Processing algorithm for laser keyboards computer science essay

Technology, Computer

The interface which we use to interact with a computer is a hardware device called the keyboard. There have been drastic changes in the keyboard layouts which have evolved into the designs like those of the DVORAK and QWERTY keyboards. Then came the digital era where almost everything is in the digital form making things simpler to use and smaller in size.

As the demand for more computing environments have evolved, new human – computer interfaces have been implemented to provide multi-form interactions between users and machines. Nonetheless, the basis for most human to computer interactions remains the traditional keyboard and mouse. Ordinary keyboards are reasonably sized, comfortable and effective. However, they are difficult to carry and often require wiring. To overcome these problems a smaller and more mobile touch – typing device has been proposed which does not have any physical support. This device is known as virtual keyboard or zero – form – factor interface.

Introduction

In 1999, a proposal was made to use a single tiny sensor to observe the user's fingers transforming motions into keystrokes. The main idea was to make a keyboard out of sensors and light, projecting it on desktops, airplane tray tables and any other flat surface. This started a new concept of using a keyboard with a different interface. The virtual keyboard was designed in a way to replace laptops mechanical keyboards, making the devices thinner and lighter. The virtual keyboard is an unbreakable, washable keypad, projected onto a flat surface used in hospital operating rooms, space vehicles and in other computerized environments.

Types of Virtual Keyboards

2. 1 On – Screen keyboard

The on-screen keyboard is built in with the windows operating system. This started a revolution of virtual keyboards in this digital era. It allows users with mobility impairments to type data by using a pointing device or joystick. It provides a minimum level of functionality for some people with mobility impairments and also helps users who do not know how to type. It can be used even when there is no external keyboard. It is also referred to sometimes as hot virtual keyboard.

A number of advanced features have been enabled to make the on-screen typing easier, faster and more accurate. It lets the users to type accurately and faster by suggesting words based on taps. This technology works similar to the one available in modern mobile phones and communicators, enabling faster and accurate typing by suggesting the correct words after entering a few symbols. This keyboard will be more useful for users of TabletPC, Ultra-mobile PC, PanelPC, CarPC and similar touch-screen devices. The picture below is that of an on-screen keyboard.

Figure 1(Tan, D. S., Keyani, P., and Czerwinski, M. 2005)

Affordances of On-Screen Keyboard

Replacing physical keyboard:

The on-screen keyboard is designed in such a way that, it replaces the physical keyboard. The people using the computer systems will find its usage very much helpful.

Can do all the work:

It functions just like an ordinary keyboard having all the QWERTY keys. It also helps the users from the tedious work of typing.

2. 2 Laser Keyboard

The laser keyboard actually replaces the traditional keyboard. This can be placed on any kind of flat surface. It can be automatically connected to the nearest device available using the bluetooth technology. It is about the size of a small cellular phone and enables the users to type texts or e-mails as easily as like a ordinary keyboard.

It uses a light projection of a full-sized computer keyboard on almost any surface. Used with PDA's and Smart Phones, the virtual keyboard provides a practical way to do e-mail, word processing and spreadsheet tasks, enabling the users to leave laptops and computers at home. The virtual keyboard adaptable technology studies the user's finger movements to interpret and record keystrokes. As the virtual keyboard is an image projected by light, it disappears completely when not in use. The picture shown below is that of a laser keyboard.

C: Documents and Settingss507046Desktoplaser_keyboard. jpg

Figure 2 (Tomasi, C., Rafii, A., and Torunoglu, I. 2003)

TECHNICAL ASPECTS:

I-Tech's opinion was to build everything from scratch. In the process, they designed sensors based on a variety of principles, from the special- purpose structured-light devices called " beam trangulators" to methods based on the measurement of time and phase1 of returning light pulses invented by Canesta's Cyrus Bamji.

The main hardware modules used in the architecture of the virtual keyboard are categorized into three modules namely 3-D optical camera, visual feedback and a processing platform. The camera is connected to the platform and to the PC via USB 2. 0 interface. Using serial port the feedback communicates with the computer system. The sensors in the camera are designed in such a way that it avoids all other background light. Together, they cost less than a mechanical keyboard, and draw less power than a cell phone. The resulting system " feels" almost like a mechanical keyboard, even if users feel only the impact of their fingers on the projection surface when typing.

The optical system projects the keyboard onto the typing surface; its infrared light source generates an invisible, fan-shaped beam grazing the surface; and its sensing system includes a processing unit. All are in fixed relative positions; no user adjustment is required. The projector is positioned high on the host device. In the simplest sensor, the camera looks down at the typing surface at a shallow angle through a wide lens sensitive only to infrared

light. A finger striking the typing surface breaks the infrared beam, thereby becoming visible to the camera. Triangulation then determines the position of the finger on the typing surface.

Even with this simple sensor, implementation of the projection keyboard under the constraints of weight, size, power, cost, reliability, and usability has involved formidable technical challenges.

Keyboard projection:

Most current optical-projection systems mask light to form images at a distance. For instance, in a slide projector, the slide itself blocks part of the light hitting it; the remaining light makes it through the lens and onto the screen, forming the image. This is the basic technique used in the projection of the keyboard on a flat surface.

Finger lighting and sensing:

When typing, a user's useful action occurs in the thin layer of space that separates the hovering and constantly moving fingers from the surface of the keyboard. In a perfect world, an infinitesimally thin sheet of infrared light grazing the typing surface could be used as a trip switch; when a finger intersects the beam, it would also be touching the surface. In this instance, a finger that becomes visible to the camera is a finger that hits a key, and all that is left for the sensor is determining the finger's position by triangulation.

Affordances of Laser Keyboard

Easy to use:

The laser keyboard is very easy to use. It gets connected to an available computer system easily without much effort.

Easy to install:

It is very easy to install and requires no wiring for it. It uses the Bluetooth technology to get connected to the computer systems.

Portable:

As it looks like a mobile phone, it is very much portable and is used irrespective of the surface used for typing purposes. It can be used as an ordinary keyboard with adjustable sensors which allow the user to change the size of the keyboard according to his usage.

2. 3 Laser Pen Keyboard

In the laser pen keyboard the sensors are attached to a device which looks like a pen. The setup also has a projector which displays the keyboard on the screen. When it is integrated with the projector it is merely used as a projecting device which projects just what is being printed on the screen. It can also be connected with a monitor for viewing the display. A picture of the laser pen keyboard is shown below.

C: Documents and SettingsS506432DesktopVKBpens5. jpg

Figure 3(Retrieved from http://us. gizmodo. com/gadgets/images/laserpen. jpg)

Technical interface

The sensors in the setup used for projecting the keyboard are the infra red rays. These rays are projected on to a flat surface for better sensing of hovering of the keys. The usage of this keyboard is very convenient as it has no wires to connect. The lithium batteries in the sensors allow us to use this setup continuously for 2 hours of typing. It comes with 63 keys and a full size QWERTY layout which allows the user to be as comfortable as he is with the standard ordinary keyboard. This also has a stylus which allows the users to use the keyboard in a compact area where the resizing of the keyboard becomes a necessity. One of the advantages of using this keyboard is that the size of the keyboard can be altered as per the user.

Affordances of Laser Pen Keyboard

Simple to use:

The setup for the laser pen keyboard is very simple to use. This makes the users to perform tasks in a simpler way. Laser pen keyboard can be connected to any computing device to perform input actions for the device. Connection can be made without using wires or any physical network.

Screen Projection:

Laser pen keyboard not only has a keyboard projection but also has a screen projection. One pen does the keyboard projection with numbers of keys on keyboard and the other pen does the screen projection which shows the keys which are selected and also actions done on the keyboard.

Working of Laser Keyboards:

The working of the virtual keyboard consists of five main modules – (1) depth map error correction, a camera dependent module based on specific models designed for the range camera, (2) background subtraction, (3) central column estimation, (4) fingertip detection, and (5) keystroke detection. The figure shows the complete working of the basic working implemented in the design of the virtual keyboards.

Figure 4(Huan Du, Thierry Oggier, Felix Lustenberger and Edoardo Charbon 2004)

A 3D range camera is placed over the input surface with a well-defined angle facing the working area. The size of the working area is limited by the spatial resolution of the camera. The display projector is mounted on the camera which would generate the visual feedback for the keyboard and input information. The camera is adjusted at startup. It assumes the surface as a projection matrix. The keystroke detection is usually done through this projection matrix. This is passed as a map and is processed for error correction. The error correction compensates the errors caused by the unevenness of the surface. The rectified range measurements, combined

with gray-scale image, are then subtracted from the reference image. It is then stored as a binary format in the matrix formed.

After applying the central column estimation, which is defined as the pixel segments associated with fingers that are good candidates for an event, by searching the local extreme in x-coordinate along the hand boundary, and applying the fingertip detection by extracting features with curve modeling, precise location of fingertips can be found in the hand region. Finally, the keystroke detection is obtained by fitting depth curve applying another feature model, and the corresponding hitting positions are mapped back to the world coordinate system to infer the stricken keys. The updated key status is then sent to visual feedback module to generate refreshed display.

The visual feedback module projects a dynamically generated image on to a LCD. When the algorithm used, detects a key-striking event on the surface, an UPDATE command is sent. The command contains the specific key information. It updates the generated display and the user can see the change of keyboard image as a textual or graphical update.

The information supplied by the camera allows developing a few simpler and more efficient algorithms to estimate the position of fingertips and to locate the corresponding key. Simplicity and efficiency are key elements to enable real-time and even portable applications.

Future and Scope of the Project:

Users see this as an emerging technology which helps as an interface to connect to the digital world. Though its use is being restricted to fewer applications now, as users learn more about this, it can be expected that users for this virtual keyboard increase in the near future. However there are a few challenges in this project. The main disadvantage is that of light scattering and close target. And due to this the image resolution becomes low and restricts the user to use it with a large view window.

In the future, we may expect that the above said disadvantages will be solved and virtual keyboard will be used on flat surfaces and also on uneven surfaces. The keyboard could also be used on any type of surface like water and so on, so that the user can use the keyboard when ever and where ever necessary.

CONCLUSION:

More than a decade ago, (Mark Weiser, 2000) of Xerox PARC, said, " The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it". This fundamental unobtrusiveness is the main metric of validity for the fledgling field of electronic perception technology.

The virtual keyboard can be termed a great invention in the digital world. Users look forward for it being used in a more effective way than before. Users also can expect the inventors to make an advancement of it in such a way that it can be used on any kind of a surface.