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A Survey of Virtual Keyboard with its Senses

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Abstract-Since the development of computers had undergone rapid miniaturization. Disks and components grew smaller in size, only component that remained similar for decades is keyboard. Input to small devices is becoming an increasingly crucial factor in development for the ever-more powerful embedded market. Since miniaturization of a traditional QWERTY keyboard is very difficult we go for virtual keyboard. Here, a sensor tracks the finger movements of the typist to get the correct keystroke. A virtual keyboard is a keyboard that a user operates by typing on or within a wireless or optical-detectable surface or area rather than by depressing physical keys. As, new and advanced technologies have been invented for providing relief to humans in day-to-day life, in every field of world. These devices have witnessed a rapid improvement in its technology to fulfill the increasingly human usage demands of weightless devices which can be taken anywhere. In this embedded market, sensor plays an important role in sensing human activities, detecting environment factors and providing accurate result to humans that helps man to use virtual keyboard anywhere in any part of world with small input device. So, this paper gives summary of sensors in virtual keyboard , which includes introduction, research issues and future research directions of virtual keyboard.

Keywords- Sensors, Artificial Intelligence, Virtual Keyboard , Finger Detection, Projection, Plane Illumination, Reflection.

I. INTRODUCTION

A sensor is a device that detects and responds to some type of input from the physical environment. The specific input could be light, heat, motion, moisture, pressure, or any one of a great number of other environmental phenomena. A signal is generally the output that is converted to human-readable display at the located sensor location or electronically transmitted over a network for reading or further processing [1]. **Sensors** are devices that are frequently used to detect and respond to electrical or optical signals. A **Sensor** converts the physical parameter (for example: temperature, blood pressure, humidity, speed, etc.) into a signal which can be measured electrically [2].

Let's explain the example of fingerprint sensing. On detecting fingerprints from the virtual keyboard, following output is displayed on the screens.

I. A. Virtual Keyboard and Its Existence

Computer technology continues to grow up, the importance of human computer interaction is rapidly increasing which has also found its way into mobile devices like palm tops and into mobile phones. But the fact that remained same since last many years is the input device, the old QWERTY keyboard and the new virtual keyboard technology which is the latest development [3].

A person with larger fingers finds the keyboards on smartphones and PDAs too small. To overcome this, some manufactures have developed special virtual laser keyboards to accompany handheld devices: a

virtual laser keyboard connects to the phone and projects a full-sized virtual keyboard onto any flat surface [4].

I. B. Description of Virtual Keyboard

This is very advanced technology that gives the new definition to the keyboard that works on sensor and artificial intelligence. They are not the electronic device they are just the set of lights that look likes the keyboard and works like a keyboard. In this technique we use a device that produces the LASER light on the flat surface this LASER light produced is the keyboard. It creates detectable surface on which user don't need to press the key like normal keyboard, we just need to move our finger to the respective key and device detects the motion of the fingers [5]. A virtual keyboard system based on a true-3D optical range camera is presented. Keystroke events are accurately tracked independently on the user. No training is required by the system that automatically adapts itself to the background conditions when turned on. The feedback text and/or graphics may be integrated with such projector, thus enabling truly virtual working area. Experiments have shown the suitability of the approach which achieves high accuracy and speed. It uses an IR detector to sense your hand movements. The usability of the keyboard entirely depends on the surface on which it is placed. It works best on smooth, flat, dull surfaces such as a wooden table. Shiny surfaces such as glass or marble tend to not work as well, if at all [6].

II. COMPONENTS SURVEY

This system comprises of three modules,
1. The sensor module.
2. IR-light source
3. The pattern projector

1) Sensor Module

The Sensor Module serves as the eyes of the Keyboard Perception technology. The Sensor Module operates by locating the user's fingers in 3-D space and tracking the intended keystrokes, or mouse movements.

Electronic Perception Technology:

Electronic perception technology enables ordinary electronic devices to "see" the world around them so they can perceive and interact with it. Now everyday electronic devices in a variety of markets can perceive users actions, gaining functionality and ease of use. The tiny electronic perception chips and embedded software work by developing a 3D"distance map" to nearby objects in real-time. This information is factored through an on-chip processor running imaging software that translates the image into defined events before sending it off-chip for application-specific processing. It's an action that is continually repeated, generating over 30 frames of 3D information per second [8].

2) IR-Light Source

The infrared light source emits a beam of infrared light. This light beam is designed to overlap the area on which the keyboard pattern projector. This is done so as illuminate the user's fingers by infra-red light beam. This helps in recognizing the hand movements and pressing of keys. The light beam facilitates in scanning the image. Accordingly information is passed on sensor module which decodes information. An invisible infra-red beam is projected above the virtual keyboard. Finger makes keystroke on virtual keyboard. This breaks infra-red beam and infrared light is reflected back to projector, reflected infrared beam passed through infrared filter to camera. The camera photographs angle of incoming infrared light. The sensor chip in sensor module determines where the infrared was broken. Detected co-ordinates determine character or actions to be generated [7].

3) The Pattern Projector

The Pattern Projector or optional printed image presents the image of the keyboard or mouse zone of the system. This image can be projected on any flat surface. The projected image is that of a standard qwerty-keyboard, with all the keys and control functions as in the keyboard. The Projector features a wide-angle lens so that a large pattern can be projected from relatively low elevations. A printed image, with replaceable templates allows system flexibility, permitting most any kind of keyboard configuration for greater functionality. In some types of virtual keyboards, a second infra-red beam is not necessary. Here the projector itself takes the inputs, providing dual functionality. A sensor or camera in the projector picks up the finger movements, and passes the information onto the sensor modules [8].

III. WORKING OF A VIRTUAL KEYBOARD IN BRIEF

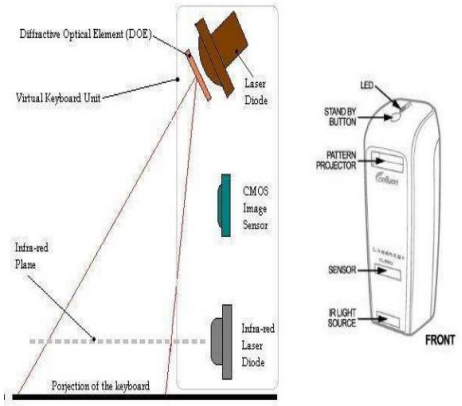

Fig: Working of a virtual keyboard.

Working of a virtual keyboard consists of three steps, described as follows:

STEP 1: TEMPLATE CREATION (PROJECTION MODULE):

A template of the desired interface is projected onto the adjacent interface surface. The Projection module produces the template by illuminating a specially designed holographic optical element which is highly effective with a red diode laser. Note: The template which is created by projection module serves only as a reference for the user and it does not involves in the detection process. In an environment, the template can easily be printed onto the interface surface [9].

STEP 2: REFERENCE PLANE ILLUMINATION (MICRO-ILLUMINATION MODULE)

An infra-red plane of light is generated just above the surface and becomes parallel to the interface surface. When the user touches a key position on the interface surface light is reflected from this plane in the vicinity of the key and directed towards the sensor module. This light generated from IR-light source is invisible to the user and hovers a few millimeters above the fixed surface [9].

STEP 3: MAP REFLECTION COORDINATES (SENSOR MODULE)

Reflected light from user interactions with the interface surface is passed through an infra-red filter and imaged on to a CMOS image sensor in the sensor module. The Virtual Interface Processing Core TM is the Custom hardware embedded in the sensor chip which makes a real-time determination of the location of the reflected light. The multiple reflection events are thus tracked simultaneously by the processing core and therefore supports multiple keystrokes and overlapping cursor control inputs [9].

IV. SENSOR THAT IS USED IN VIRTUAL KEYBOARD:

Image Sensor

Definition: An Image Sensor is a device that converts an optical image to an electric signal. It is used mostly in digital cameras and other imaging devices like virtual keyboard. It is a set of charge-coupled devices (CCD) or CMOS sensors such as active-pixel sensors.

There are two main types of image sensor. These are charge-coupled devices (CCD) and complementary metal–oxide–semiconductor (CMOS) active pixel sensors.

Both types of sensor convert the light striking the individual sensor points to electrical signals. However they differ in how resultant electrical signal is collected and treated.

IV.A. Difference of Working

In the CCD device each sensor point struck by light creates an electrical charge proportional to the light intensity striking it. All the sensors are activated at once and the charge is stored. Once the exposure is complete the first row of the array is read by the on-board computer. Each charge is converted to data describing the light that struck that sensor point. Next the second row of of the array is emptied into the first row and read by the computer. Then the third row is passed on to the second, then to the first, and in turn is read by the computer. This cascade of signals allows the entire array to capture the data in one instant and be sequentially read-off after the exposure. This ‘frame-transfer’ method captures the entire image at once [10].

In the CMOS device each sensor point is directly integrated with an amplifier. In this case when the light strikes the sensor surface it creates an electrical voltage signal that is immediately amplified and changed to image data. The computer reads off the amplified signals sequentially, row-by-row during the exposure. During the course of an exposure the first sensor point is read a fraction of a second before the last one is read by the computer. This time difference has consequences for the design of the camera shutter. It can also lead to predictable image distortion effects and some image artifacts particularly when shooting fast moving objects [10].

IV.B. Cost and Use

CCD technology is expensive and often requires more processing power. The need for more components to complete the processing make it difficult to use CCD technology in compact technologies like consumer cameras. In addition the technology suffers from the creation of high noise levels, particularly in high light intensity. In low end cameras this is not a problem. To prevent the noise levels, cooling systems have often been used, adding to the expense. However, the quality of the image improves.

These devices have been used in high end imaging devices astronomy, specialist cameras, and medical imaging devices as well as consumer cameras, mobile phone cameras, web cams and low-end sensors [10].
CMOS Active Pixel Sensors are best used for applications where compact size, low power consumption and on-chip processing are important. CMOS sensors are used in high-end digital cameras down to mobile-phone cameras. This compact technology is cheaper than CCD, and uses less power [10].

V. OTHER SENSORS THAT CAN BE USED IN VIRTUAL KEYBOARD ARE:

1) Position Sensor

A position sensor is any device that permits position measurement. It can either be an absolute position sensor or a relative one (displacement sensor). Position sensors can be linear, angular, or multi-axis [11]. This sensor can be used to detect the position of the finger movements and can help to find a pattern in a virtual keyboard.

2) Motion Detector Sensor

A **motion detector** is a device that detects moving objects, particularly people. Such a device is often integrated as a component of a system that automatically performs a task or alerts a user of motion in an area. They form a vital component of security, automated lighting control, home control, energy efficiency, and other useful systems [11]. This sensor can be used to detect the motion of human finger and make virtual keyboard automatically visible and disappear when not in use. Even **Proximity Sensor** can be used for the same purpose to detect the presence without any physical contact.

3) Visual Sensor Network

A **visual sensor network** is a network of spatially distributed smart camera devices capable of processing and fusing images of a scene from a variety of viewpoints into some form more useful than the individual images. A visual sensor network may be a type of wireless sensor network, and much of the theory and application of the latter applies to the former. The network generally consists of the cameras themselves, which have some local image processing, communication and storage capabilities, and possibly one or more central computers, where image data from multiple cameras is further processed and fused (this processing may, however, simply take place in a distributed fashion across the cameras and their local controllers). Visual sensor networks also provide some high-level services to the user so that the large amount of data can be distilled into information of interest using specific queries [11].

V. A. CRITERIA TO SELECT SENSOR

There are certain features which have to be considered when we choose a sensor. They are as given below:

1. Accuracy
2. Environmental condition - usually has limits for temperature/ humidity
3. Range - Measurement limit of sensor
4. Calibration - Essential for most of the measuring devices as the readings changes with time
5. Resolution - Smallest increment detected by the sensor
6. Cost
7. Repeatability - The reading that varies is repeatedly measured under the same environment [2].

VI. CONNECTIVITY FOR VIRTUAL KEYBOARD

Projection keyboards connect to the devices they are used for either through Bluetooth or USB.
The Bluetooth projection keyboard is a wireless virtual keyboard, a pocket-size device that projects a full-size keyboard through infrared technology onto any flat surface.
Bluetooth dongle technology enables the projection keyboard for point to multi-point friendly connectivity with other Bluetooth devices, such as PCs, PDAs and mobile phone. Bluetooth is an open specification for wireless data transmission which operates on the globally available 2.4GHz radio frequency.
The USB projection keyboard works like a regular USB keyboard. The connection between the virtual keyboard and the device is made through a USB port, which is available on every computer, laptop and other devices that are compatible with the projection keyboard. Connection instructions come as well with the product and with the manufacturer's specifications but it mainly consists in Plug and Play the devices [12].

VII. ADVANTAGES OF A VIRTUAL KEYBOARD

1. It can be projected on any surface or you can type in the plain air .
2. It can be useful in places like operation theatres where low noise is essential.
3. The typing does not require a lot of complexity because it works on persons fingertips.
4. High battery life. The standard coin-sized lithium battery lasts about eight months before needing to be replaced.
5. The Virtual Keyboard is not restricted to the 'QWERTY' touch-typing paradigm, adjustments can be done to the software to fit other touch-typing paradigms as well [13].

VIII. DRAWBACKS

1. Virtual keyboard is hard to get used to. Since it involves typing in thin air, it requires a little practice. Only people who are good at typing can use a virtual keyboard efficiently.
2. It is very costly ranging from 150 to 200 dollars, difficult for common man to afford.
3. The room in which the projected keyboard is used should not be very bright so that the keyboard is properly visible

IX. APPLICATIONS OF VIRTUAL KEYBOARD

1. It is good to be used by Business men/ women, Suppliers/ Invoice keepers, Students/ teachers, Tourists/trekkers, High-tech employees, Lawyers/ accountants, Architects, Land surveyors, Field engineers.
2. Used with smart phones, PDAs, email, word processing and spreadsheet tasks.
3. Operation theatres.
4. Most systems can function as a virtual mouse or even as a virtual piano [7].

X. CONCLUSIONS

Brief overview of the technology is mentioned with a detailed description of working model and its components. The description of some sensors that can be used for making virtual keyboard more comfortable and advanced. Conclusions can be day-by-day technology is getting smaller and smaller starting from a room-sized computer to palmtop, difficulty arises in typing into small devices. So, as per person choices i.e. weight decreasing and getting smaller concept too remains same with the sensor and artificial intelligence technology named virtual keyboard for making typing easier, compatible with that small device.

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