VIRTUAL KEYBOARD PROJECTION

Nirav Shah, Saumya Lahera
Department of Computer Science, Rajiv Gandhi Institute of Technology, Mumbai
Shah & Anchor Kutchhi Engineering College, Mumbai, India
nrvshah10@gmail.com, saumyanyca@yahoo.com

Abstract

Input to small devices is becoming an increasingly crucial factor in development for the ever-more powerful embedded market. Speech input promises to become a feasible alternative to tiny keypads, yet its limited reliability, robustness, and flexibility render it unsuitable for certain tasks and/or environments. This paper surveys technology for alphanumeric input devices using virtual keyboard projection with a strong focus on touch-typing.

Keywords*:* **Sensors, Template Projection, Illumination, Interpretation, Communication**

1. INTRODUCTION

Virtual keyboard is just another example of today's computer trend of 'smaller and faster'. Computing is now not limited to desktops and laptops, it has found way into mobile device also. But what is not changed is the input device, the good old QWERTY keyboard. The virtual keyboard technology is a tabletop unit that projects a laser image of a keyboard on any flat surface. 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, when a user touches the surface covered by an image of a key, the device records the corresponding keystroke.

Full size keyboard can be projected on any flat surface. It can be useful in place where low noise is essential. The typing does not require a lot of force and hence easing the strain on wrists and hands. The Virtual Laser Keyboard uses a fixed image i.e., the projected image never changes. 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.

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. No specific hardware must be worn and in principle no dedicated goggles are necessary to view the keyboard since it is projected onto an arbitrary surface by optical means. 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.

People with bigger fingers may find the keyboards on smart phones and PDAs too small. To make up for this, some manufactures have developed special virtual laser keyboards to accompany handheld devices. Instead of having to poke lightly around your phone's keyboard, a virtual laser keyboard connects to the phone and projects a full-sized virtual keyboard onto any flat surface.

2. SYSTEM ARCHITECTURE

Figure 1 shows the physical setup of the system. The 3D range camera is placed several centimetres over the input surface, with a well-defined angle facing the working area. The size of the working area, limited by the spatial resolution of the camera, is 15 cm × 25 cm, which is comparable to a full-size laptop-computer keyboard. The display projector is mounted on the camera, facing the same area, which would generate the visual feedback for the keyboard and input information. The proposed system consists of three main hardware modules.

A. Sensor module

The sensor module serves a eye of keyboard perception technology. The sensor module operates but locating user's fingers in 3-D space and tracking the intended keystrokes. Keystroke information is processed and can then be output to host device via a USB or Bluetooth.

B. IR Source(illumination module)

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.

C. Pattern projector

The pattern projector presents the image of keyboard. Thus image can be projected on any flat surfaces. This projected image is that of standard QWERTY keyboard, with all the keys and control functions as in the keyboard.

The projector features a wide-angle lens so that large pattern can be projected from relatively low elevations. In some type of virtual keyboard, a second infra-red beam is not necessary. Here the projector itself takes the input, providing dual functionally. A sensor or camera in projector picks up finger movements, and passes the information on sensor modules.

3. WORKING OF VIRTUAL KEYBOARD

The projection is realized in main 4 steps.fig.1 shows working of it.

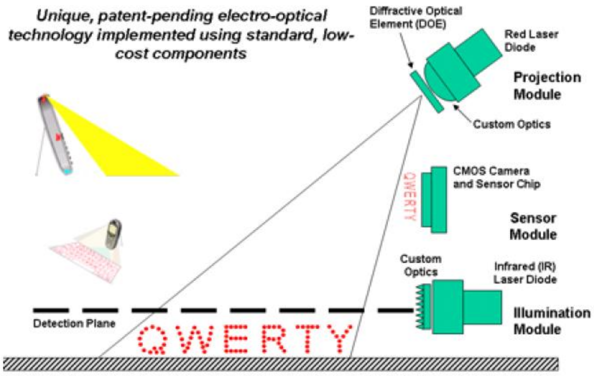

Figure 1: Virtual Keyboard Architecture

A. Template projection

A template produced by a specially designed and highly efficient projection element with a red diode laser is projected onto the adjacent interface surface. The template is not however involved in the detection process and it is only used as a reference for the user. In a fixed environment, the template can just as easily be printed onto the interface surface. Figure 2 shows projection of template (keyboard).Various types of projection elements are available in market.

Figure 2: Projection of Template

B. Reference plane illuminations

An infra-red plane of light is generated on the interface surface. The plane is however situated just above and parallel to the surface. The light is invisible to the user and hovers a few millimetres above the surface. When a key position is touched on the surface interface, the light is reflected from the infra-red plane in the vicinity of the key and directed towards the sensor module.

C. Map reflection coordinates

The reflected light 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 sensor chip has a custom hardware embedded such as the Virtual Interface Processing Core and it is capable of making a real-time determination of the location from where the light was reflected. The processing core may track not only one, but multiple light reflections at the same time and it can support multiple keystrokes and overlapping cursor control inputs.

D. Interpretation and communication

The micro-controller in the sensor module receives the positional information corresponding to the light flashes from the sensor processing core, interprets the events and then communicates them through the appropriate interface to external devices. By events it is understood any key stroke, mouse or touchpad control.

Most projection keyboards use a red diode laser as a light source and may project a full size QWERTY keyboard. The projected keyboard size is usually 295 mm x 95 mm and it is projected at a distance of 60 mm from the virtual keyboard unit. The projection keyboard detects up to 400 characters per minute.

The keyboard unit works on lithium-ion batteries and offers at least 120 minutes of continuous typing. The projection unit size varies but normally is not bigger than 35 mm x 92 mm x 25 mm.

4. CONNECTIVITY

i. Projection keyboards connect to the computer either through Bluetooth or USB.
ii. Bluetooth dongle technology enables the projection keyboard for point to multi-point connectivity with other Bluetooth devices, such as PCs, PDAs and mobile phone.
iii. How the Bluetooth projection keyboard connects to devices depends on the specific tablet, phone or computer.
iv. The connection between the USB keyboard and the device is made through a USB port which is available on every computer and (via an adapter) other devices.

5. APPLICATIONS

i. 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.
ii. Used with smart phones, PDAs, email, word processing and spreadsheet tasks.
iii. Operation theatres.
iv. Most systems can function as a virtual mouse or even as a virtual piano.

6. DISADVANTAGES

i. The users who use laser keyboards with tablets and other such devices often suffer from ergonomic issues because the device must be kept at the correct angle and the user has to be present in a proper sitting position so that he can type comfortably on the set. To some folks, these keyboards do not provide that comfort which is required for typing. Nevertheless, a majority of folks are happy with this part.
ii. Virtual keyboard is hard to get used to. Since it involves typing in thin air, it requires little practice.
iii. Not good enough for good gaming experience.
iv. It is very costly ranging from 150 to 200 dollars.

7. CONCLUSIONS

We first gave an overview of the technology. We then had a closer look at how the technology actually works. This was followed by application of virtual keyboard projection technology and its difficulties or disadvantages. Our conclusions are that while the keyboard is often regarded as an antique method that is unsuitable to modern computing devices, a number of characteristics are inherent in the way it that make it preferable over alternative methods. Input with keyboards is and will be an important user interface modality for computers for decades to come.

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