Wearable Computing Using Key glove

Balaji Gole¹, Amar banmare², Chandan Premchand Singh³

¹ Asst. Professor, Department of Electronics and Telecommunication, G.N.I.E.T. Nagpur
   balajigole@gmail.com

² Asst. Professor, Department of Electronics and Telecommunication, G.N.I.E.T. Nagpur
   amar_bamare@rediffmail.com

³ Asst. Professor, Department of Electronics and Telecommunication, G.N.I.E.T. Nagpur
   Chandang2805@gmail.com

Abstract

“At present, personal computers sit on the desk and interact with the users for only a small division of the day. Their competence for information access and data management is not fully realized for the majority of the time. Hence, a person’s computer should be bushed and interact with the user based on the context of the circumstances. With heads-up displays, unremarkable input devices, individual wireless local area networks, and a host of additional circumstance sensing and communication tools, the wearable computer should act as an intellectual assistant that could contact, process, and store information anytime and anywhere the user wants. With the trend towards portability seen in personal digital assistants it becomes necessary to look towards portable accessories that make the PDA and its successor, the wearable computer and productive instrument. Since handwriting recognition is flawed and alternative key inputs are slow and inefficient, a multitude of input devices have been developed to enhance portability, wearability/mobility and usage. A survey of all devices in development and on the market has shown that none of the existing systems has met all typical user needs. The Keyglove prototype attempts to deliver a key input device that combines the advantages of existing data entry systems, and meets the needs and requirements of all portable users”.

Keywords: Key glove, wearable.

1. INTRODUCTION

1.1 OVERVIEW

Wearable computing facilitates a synergy of physical reality and augmented reality, which enables the human to freely interact with his computer in any environment. This means that the computer is "always on" and "always ready" for the human to access. This facilitates the gathering of on the fly information within reach. With the advent of small and powerful computers, the development of wearable computing is ever more plausible.

A wearable computer then is a computer that is subsumed into the personal space of the user controlled by the user and has both operational and interactional constancy i.e. is always on and accessible. In essence, there are six attributes that fully characterize a wearable computer. First, un-monopolizing of the user’s attention in a way that doesn’t cut off the user from the outside world. It is built with the assumption that computing will be a secondary activity rather than a primary focus of attention. Second, a wearable computer should not be restricting to the user. It should be ambulatory, mobile, and roving, which means that it would allow the user to do other things while using it. Third, its output medium must be constantly perceptible or observable to the user. Fourth, the computer should be entirely controllable by the user. The controls should be responsive which would allow the user to grab control of the computer any time that he/she wishes. Fifth, it can also be attentive to the environment, being environmentally aware, multimodal, and multisensory. Ultimately, it could give the user increased situational awareness. Finally, the wearable computer should be communicative to others. A key glove is an input device for wearable computing that supports several of these attributes. Being an input device, it gives the user responsive control over the computer and at the same time, it also serves as a communications medium. Furthermore, because of its characteristic design for portability, it is not restricting to the user. It still allows the user to do other activities while entering commands to the computer through keypresses.

1.2 APPROACH TOWARD GOAL

1.2.1 STATEMENT OF PROBLEM

With heads-up displays, unobtrusive input devices, personal wireless local area networks, and a host of other context sensing and communication tools, the wearable computer should act as an intelligent assistant that could access, process, and store information anytime and anywhere the user wants.

As such, the design of an alternative and portable input device such as a key glove is a fine research for the development of wearable computing. Ideally, it should be able to incorporate all the keyboard functions into one small
input device to achieve absolute portability. Along with this, the device should not have any external power supply since this would make the design hulky. However, the ergonomics of such a design should also be considered so that the ease of its usage would not be sacrificed and convenient to use.

1.2.2 OBJECTIVE TO STUDY

- Create hardware interface that would emulate normal QWERTY keyboard operation.
- Create a software that would enhance the 16 key Keyglove into std. alphanumeric keyboard. The software would run on its own environment.

2. LITERATURE SURVEY

2.1 KEY SEGMENT

The “Key Segment” is a tiny new input device, which works with a palmtop computer. It is a high speed text input device which uses “touch-typing”. It has eighteen keys for “touch-typing” using a single hand. Two alphabetic characters per key for twelve keys and one keystrokes. While a different system of key entry may help in reducing the size of the device, many users may not feel that the effort in learning a new system is worth the portability.

2.2 KEYGLOVE

The KeyGlove, which has been designed by Melbourne (Australia) based wirejunkie.com employs a keymap which is slightly different from the Key-Glove designed by R. Paul McCarty. The Keyglove prototype uses “old keyboard” electronics with a 16 x 8 grid encoder. To facilitate the functionality of the key-layout a software program was written, which install a global hook that grabs key presses and translates them appropriately. The Key-Glove and KeyGlove use the same one-handed design but with a different arrangements of the contacts. Both having a large number of contacts with some placed in very awkward (i.e., difficult to reach) positions. The Key-Glove, originally designed by R. Paul McCarthy, acts like a standard keyboard and is designed for one hand only. The glove maps the make and break mechanism of the standard QWERTY keyboard onto the glove.

2.3 BRAILLE CHORD GLOVES

The Braille Chord Gloves use pressure sensing technology. The Braille Chord Glove uses three pressure sensors at the fingertips of a full glove. These sensors correspond to the dots in Braille which is a chorded system. It requires a working surface to provide the opposing force to the finger sensors. The gloves are connected to an embedded system that translates each chord information into its corresponding character or number. Each glove has seven keys. Three keys at the fingertips of each glove correspond to three dots in Braille, of which the number is exactly the same sequence as in a Braille keyboard. Other three keys perform the functions of pressing all three keys at the fingertips altogether, space bar or the backspace bar, and carriages return or enter, respectively. The other key at the little fingertip is reserved for future use. The gloves use polyvinylidene fluoride (PVDF) for the fingertip contacts. PVDF generates a voltage of 1V to 5V when it is deformed by pressing a fingertip on a hard surface. The output is connected to an embedded system, which can display the character or number on a LCD and also has LEDs displaying five Braille cells.

2.4 ACCELERATION SENSING GLOVE & FINGERING

The Acceleration – Sensing Glove and the Fingering use accelerometers for measuring finger motion. ASG built with accelerometers that recognize hand gestures as mouse signals. Sensor on the back of the hand moves the pointer of the mouse. Sensors on the fingertips act as mouse buttons. As with any continuous signal from an accelerometer, unintentional gestures can lead to inaccurate input. The Fingering uses rings on all five fingers to detect the typing action of the fingers, it does not attempt to measure individual keystrokes but uses the chording system. Keystrokes are read when the fingers touch a grounded surface while the body is grounded, relying on the conductivity of the human body for signal communication. Transceivers are mounted in the rings while a receiver is mounted on the wrist. While the employed chording system may decrease approximation errors, the device is still subject to the problems of air-typing and the learning requirements associated with chording. The lack of a fully enclosed glove makes the device more comfortable to wear, however, indiscrete readings lead to anomalies from random finger movement.

2.5 KITTY PROTOTYPE
The wireless design in this KITTY prototype gives the touch typist the familiarity of a QWERTY keyboard and the comfort of finger rings that do not interfere with other manual tasks. The thumb to finger contacts are easy to use and have force and tactile feedback for improved accuracy and efficiency. It is extremely portable, allowing input even while the user is walking.

2.6 LIGHTGLOVE

The Lightglove is not a glove at all, but is an innovative, wrist mounted device that uses infrared LED’s and phototransistors to sense finger motion in an “air typing” action. A key stroke is activated when the user’s fingers obstruct the LED array, but any obstruction can also be seen as a keystroke. Care must be taken not to relax the fingers into the LED array unintentionally. The user’s fingers act as reflectors that interrupt the optical plane created by sequential columns of light sources emitting below the palm of the hand. This device has the advantage order to verify a proper keystroke, a keyboard image is superimposed on the host application. Verifying the keystroke decreases input anomalies, but as with any sound recognition, may have difficulties in noisy environments. It would also create disturbances in quiet environments. The Light glove lacks tactile feedback to confirm proper key position resulting in decreased input speeds as the user adjusts for proper finger positioning.

3. WORKING

3.1 WORKING PRINCIPLE

1. Built using established and well documented component starting with Atmel’s AVR series of microcontroller the Keyglove combines conductive fabric and digital motion sensor to detect fingertip touch and both linear and rotational hand motions.
2. The main controller module translates this information into computer control signals, which are then sent to the host computer as Human Interface Device HID commands or optionally sent over wired or wireless UART port for completely customized behavior.

3. The glove uses conductive fabric for many of the touch sensors. This fabric is a thin, elastic silver-infused material that is so flexible.
4. Since no mechanical switch or buttons are involved, only a very light touch is require to trigger electrical connection, which means less physical effort is required and fewer parts are prone to wear out and require maintenance or replacement.
5. The touch sensors are mounted on the fingers and palm of the glove strategic places to allow the greatest possible number of combinations. Some of the combination, more physically difficult than others, but most are simple and all are possible.

3.2 MOTION SENSING

1. For motion sensing, the glove also has an accelerometer and gyroscope mounted on the back with the controller board. Tilt, gestures, and rotation readings from these sensors are translated individually into actions on the host device such as mouse control or 3D movement.
2. Using simple one-to-one touch combinations (connecting only two distinct sensor), there are over 60 easy possibilities. Example of such combination are the thumb tip to each of the finger tips, and the thumb tip to each middle and lower finger segment.
3. The Keyglove also support multiple simultaneous touch detection.
4. The number of possible skyrockets. There are many hundreds of unique combinations.

4. KEY COMPONENT DESCRIPTION

4.1 TEENSY++2.0 BOARD

**PROCESSOR**

![Figure 2: Pin Configuration of AT90USB1286](image)

The AT90USB64/128 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the AT90USB64/128 achieves throughputs approaching 1 MIPS per MHz allowing the system designed to optimize power consumption versus processing speed. The device is manufactured using Atmel’s high-density non-volatile memory technology. The On chip ISP Flash allows the program memory to be reprogrammed in-system through an SPI serial interface, by a conventional non-volatile memory programmer, or by an On-chip. Boot program running on the AVR core. The boot program can use any interface to download the application program in the application Flash memory.

**KEY FEATURES**

1. High Performance, Low Power AVR® 8-Bit Microcontroller.
2. Non-volatile Program and Data Memories-6/128K Bytes of InSystem Self Programmable Flash.
3. USB Full-speed/Low Speed Device Module with Interrupt on Transfer Completion.
4. Peripheral Features-
   - Two 8-bitTimer/Counters with separate Prescaler & Compare Mode.

4.2 WT12 BLUETOOTH MODULE

WT12 is a next-generation, class 2, Bluetooth 2.1 + EDR module. It introduces three times faster data rates compared to the existing Bluetooth 1.2 modules even with a lower power consumption.

![Figure 3: WT12 Bluetooth Module](image)

WT12 is a highly integrated and sophisticated Bluetooth module, containing all the necessary elements from Bluetooth radio antenna to fully implemented protocol stack consumption. WT12 is a highly integrated and sophisticated Bluetooth module, containing all the necessary elements from Bluetooth radio antenna to a fully implemented protocol stack. Therefore WT12 provides an ideal solution for developers who want to integrate Bluetooth wireless technology into their designs with limited knowledge of Bluetooth and RF technologies.

**KEY FEATURES**

1. Integrated chip antenna.
2. Enhanced Data Rates (EDR) with data throughput up to 2-3Mbps.
3. Support for Adaptive Frequency Hopping and 802.11 co-existence.
4. UART with bypass mode.
5. 8Mbits of flash memory.
6. Supported Bluetooth profiles: SPP, DUN, OBEX OPP, HFP v.1.5, DID, HID + HCI.
7. Industrial temperature range from -40°C to +85°C.

4.3 ITG3200/ADXL345 6-DOF

This is a simple breakout for the ADXL345 accelerometer and the ITG-3200 gyro. With this board, you get a full 6 degrees of freedom.

Figure 4: ITG3200/ADXL345 6-DOF breakout

The sensors communicate over I2C and one INT output pin from each sensor is broken out.

**KEY FEATURES**

1. ADXL345 accelerometer.
2. ITG-3200 gyro.
3. 3.3V input.
4. I2C interface.

**FEATURES**

1. Touch-based full keyboard input.
2. Motion-based full mouse control.
3. Gesture control for mouse and/or keyboard commands.
4. 3D spatial input for representing motion and position in a 3D environment.
5. Completely customizable touch configuration and behavior.
6. Touch-and-hold modifier key capability.
7. Shortcut key combinations (e.g. Ctrl+Alt+F1).
8. Batch entries (e.g. one touch to send full words at once).
9. Automatic application-specific profile switching based on active programs.
10. Multiple motion-based mouse control methods.
11. Rotational and linear motional detection.
14. Visual feedback (RGB LED to indicate status, mode, success/failure).
15. Wearable glove form factor.
16. Single-handed or double-handed configuration.
17. Left-handed and right-handed versions.
18. Breathable, washable glove unit.
20. Removable wireless daughter card for future upgradeability.
21. Comfortable conductive fabric touch sensors also work on touch screens.
22. Rechargeable Lithium Polymer (LiPo) battery.
23. Windows, Mac, and Linux support.
25. Standard HID protocols for simple driverless OS cross-compatibility (USB and Bluetooth).
26. Standard mini-USB connection for charging and configuration.
27. Supports most Android phones, iPhone, iPad, and PS3.

6. FUTURE SCOPE

1. **Wearable computing:** This technology hasn’t taken off yet because the optics aren’t economical enough, but it’s definitely coming! If the display was a translucent projection in glasses then computer will be in Pocket.
2. **Unique artistic creativity:** We’re used to traditional interfaces for art and music. Much the same way that recent touch based interface have allowed for a new way to create art and music using tablets, the Keyglove can provide a new way to turn your imagination into something tangible.
3. **Portability:** It will increase portability of many devices by reducing hardware requirement such as mouse & keyboard will be replaced by it.

7. APPLICATION

1. **Gaming:** If you find yourself using a custom keyboard commands to do things in the games you play, the Keyglove is the perfect device to allow the same control with much less effort and much more efficiency. Anything you can do with a keyboard can be done with a Key availability—you’ll never need to find the right position on the keyboard again, since your keyboard is fitted to your fingers!

2. **Mobile devices like Smartphone and tablets:** Some people can get by with miniaturized QWERTY hardware or on-screen keyboards—in fact, some people can use them with amazing dexterity and accuracy. Others aren't so devoted to learning the skill. The Keyglove can act as a wireless input device for most Smartphone and tablets, negating the need to use the other, sometimes difficult input options.

3. **3D spatial or VR interfacing:** Because the Keyglove has motion 3D control is necessary or helpful. This may include CAD software or other modeling navigation and basic telepresence remote control.

4. **Specialized device control in extreme or industrial situations:** The Keyglove can be a simple, no-eyes-required input device that is easy to keep track of (since you'd be wearing it!) and hard to lose, perfect for high activity or dangerous areas where a regular keyboard and mouse wouldn't survive intact for long.

5. **Handicapped, disabled, or limited-mobility users:** Some people only have the use of one of their hands, or they can't manage the motions necessary for typing on a regular keyboard or using a regular mouse. The Keyglove's design is such that it can overcome many of these problems and give some computer control backup to people who have lost it.

8. CONCLUSION

1. From the study of wearable computing device, the implementation of such a wireless computing device is quite difficult, but in prototype stage it is somewhat successful.
2. It has been proved a boon for challenged or handicapped person. Also it increases the working efficiency of person.
3. Since, it uses sensor for tilt, gestures, and rotation readings which is translated individually or collectively into actions on the host device such as mouse control or 3D movement. Hence it gives flexibility to user.
4. The wireless KITTY prototype attempt to create simple and easy to use design that is highly portable.
5. The use of contacts fitted to a QWERTY layout gives the typical touch typist a familiar typing environment for easy transition.

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AUTHOR

Mr Bala Ji Gole working as Asst. Professor at Guru Nanak College of Engg. & Tech. Nagpur. He has completed his Bachelor of Engineering from B.D.C.O.E. Sewagram, Wardha in 2001.


Mr Chandan Premchand Singh working as Asst. Professor in Guru Nanak College of Engg., Nagpur. He has completed his M Tech from Technocrat Institute of Technology, Bhopal in 2013 and Bachelor of Engineering from Rajiv Gandhi College of Engg, Nagpur in 2008.