DATA GLOVE FOR NOTE-TAKING

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Abstract

We aim at creating a note-taking device typically to be used in a classroom environment. Traditional methods of writing have limited speed and cannot keep up with speech. Writing with pen on paper requires us to look at the paper, which can reduce concentration on the ongoing discussion. Laptops are costly, power consuming and heavy for such a trivial task. Voice to text programs don't have the freedom of choosing the text to be included, and noise in the room can affect performance of such a program. Smart phones have a small keypad, which demands more user concentration. We have created a glove that one can wear and touch-type on any flat surface with minimal costs and power consumption. With ergonomics in mind, the glove has been designed to yield ten self fabricated switch button sensors to finally create a complete utility for simple and an inexpensive typing tool.

Keywords: Interaction, Gloves, Gesture Control, Input device

1. Introduction

Touch typing is widely used in the form of QWERTY system of typing. Generally, people type using a fixed set of keys assigned to be pressed by a particular finger. Now after some experience, all those who use these techniques tend to type without looking at the screen. This is the basis for the success of our idea. The fact that the people can type without looking at the keyboard works to our benefit by allowing us to eliminate the costly interfaces like laptops or touch screens used for touch typing.

With this simple yet extremely useful premises, we have developed a cheap and power efficient touch typing glove which can help ease fast note taking. Apart from this, the text the user intends to type will be saved on the glove, which can either be streamed to host device while the user is typing or transfer the text once the task is done. These gloves are not to be used as a replacement for a standard keyboard, as only a subset of all the keys on the keyboard will be included on the glove.

2. Description

The glove consists of 26 switch buttons and 6 bend sensors, ATMEL89C51 microcontroller, 2 16:1 multiplexers (74150), one for each hand.

2.1. Observation

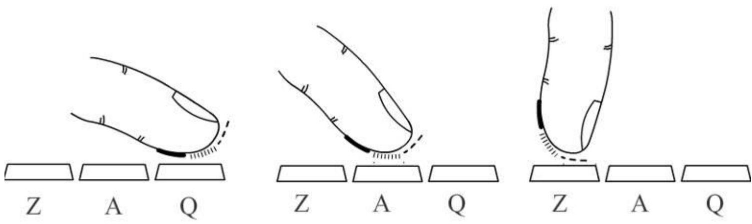


Figure 1. Contact Points

The designing of the glove was derived from the observation of the points of contact between the fingertips and the keyboard. The entire working of the glove is based on the assumption that the user will be operating the gloves with the accepted methods of touch-typing. It was observed that the keyboard touches the fingers in three distinct positions on the fingertip.

2.2. Design

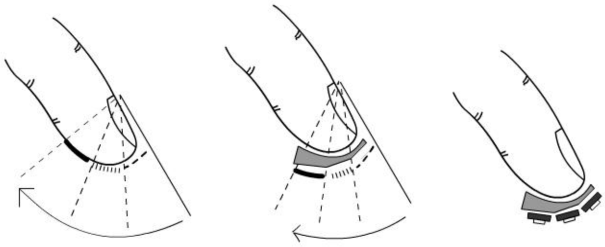


Figure 2.Fingertip Design

These positions for all the fingertips of the hands with respect to the keys on the keyboard were noted. Switch buttons were attached to these potions. A wedge was inserted between the finger and the buttons to reduce strain on the joints and to make the device ergonomically sound. The aim was that when the user taps a finger on any flat surface, with the familiar sense of position of a keyboard, the corresponding key will be registered by the device.

2.3. Switch buttons on glove

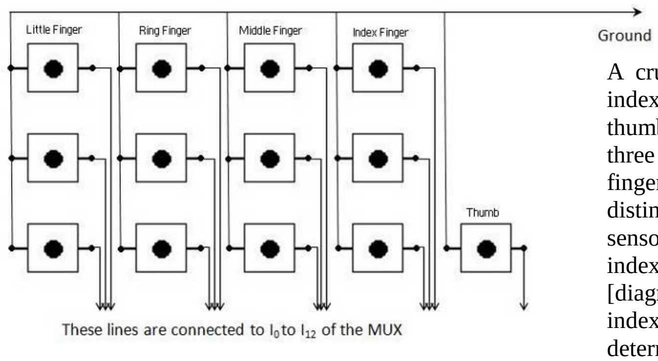
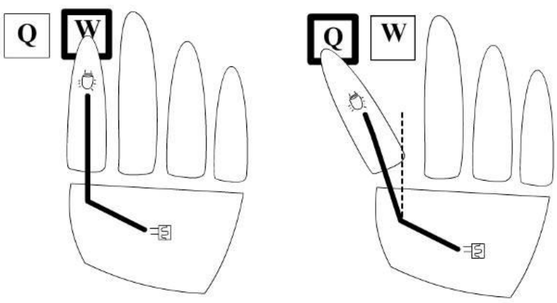


Figure 3. Block diagram of switches

Figure (5) shows a switch block. There are 2 such blocks (one on each glove). Each of these blocks consists of 13 switches. Three switches on each of the four fingers and one switch on the thumb. These switches when pressed connect the respective multiplexer input pin to ground.

This is detected by the microcontroller while it polls the select lines of the multiplexer.

2.4. Bend sensor



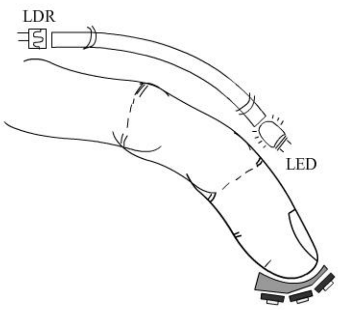


Figure 4.Bend sensor

A crucial point was designing the working for the index finger of the glove. All the fingers, except the thumb, had three switch buttons and corresponding three keys to be registered. But in the case of index fingers, there were three buttons and six keys (six distinct positions) that needed to be marked. A bend sensor was created to be put at the knuckle of the index finger.

[diagram] The bend sensor notes the deviation of the index finger with respect to the middle finger to determine which three of the six keys. The exact switch that is pressed determines which key of the three keys to register.

Each glove consists of 1 tube sensor. This is used to distinguish between the 6 keys which the index finger would type. 5 V is provided to one of the LDR pin via a 10K resistance and an output from the same line is taken. The other LDR pin is grounded. Now the output line provides with a range of Analog values which depends upon the intensity of light reaching the LDR. To determine the deviation of the index finger, we carry out thresh-holding in order to convert this Analog signal to a distinct 0 or 1. This is done by using Transistor and switch. Potentiometer is connected to the collector such that voltage swings around threshold voltage. This results in logic 0 and 1.This helps us differentiate between keys (R, F,V) and keys (T, G, B) in case of left hand and keys (Y, H, N) and (U, J, M) in case of right hand.

2.5. Multiplexer

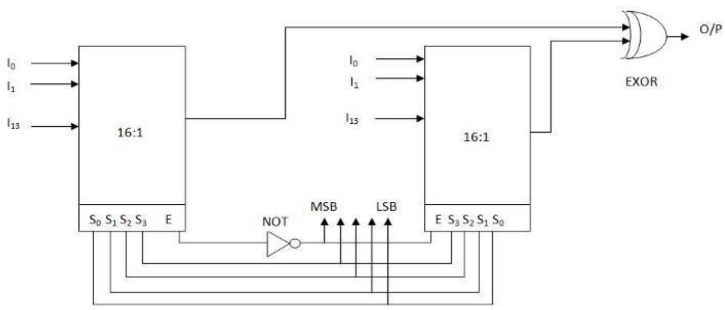


Figure 5. Multiplexing System

The multiplexer block consists of two 16:1 multiplexers. The multiplexers are integrated together and are used as a 32:1 multiplexer as shown in fig(5).This is done by using a NOT gate at the Enable lines (E) which is then pulled out as a select line. OR-ing the outputs from both the multiplexers gives us the final output which is then given to the microcontroller. The multiplexer hence produces 5 select lines for input select. The microcontroller continuously polls values from 0(binary 00000) to 31 (binary 11111) at the select lines. As soon as a high output from the multiplexer is detected, the respective count is stored by the microcontroller. Each count within the controller signifies a particular alphabet. This alphabet is then displayed on the LCD.

2.6. Glove synchronisation

Synchronisation between the two gloves is imperative to get meaningful data. Since the display is connected to only one glove, we need to get the text in the exact same order it is indented to be. For prototyping purposes the two gloves were connected by wires. For simplicity reasons all the modules are placed on one glove and the other is connected to it. In future, IR or RF module can be easily implemented between the two fingers for wireless synchronisation.

2.7. Display

Visual Feedback while using the device is crucial as there is no visual prompt for keys. It is required to check the word currently typed for spell check or other grammatical considerations. For these reasons, a display is attached to the right hand glove. This display is continuously updated with the real-time data connected from the two synchronised gloves. Experimentally, the size of the screen is just enough to display a word.

2.8. External connectivity and storage

External memory card is used to store text data. This card can be inserted in other devices which support it. RS232 is the port on the computer on which the device can be directly connected. In that case the text will be saved directly on the computer.

3. Block Diagram

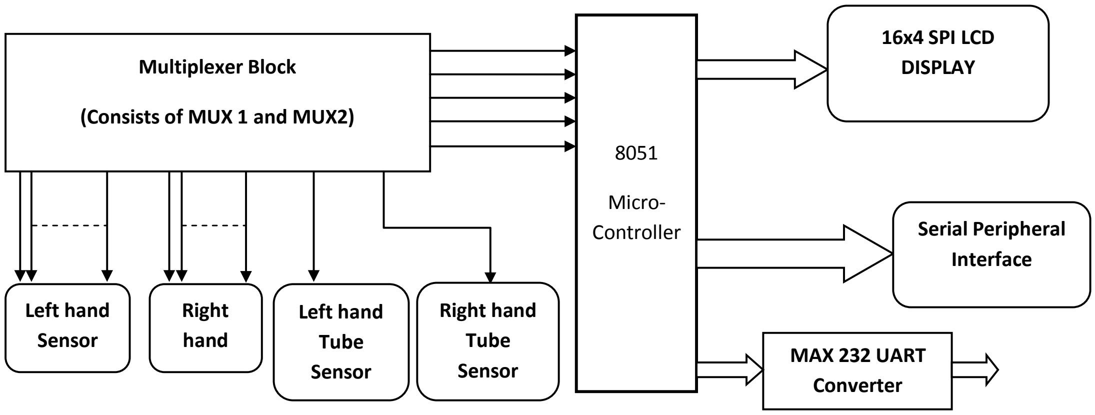


Figure 6.Block diagram of system

Multiplexer block: Consists of two 16:1 digital multiplexers (IC 74LS150), one for each hand.

The input lines are used as follows:

Block	Number of lines
Left Hand Switch Block	13 lines (I_0-I_{12} MUX-1)
Right Hand Switch Block	13 lines (I_0-I_{12} MUX-2)
Left Hand Tubes Sensor	1 line (I_{13} MUX-1)
Right Hand Tube Sensor	1 line (I_{13} MUX-2)

Switch Block: There are two switch blocks namely-Left hand switch block and Right hand switch block (identical to fig 3). These switches are interfaced to the multiplexer inputs. When no switch is pressed the multiplexer pin is considered as logic high. A logic low on any of the multiplexer pins is detected by the microcontroller.

Tube Sensor: There is one tube sensor in either hand along the index finger. The analog output is converted into distinct logic 0 or 1 by thresh-holding. This is given to the multiplexer.

89C51: This is a 8-bit microcontroller which picks up input from the switches and the tube sensor (via multiplexer), decodes it, and displays it on the screen. It also stores the data in the external memory. It is extremely reliable and efficient to code on 89C51

MAX 232: This IC is used to convert TTL level into UART level for interaction between computer and the glove.
16x4 SPI LCD Display: The SPI interface helps reduce the data lines from the microcontroller to the LCD. The screen is large enough and ensures easy editing.
Serial Peripheral Interface & SD card slot: This is used to store the data in SD card which is a non-volatile memory. Hence even if the power to the glove is disrupted, no data will be corrupted. This is because all the data while being displayed is also getting updated in real time in the SD card. For communication purpose SPI is used which is a basic 4 wire connection and is easy to implement and code.

4. Performance Experiments

The switch buttons are placed in a manner that no two buttons can be pressed at once. The accuracy in using the device is almost the same as that of a keyboard. User experience was satisfactory when tested with a sample of people who were adept at touch-typing.

The total cost of the device is 300INR. This makes it the cheapest option for note-taking in the market. The device can run on 9V battery for 200hours. The form factor of the device is also small and its light weight makes it a portable device.

5. Conclusions

This paper presents an alternative to note-taking lectronically, by making use of touch-typing methods. We create a piece of wearable technology that will facilitate rapid note-taking. Not only it overcomes the difficulties in the traditional methods, but also provides an affordable alternative to existing electronic devices. We hope this evolves into a ubiquities input device.

6. Future Work

A combination of the tube sensors with the switches can be used for gesture control in video games and multimedia. For example in an action based game, the circular motion of the middle finger and the index finger can signify running motion of the game character. This will be implemented with the help of two bend sensors on two fingers. For applications in multimedia it can be used to control a slideshow presentation or the tone, pitch or volume of music being edited.

The glove fabrication can be made seamless. Conductive fabric can be used in place of the switch buttons. The components can be further miniaturised to improve the design of the glove.

Display options can be further explored by connecting the device with smart phones and tablets. The device can be integrated with existing applications on the smart phones to act as the input device.

Word prompt can be implemented to further speed up the performance of the device. A list of active words can be stored and prompted while the device is in use. This will also cut down human errors in typing.

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