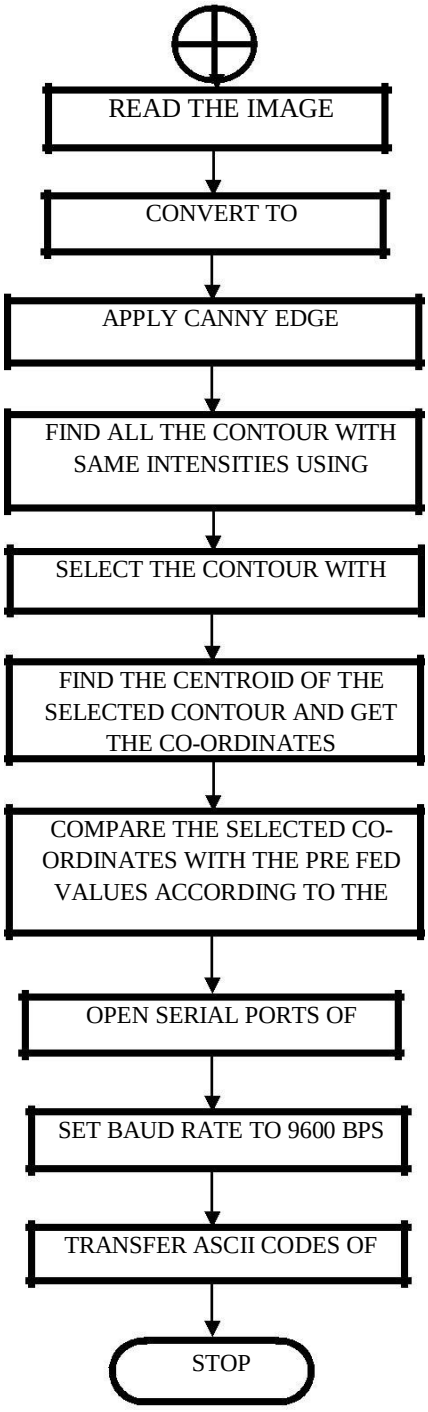
Image Processing:-

Here in the image processing part counter formation and processing of the curved structures formed due to the finger tips. Here the basis of simplification is that the frames captured by the camera are having fingers vertically oriented, from far to near (fingertip) regions in a virtual keyboard space (with respect to a camera position).Consecutive steps in implementation of fingertip localization include following procedures.

1. Edge detection.
2. Elimination of short lines in edge map.
3. Extraction of simplified contour.
4. Find local maxima representing fingertip candidates.
5. Apply additional criteria to reduce false positive detections.

The key stage in the counter formation is that edge detection for which canny edge detection is being used, invented by Jonny F. Canny in 1986. It tends to produce connected lines suitable for contour construction while its computational cost is acceptable in real-time image processing. The canny edge method uses local maxima of the image gradient, the gradient is found out by derivative the Gaussian filter. The method uses two thresholds high, low to detect the strong and weak edges, weak edges are considered only if those edges are connected to the strong edges so this method has better noise cancellation capacity than that of the other algorithms.Important condition for good performance of the proposed algorithm is setting proper threshold values and filtering kernel parameters. We have used Gaussian kernels of $\sigma = 3$ parameter truncated to 11 pixels width. Basis for automatic threshold value selection is histogram of gradient magnitudes.

After the edge detection some more accuracy can be obtain by the short line elimination for the curved length detection. The lines having the length shorter than the preset value are eliminatedTo find fingertip position we proposed concept of edge curves – simplified contour SimCon() of an object. For each column of the image, identified by coordinate x, we find point of the object (foreground) with highest row coordinate y = robmax(x).
This row coordinate then represents value of SimCon(x) = robmax(x).



Results:-

- The results at each step were encountered with problems and dis-functioning at times.
- The components and the respective algorithm were constantly compared in order to achieve a smooth and an economical product.
- The final results as achieved were satisfactory and reflected the reasons and objective for undertaking this particular project.
- A new age device providing an easy interface, along with major size and space optimization were the achieved objectives.
- A computer has evolved over the years but what hasn't changed is the input keyboard. Our product is the first and basic step in order to completely optimize the keyboard using the artificial intelligence and digital image processing.

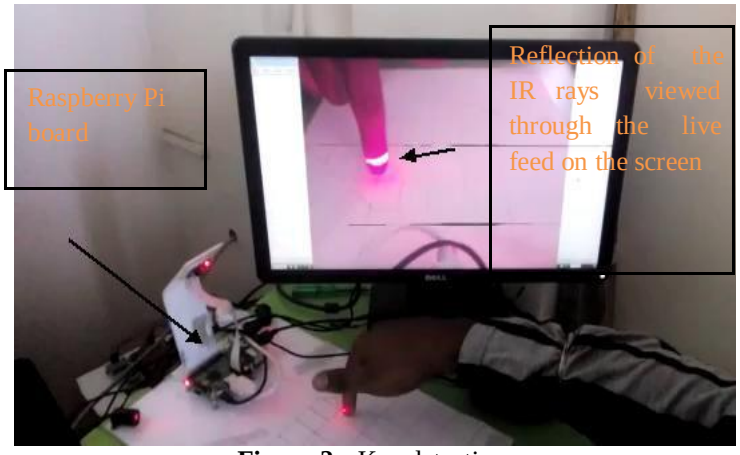


Figure 2:- Key detection.

The above snapshot is the testing of the module with preview being observed on the desktop monitor, here the pi camera mounted on the stick is capturing the image when red contour is detected and locating the co-ordinates. In the actual working of the module the preview function can be eliminated and the program could be run as the system program of the raspberry pi

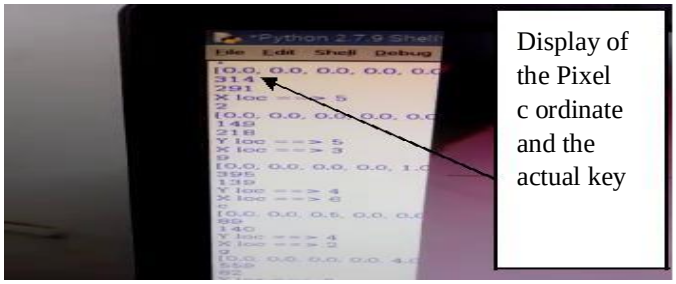


Figure 3:- Display of the detected key's Co-ordinate.

Here in the above snapshot we can see that the actual co-ordinates of the Pixel in the red contour as well as the key being pressed is shown. Co-ordinate (314,291) is position of the centroid of the contour and displaying the key 2.

Applications:-

1. High-tech and industrial Sectors Used with Smart phones, PDAs, email, word processing and spreadsheet tasks.
2. As computer/PDA input.
3. Can be used in places where low noise is required (e.g. operation theatres).
4. Can be used in Hi-tech cars in place of holographic or laser keypad. These keypads are mounted on the windshield as they did not obstruct the driver. In such vehicle these keypad are used to control all control action which are normally controlled through dashboard. This facilitates the driver to not to look from windshield to dashboard and then back to windshield while driving, specially while driving on highways with speed of 100kmph to 120kmph.
5. As keys are not visible and only user knows the exact location of keys, these keypads can be used for security purpose. For example in banks for safety lockers etc.
6. Can be used where importance is given to elegance. For example in Five Star Hotels etc.
7. Can be used in public information displays.
8. This technique will be in useful in designing low cost touch screens for PC monitors.

Conclusions:-

The virtual keyboard is far much better than that of the traditional ones with far more portability and durability along with the facilities of personalization. This keyboard can be used for by the people with disabilities.Although there are many kinds of virtual keyboards on markets, this is one of the few who uses microcomputer to implement the

function. In this paper, we demonstrate the hardware and software implementation in detail and the testing results shows the accuracy of keys. From this we can confidently draw conclusion that this implementation is absolutely practical and attainable. This paper is served as the instigator to illustrate the application of CMOS camera and RASPBERY PI in virtual keyboard.

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