

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ



**Palestine Polytechnic University**

**Graduation Project**

**KeyGlove**

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Computer Engineering**

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## Abstract

Keyglove is a portable, wearable input device which be designed to control the mouse, switch between applications, enter text data, it will reduce using the traditional keyboard, so this device can reduce the computer size.

The Keyglove is an open-source that uses touch combinations (for keys) to generate keyboard using only one hand. Each finger in the glove have many push button switches, which represent a particular command, the Mega microcontroller (is a complete USB-based microcontroller development system) translate it and will send to computer via Bluetooth to print the text in computer screen.

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## Acknowledgements

We would like to thank our family and friends for their continuous support to us in all aspects and to stand by us in following up the work of the project, people should not retreat or despair. Perhaps it is close to success, patience is the first step in success.

Do not forget the efforts of Dr. Elayan Abu Gharbyeh to follow up the project and the time spent with us, for the success of the project and we would like to thank the Eng. Wael Al-Takrouri for valuable information he has given us and help us with the project.

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# Chapter 1: Introduction

---

**1.1 Overview**

**1.2 Motivation**

**1.3 Project Objectives**

**1.4 General description of the project**

**1.5 List of Requirement**

**1.6 Expected Result**

**1.7 Problem Statement**

**1.8 Limitations**

**1.9 Literature Review**

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# Chapter 1: Introduction

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## 1.1 Overview

Recent years have seen a growth in the computer based system which can work independently, and most of the daily jobs become dependent on computers, so we have an interaction between humans and computers, wearable devices developed to improve that, fill the gap between humans and the system they interact with.

Wearable devices work to spread technology by linking it to our daily lives, it is an important point in medical applications, it used by people with physical disabilities used to improve lifestyle.

The aim of the project is to design a glove that user can wear by his hand ,enter the characters without touching the keyboard. The user can enter the English characters on the screen.

This chapter demonstrates a general idea about the project, its objective, motivation, list of requirement, expected result, problem statement and challenges.

## 1.2 Motivation

One of the most important motivations for the project is that it does not need to coordinate the look between the eye and the keyboard. Only once the person saves(in brain) the characters places on the glove he can print quickly without having to look at the characters, also when writing on the keyboard, the hands are in a state of discomfort either when writing with one hand, the hand is in a normal and comfortable condition, also using a single finger to print or type will reduce the stress that occurs using most fingers when printing.

These achieve several points:

1. Print characters has become easier and simpler.
2. The method of inserting texts into the computer has become easier because of the daily exercise of the method of inserting texts for smart phones using one hand.



3. To help deaf and disable people to use computer.
4. Using computer without touching.
5. Incorporate and perform many of keyboard function using a small input device.

### 1.3 Project Objectives

The main objective of our project is to design a keyboard that are controlled wirelessly by human hand that wear a glove at which electronic parts are attached.

To achieve this objective many sub objectives are to be done:

1. Read data by Mega microcontroller.
2. Apply Bluetooth technology to transfer data wirelessly.
3. Build software at the PC side to control the keyboard operations.

### 1.4 General description of the project

In this project we'll design a glove which use a Microcontroller that reads the letters and symbols that are entered using simple push button switches combinations, fixed on hand and send this data wirelessly to the PC. a microcontroller allows a great deal of feature customization which would be impossible without it, it ties together all of the switches inputs and control output to the connected PC.

The fingers covered all the letters of the English language, distributed over the four fingers (Pinky and ring finger each carry six letters, Central and index finger each carry seven letters), in addition of many symbols such as space as shown in the picture below.

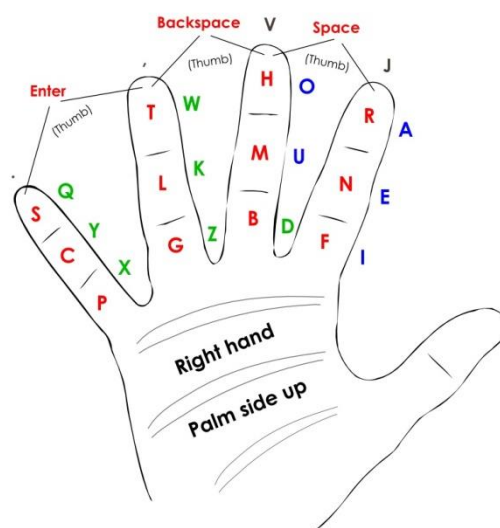
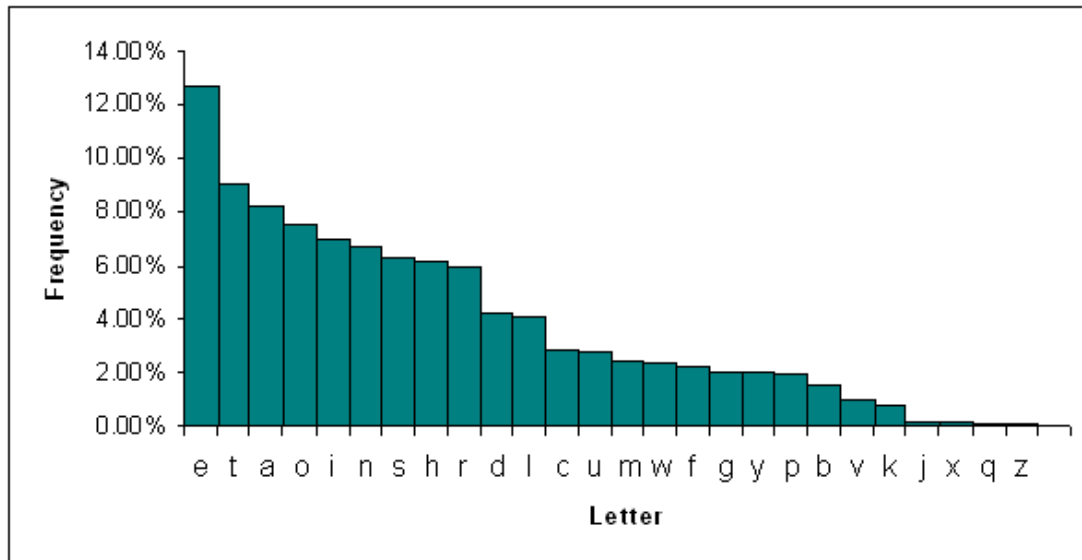


Figure 1.1: Distribution letters on Glove



**Figure 1.2: Distribution letters on English Language**

The letters are shown generated by touching those switches with the tip of the thumb.

Push buttons that take the value Per keystroke, and send it to the microcontroller, It should be programmed to process these switches value and transmit it wirelessly by Bluetooth technology to a receiver which is cabled to computer then reads received data and doing operations which still allows the user to do other activities while entering commands to the computer through keypresses.

## 1.5 List of Requirement

We can summarize our project requirement as:

1. Use the Microcontroller to read the letters and connect output. We use Mega(Arduino) as a microcontroller.
2. Also we use Bluetooth to communicate wirelessly between microcontroller with PC and glove.
3. In addition of software program for Arduino.

## 1.6 Expected Result

We expect to accomplish the following at the end of the project:

1. keyglove will be built with its final form of simplicity to accomplish our needs.
2. Print the English characters on the PC as soon as you press the thumb on the corresponding switches of the letter with the other fingers.

3. Build the Bluetooth interface with Mega microcontroller.

## 1.7 Problem Statement

At present, computers have become much more sophisticated than previously, and there is a need to wear the computer based on the context of the situation, through the advanced display screens and various input devices and a set of switches where this wearable device is a smart assistant that stores the control of operations and store and retrieve them easier than before.

Such as the design of the glove, which is a new research to develop wearable computing.

## 1.8 Limitations

We forced many challenges in our project:

1. Finding the appropriate switches from fingers to read the keystrokes.
2. Experience the best way to connect the devices via Bluetooth.
3. Errors during connection because the glove have a lot numbers of wires, which use to cover all English letters and space.

## 1.9 Literature Review

1. Piano Glove: Dania Jabareen, June-2015, Dr.Mousa Farajallah

The idea of the project came from a project that was done within the university, which is a project that enables you to play the piano by using the glove, without touching the piano, each fingertip represent a different music note, each finger has a small magnets, and each one has a Hall Effect sensor that take the value of the magnetic field in order to send it to microcontroller, then sensor values are processed and translated to the speaker and to the Bluetooth to play the sound of each specified note.

This project is based on the use of the glove to replace the piano and our project is based on using the glove to do the work of the keyboard in addition to the work of the mouse.

2. Mouse Glove: Mu'tasem Alheeh, Khalid A.K Daud, Yasser Abu Zneid, June-2008, Dr. Amal Al-Dweik.

The aim of this project is to design a wearable mouse, which user can wear by his hand and perform as a mouse wirelessly. User can move mouse, click, scroll, and do other operations that can be done by mouse. By using this system user can perform mouse operations without restricting cable, and without needing a platform to move mouse on it.

By a wearable glove that user can wear; on which sensors are attached, sensors readings are read by a PIC; then transmitted wirelessly using a Bluetooth to the PC. When data reaches the PC it will be analyzed to control mouse.

The glove is currently available, but it is expensive and under development, it is connected to the computer screen via USB connection.

In our project we will connect the glove with the computer screen using Bluetooth technology and the lowest prices for the tools we will use it.

# Chapter 2: Theoretical Background and Project Components

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## **2.1 Overview**

## **2.2 Theoretical Background**

## **2.3 Hardware Components of the System**

## **2.4 Software Components of the System**

## **2.5 Design Specification and Constraints**

## **2.6 Constraints**

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## Chapter 2: Theoretical Background and Project Components

---

### 2.1 Overview

This chapter will include the theoretical background of the project, and some description of hardware and software components used in the system.

### 2.2 Theoretical Background

In the use of computing devices there are several devices, including the keyboard, which usually have a particular shape, for example the keyboard which is an input device is rectangular and flat shape and takes space near the computer screen, it connected to the CPU of the device by wire or wirelessly, this often requires space beside the device and the installation process requires effort. Instead, some computing devices have become smaller and perform one or more different input devices as well as not connect to the device with a certain wire such as a glove.

The glove is used as a wearable insertion device and is an alternative to the use of the keyboard and usually uses finger touch switches.

The origin of the idea came from the project of the music glove, which is based on shortening the work of the piano and the integration and put it with a miniature application can be worn. Our project will use the idea of glove for different purposes and objectives, which include English letters and some characters are the function of inserting characters which is a basic part of the function of the keyboard.

Microcontroller is a small computer on a single integrated circuit. In modern terminology, it is a system on a chip. It contains one or more CPUs (processor cores) along with memory and programmable input/output peripherals. Keyglove is very important problems in microcontroller technology, microcontroller used to power the Keyglove, also it translates fingertip touches into computer control signals, which are then sent to the host computer as standardized HID commands or optionally sent over wired or wireless serial port for completely customized behavior<sup>[2]</sup>

Another important technology is a Bluetooth technology which is a combination of hardware and software technology, running on a hardware radio chip and utilizing software to provide the main control and security protocols. The movement towards Bluetooth is rapidly rising and the low cost and efficiency is a clear indication of the unlimited possibilities of Bluetooth. In our project Bluetooth is used to connection with Mega microcontroller to send and reserved data (letters and symbols ) between them.

## 2.3 Hardware Components of the System

### 2.3.1 Mega Arduino

The Arduino mega is a microcontroller which has 54 digital input/output pins (of which 14 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a 128KB flash memory for storing code, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply, we can power it with AC-to-DC adapter or battery to get it started. It is used in this project because of its capability to handle more than one switches. In addition, it has 2 hardware serial channel so we can use one of its serials hardware to connect the Bluetooth module.

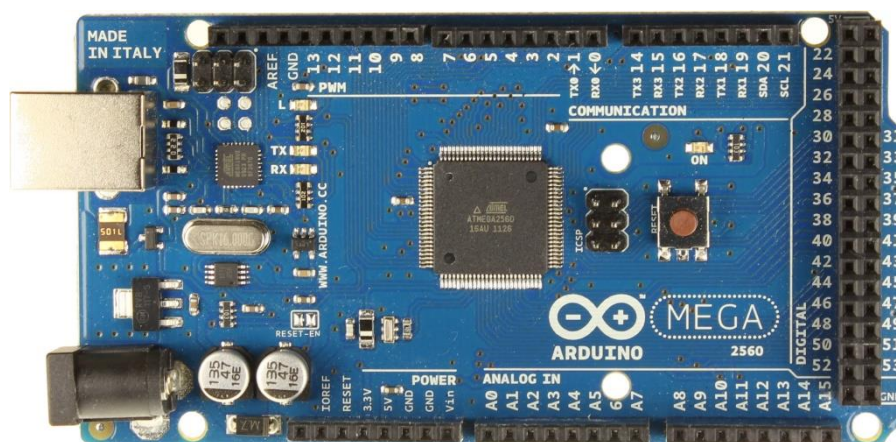


Figure 2.1: Mega Arduino

### 2.3.2 900 mAh LiPo battery

Lithium polymer batteries are the type of rechargeable battery, very slim, extremely light weight batteries, it has a standard voltage of 3.7V, Capacity indicates how much power the battery pack can hold.

We use it because it has excellent long-term self-discharge rates and Robust power source under extreme conditions.

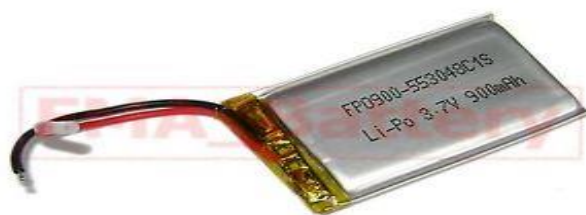


Figure 2.2: 900 mAh LiPo battery

### 2.3.3 LiPo battery charger

Batteries lithium polymer batteries have several cells that have a very specific voltage range so, we need to use a LiPo compatible charger. then it used in our project to charge the LiPo battery.

### 2.3.4 Cotton handbell glove

We need a Cotton handbell glove to put the conductive fabric and switches in it and also connected the wires with Mega Arduino above it, also we need it made from cotton that mean a dielectric material that does not contact the wires attached to the glove.

### 2.3.5 Hookup wire

It is a single insulated conductor wire in the family of lead wire<sup>[6]</sup>, it have color-coded insulation for easy circuit identification<sup>[7]</sup>, it used for low voltage, low current application, and internal wiring of computers, electronic equipment.





Figure 2.3: Wiers

### 2.3.6 Mini USB cable

This standard USB 5-pin Mini-B cable is needed to connect the Mega to your PC .



Figure 2.4:USB cable

### 2.3.7 Bluetooth Module HC-06

Bluetooth module provide a simply way to communicate wirelessly between microcontroller with PC and glove, it can be used with any microcontroller, It uses the USRT(Universal Asynchronous Receiver/ Transmitter) protocol to make it easy to send and receive data wirelessly, and it easy to connect .

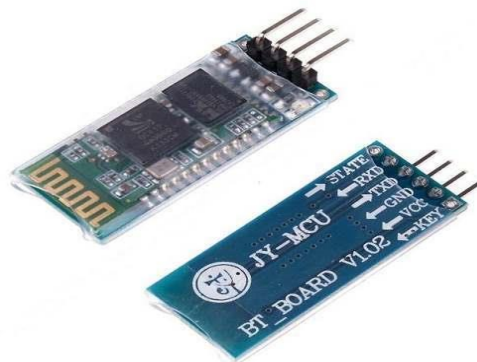


Figure 2.5: Bluetooth Module HC-06

### 2.3.8 Push-Button

A push-button (also spelled pushbutton): or simply button is a simple switch mechanism for controlling some aspect of a machine or a process. Buttons are typically made out of hard material, usually plastic or metal. The surface is usually flat or shaped to accommodate the human finger or hand, so as to be easily depressed or pushed. Buttons are most often biased switches, although many un-biased buttons (due to their physical nature) still require a spring to return to their un-pushed state.

We uses push button in our project to represent a character(each push button to represent single characters), to send the data to microcontroller.



Figure 2.6: Push Buttons

### 2.3.9 Resistor

A resistor is a passive two-terminal electrical component that implements electrical resistance as a circuit element. In electronic circuits, resistors are used to reduce current flow, adjust signal levels, to divide voltages, bias active elements, and terminate transmission lines, among other uses.



Figure 2.7:Resistors

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## 2.4 Software Components of the System

### 2.4.1 Arduino IDE

The Arduino Integrated Development Environment or Arduino Software (IDE) It is an open source, contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuine hardware to upload programs and communicate with them. It runs on Windows, Mac OS X, and Linux, written in the java programming language, also we need it to write the Bluetooth code .

Programs written using Arduino Software (IDE) are called **sketches**. The main Keyglove sketch file uses the new .ino extension instead of the older .pde extension<sup>[9]</sup>.

### 2.4.2 Arduino Software

Integrative developmental environment for writing software for the Arduino, we chosen Arduino IDE program; because it is much easier to deal with, and it has stronger abilities to deal with various electronic parts and software.

### 2.4.3 Tera Term Software

Tera Term (rarely TeraTerm) is an open-source, free, software implemented, terminal emulator (communications) program. It emulates different types of computer terminals, from DEC VT100 to DEC VT382. It supports telnet, SSH 1 & 2 and serial port connections. It also has a built-in macro scripting language and a few other useful plugins.

## 2.5 Design Specification

### 2.5.1 Design Specification

The keyglove should be built in a simple form and must be ready to receive instructions from Arduino to start printing the letters.

## 2.6 Constraints

- A. The keyglove should be comfortable and accurate with specific measurements in order to print without mistakes at the same time as the users entering a letters.
  
- B. The Mega microcontroller must be used because it does not used additional circuit like Arduino Uno.

# Chapter 3: System Design

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## **3.1 Overview**

## **3.2 Brief Description of the System**

## **3.3 Design Option**

## **3.4 System Diagrams**

## **3.5 Conclusion**

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## Chapter 3: System Design

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### 3.1 Overview

This chapter discusses the design option of hardware and software, and conceptual design of the system such as block diagram of the hardware component of the system.

### 3.2 Brief Description of the System

Our glove will be designed to be able to do operations in computer that have Bluetooth, if computer does not have a Bluetooth, the glove can be connected by a USB cable.

When you press one of the switches on the glove, the desired character is written on computer screen, and then when the hand is tilted to the right.

### 3.3 Design Option

#### 3.3.1 Hardware Design

As we mention, the system consists of the Bluetooth module, Mega Arduino. We will discuss each one next.

##### 3.3.1.1 Bluetooth Module

We use HC-06 Bluetooth

- Advantages:
  - Low cost , you can find these module for about \$6 on eBay.
  - Usage of the module is very simple.
  - More secure than wireless connection.
  - Can easily connect it to any pins on the Arduino board.
- Disadvantages:
  - Limited range(10m to 30m).
  - It can only connect two devices at once.

##### 3.3.1.2 Microcontroller

We use Mega Arduino Microcontroller.

- Advantages:

- 
- Has many more digital and analog pins.
  - Memory size is larger.
  - Easy to use.
  - Disadvantages:
    - Higher cost.

### 2.3.2 Software Design

We use one programming software for programming the Arduino as described below:

Arduino Software: The open-source Arduino Software (IDE) makes it easy to write codes and upload them to the board. It runs on Windows. The environment is written in java and based on processing and other open-source software. It will be used to write codes for driving the component of the kit to be able to function.

The reason for choosing Arduino IDE program; it is much easier to deal with, and have many libraries built in to deal with it.

## 3.4 System Diagrams

### 3.4.1 System Diagram

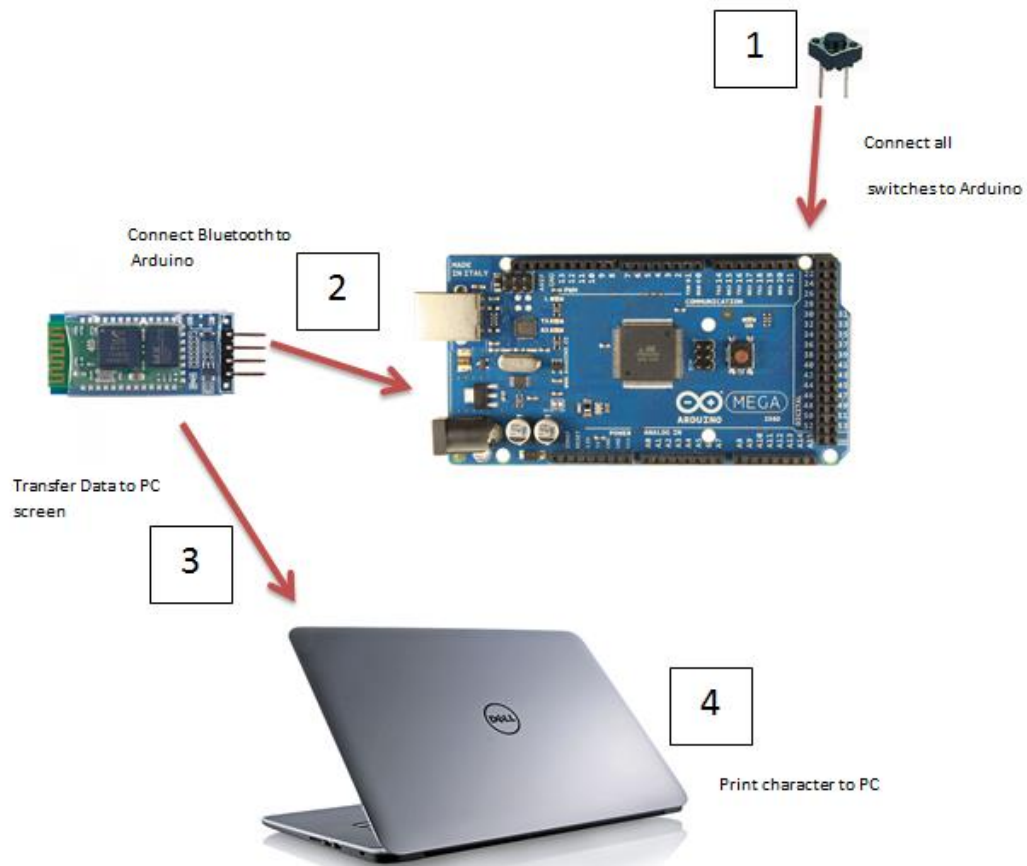


Figure 3.1: System Diagram

### 3.4.2 Block Diagram

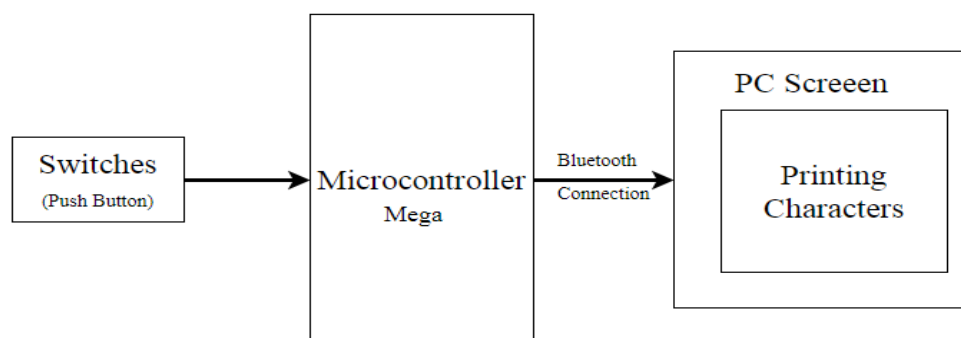


Figure 3.2: Block Diagram



Block diagram in Figure 3.2 shows how The reading switches will be transformed to Arduino in form of data via Bluetooth. The Arduino should receive data and send signals to the PC to printing data. This is done by press the switches to write the characters.

### 3.4.3 System Flowchart

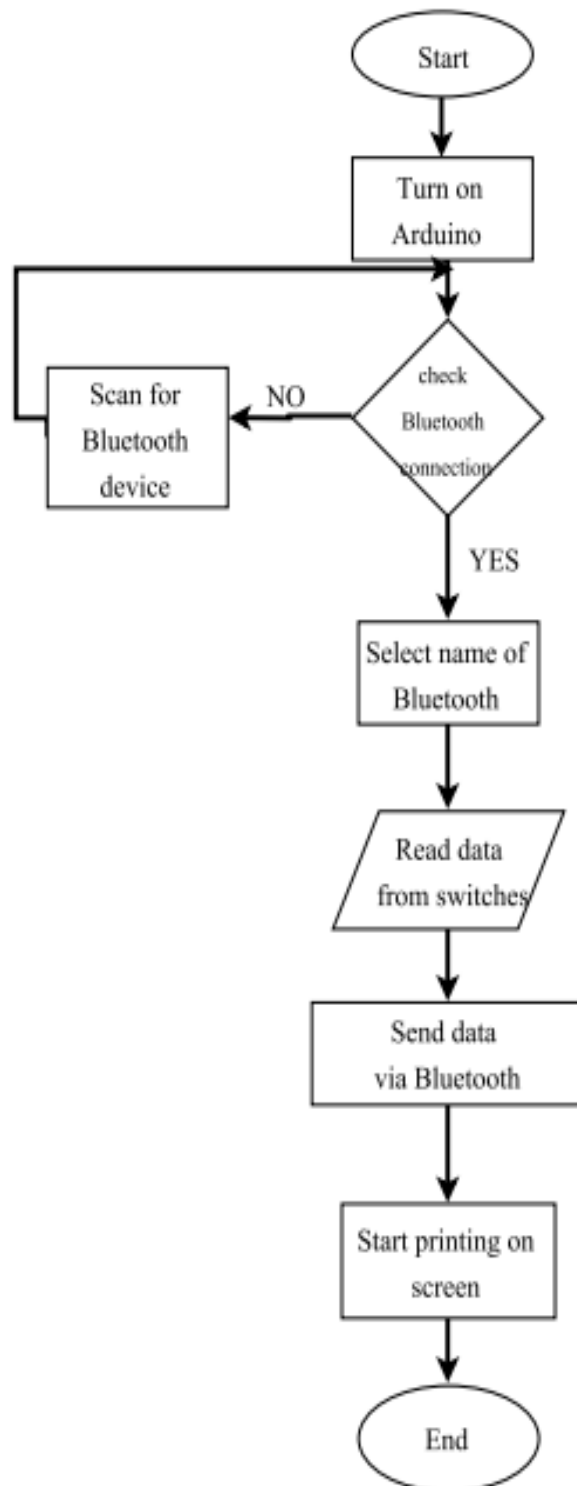


Figure 3.3: System Flowchart

#### Flow Chart Description:

1. Turn power the Arduino.
2. Check the Bluetooth connection: if Bluetooth devise enable, connect with name of the device available to start transfer data. If not enable, scan for Bluetooth device.
3. Start read data from switches that connect to the Arduino.
4. Send data via Bluetooth to PC screen.
5. Print data on the screen laptop.

### **3.5 Conclusion**

The main purpose of this project was to build a glove using Arduino (Hardware, Software), that will assist the users to entry characters in an easy and simple via Bluetooth.

# Chapter 4: Software and Hardware Implementation

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## 4.1 Overview

## 4.2 Software Implementation tools

## 4.3 Hardware Implementation

## 4.4 Software Implementation

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## Chapter 4: Software and Hardware Implementation

---

### 4.1 Overview

In this chapter we will describe all software and hardware components that we have used in our project, the IDEs that have been used write the Arduino code.

### 4.2 Software Implementation tools

We used Arduino IDE in our project , as we mentioned in chapter 2 section 4.

#### 4.2.1 Programming language

The Arduino has its own IDE where you write the program . C++ code is just used as a partial interface between humans and the Microcontroller to instruct the Microcontroller so as to perform a particular operation.

After the code is written, it is compiled. Compiling is basically converting the code written in English words into a hex file which is a series of 1's and 0's. The Microcontroller only understands binary language and hence the compilation process is required.

So, the code is implemented using C++ and is executed by a hex code.

### 4.3 Hardware Implementation

#### 4.3.1 Arduino mega with Bluetooth HC-06

We connect Arduino with Bluetooth to receive the data. Figure 4.1.a show how to connect Arduino mega with Bluetooth.

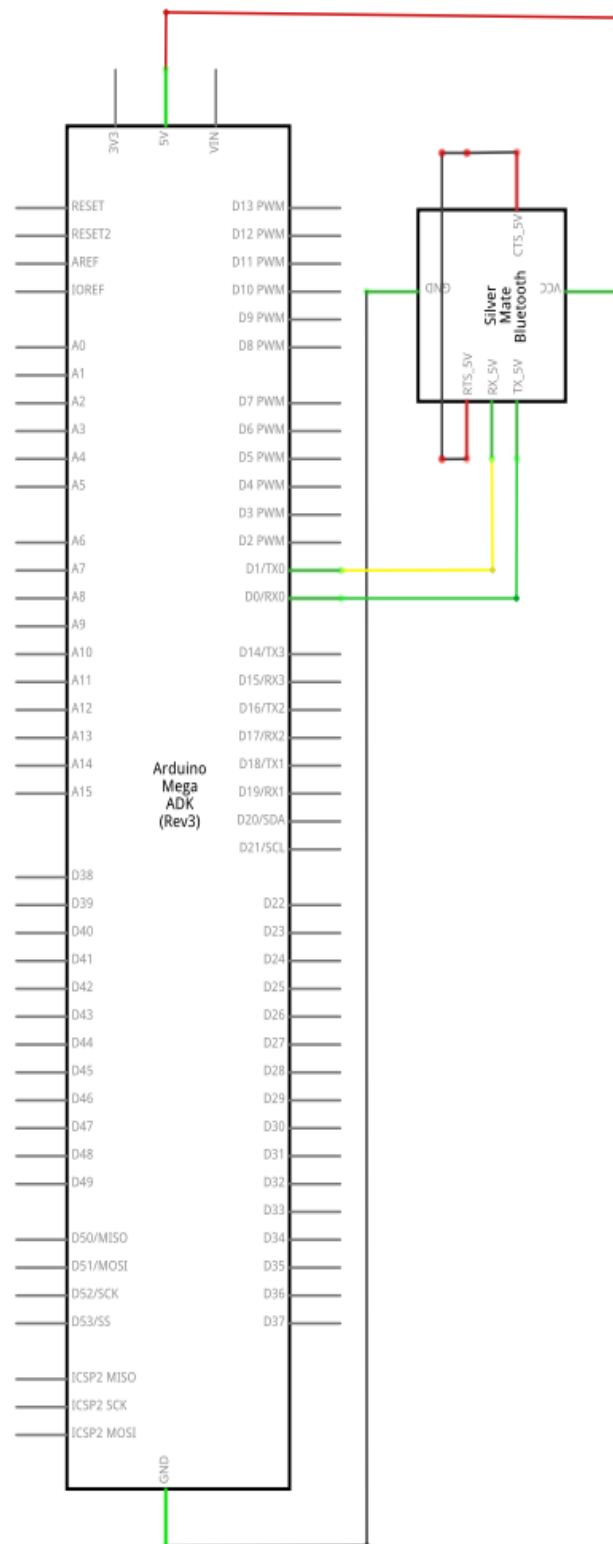


Figure 4.1.a: Bluetooth connection

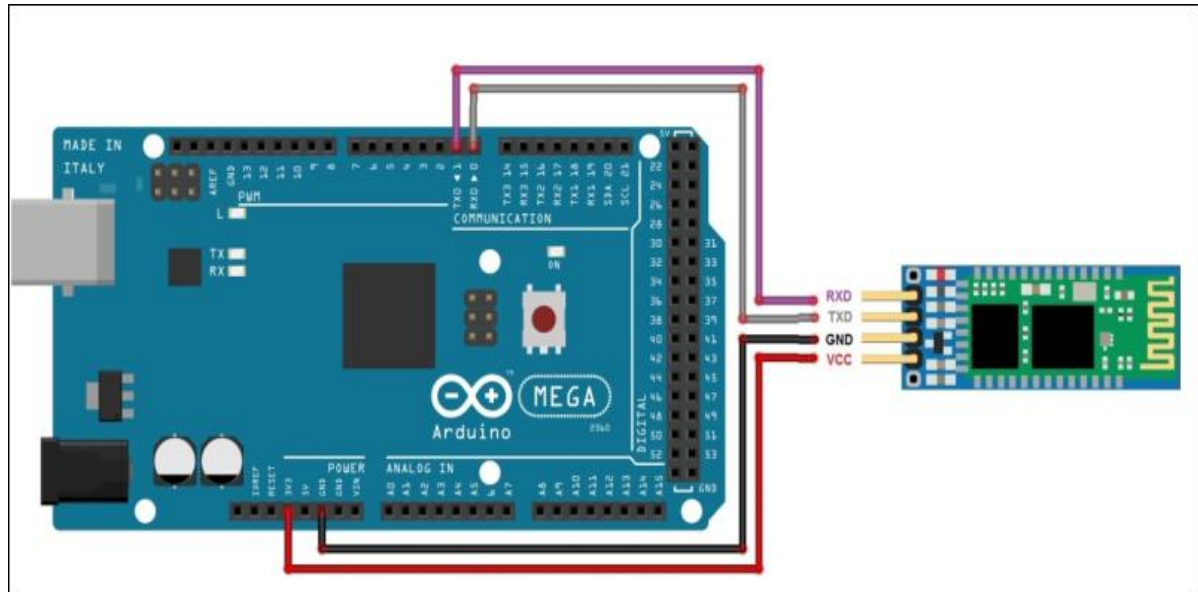


Figure 4.1.b: Bluetooth connection

### 4.3.2 Arduino mega with push button switches and resistors

We connect each push button switch with resistor to microcontroller, using the switches to send the data to microcontroller, resistor are used to reduce current flow. Figure 4.2.a show how to connect Arduino Mega push button switches.

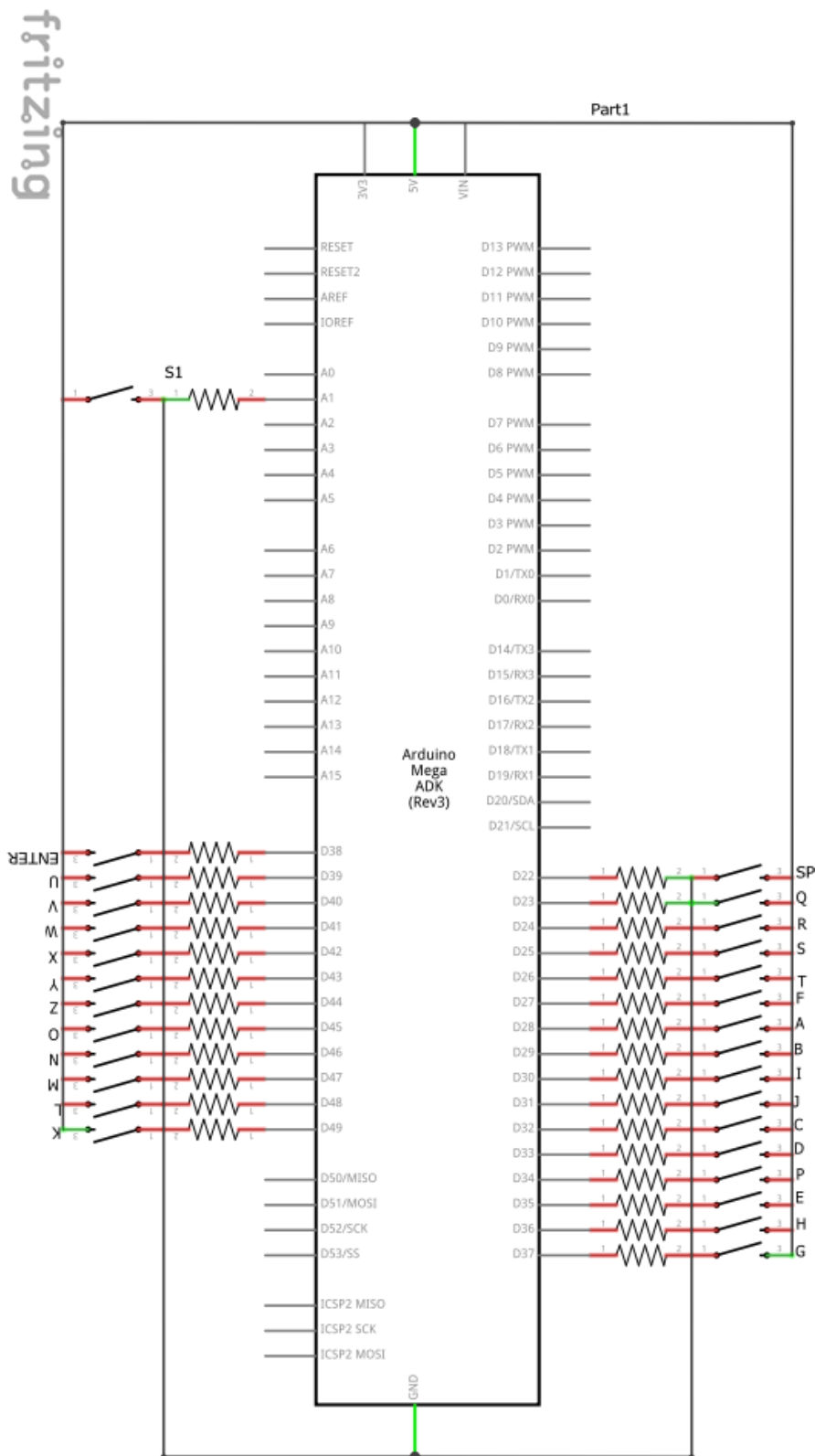


Figure 4.2.a: switches connection



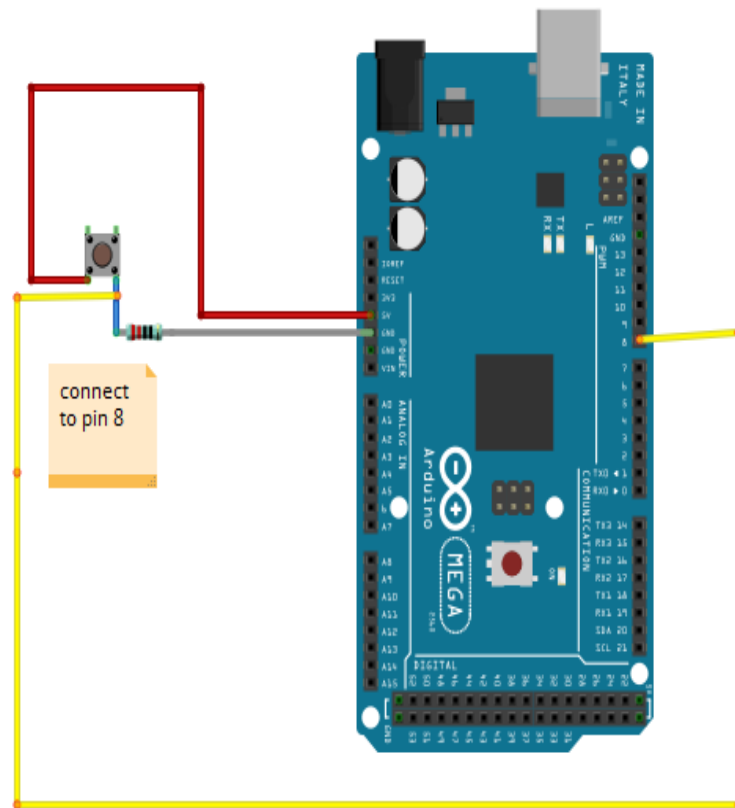
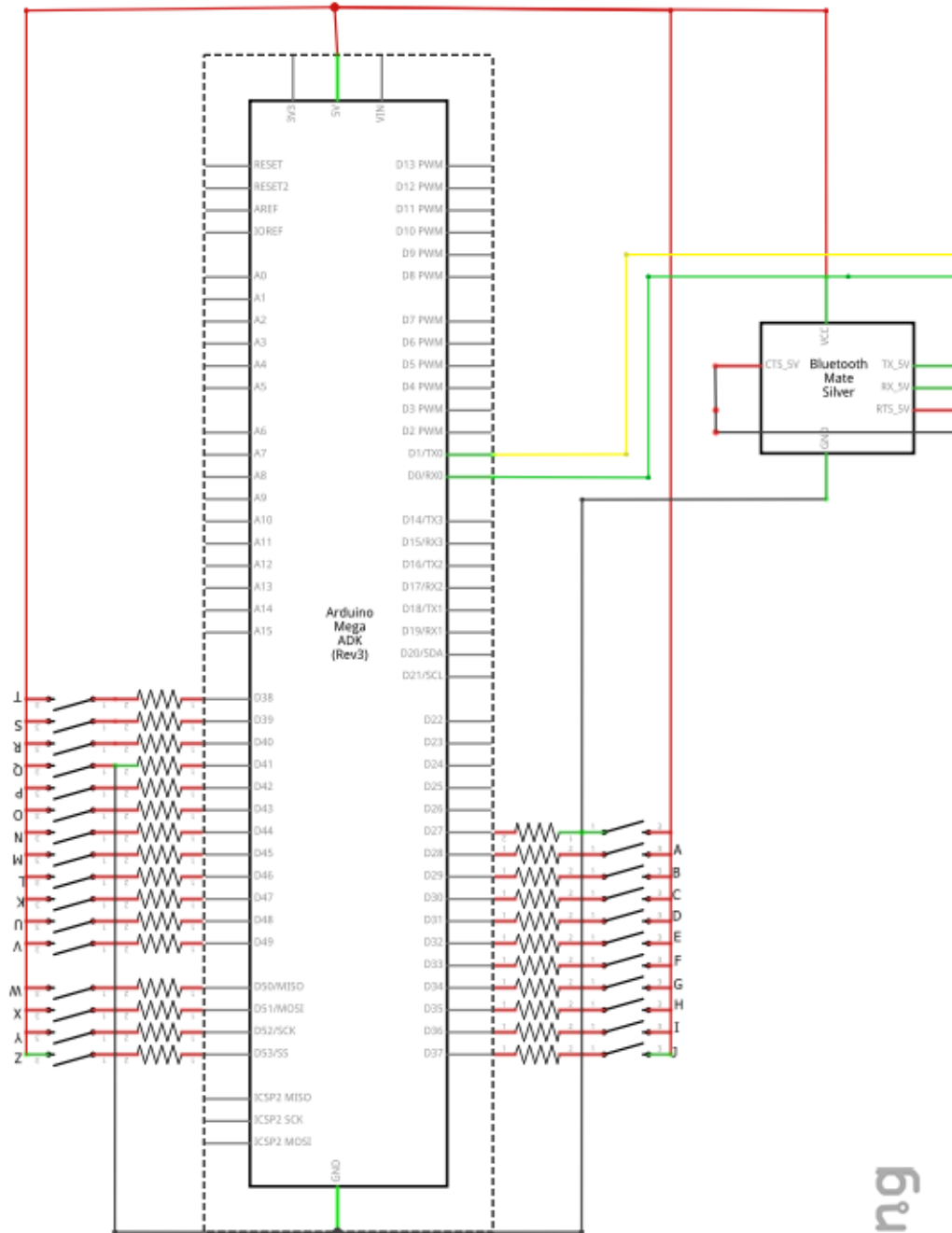


Figure 4.2.b: switch connection

## 4.4 Software Implementation

### Communication

To connect Arduino mega with PC a Bluetooth connection is needed, before we start printing characters. The figure shown the schematic diagram for our Project.



fritzing

Figure 4.3: schematic diagram

# Chapter 5: Testing

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## 5.1 Overview

## 5.2 Units Testing

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## Chapter 5: Testing

---

### 5.1 Overview

In this chapter we will describe and discuss the steps, results of the implementation and testing of the system.

### 5.2 Units Testing

We start by testing all the parts to ensure that all of the functions works perfectly and without errors.

#### 5.2.1 Hardware Testing

1. Testing connection of push button switches with resistors.
  2. Testing connection of all switches with microcontroller to correct printing .
  3. Testing Bluetooth Module HC 06.
- 
1. The figures 5.1, 5.2, 5.3 shows the connection of push button for two letters(A,B), when we press on the switch the letter show on the serial monitor for Arduino IDE.

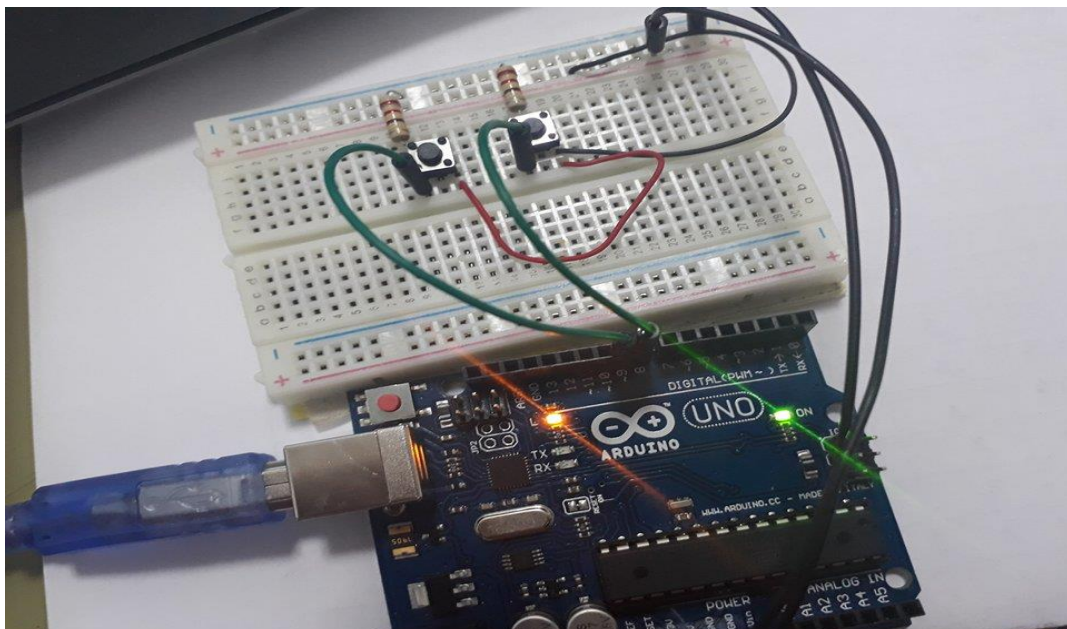


Figure 5.1: connection of push button for two letters

```
Serial.begin(9600);
}

void loop()
{
  if(digitalRead(8)== HIGH) // when like button pressed
  {

    Serial.flush();
    Serial.print(pin1);
    delay(1000);

  }

  if(digitalRead(9)== HIGH) // when
  {

    Serial.flush();
    Serial.print(pin2);
    delay(1000);

  }
}
```

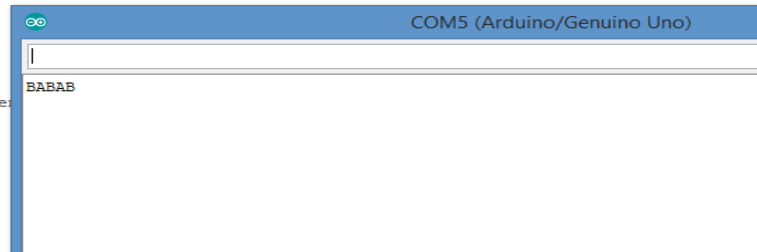


Figure 5.2: print 2 letters on PC

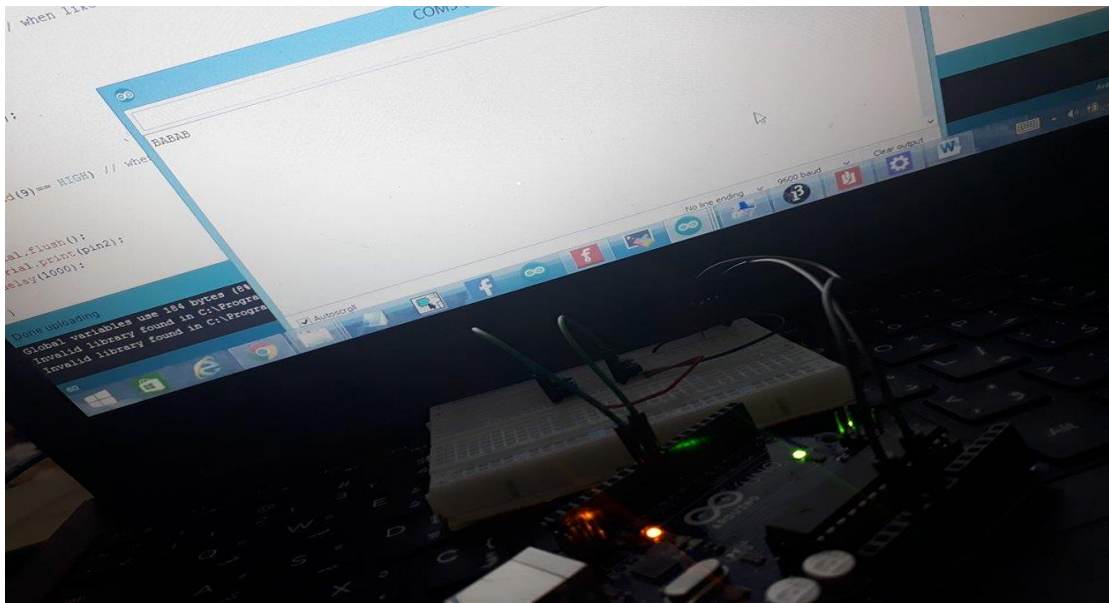


Figure 5.3: connect 2 letters and print on PC

2. The figures 5.4, 5.5 shows the connection of push button for all letters, when we press on the switch the letter show on the serial monitor for Arduino IDE.

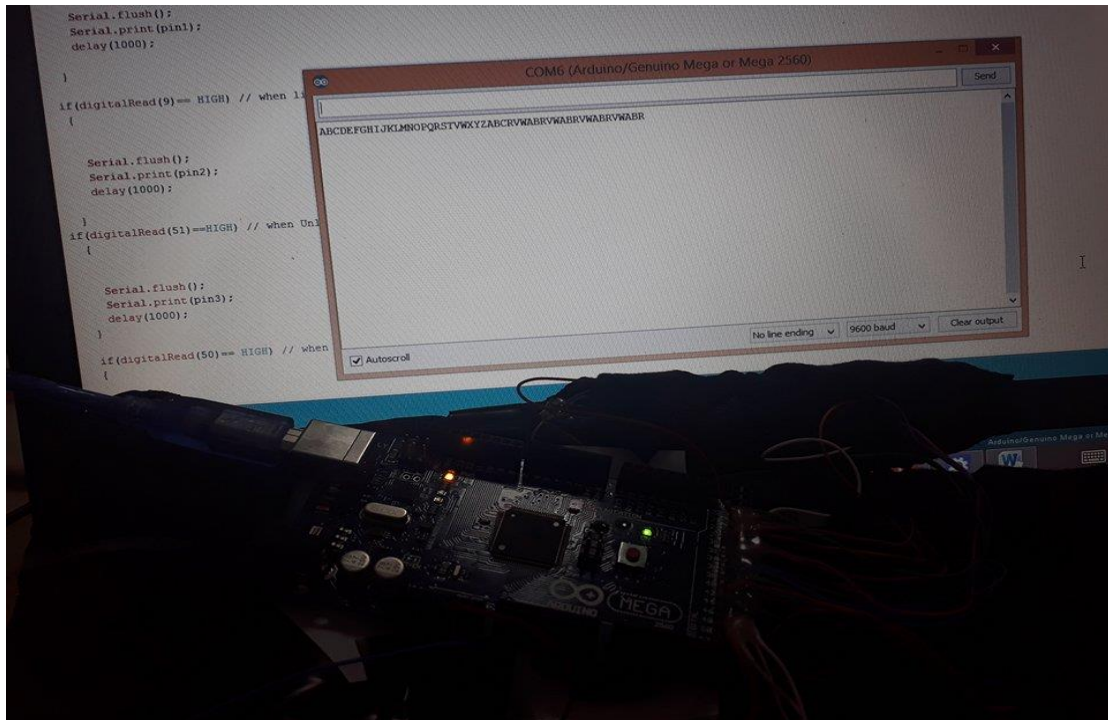


Figure 5.4: Print all letters

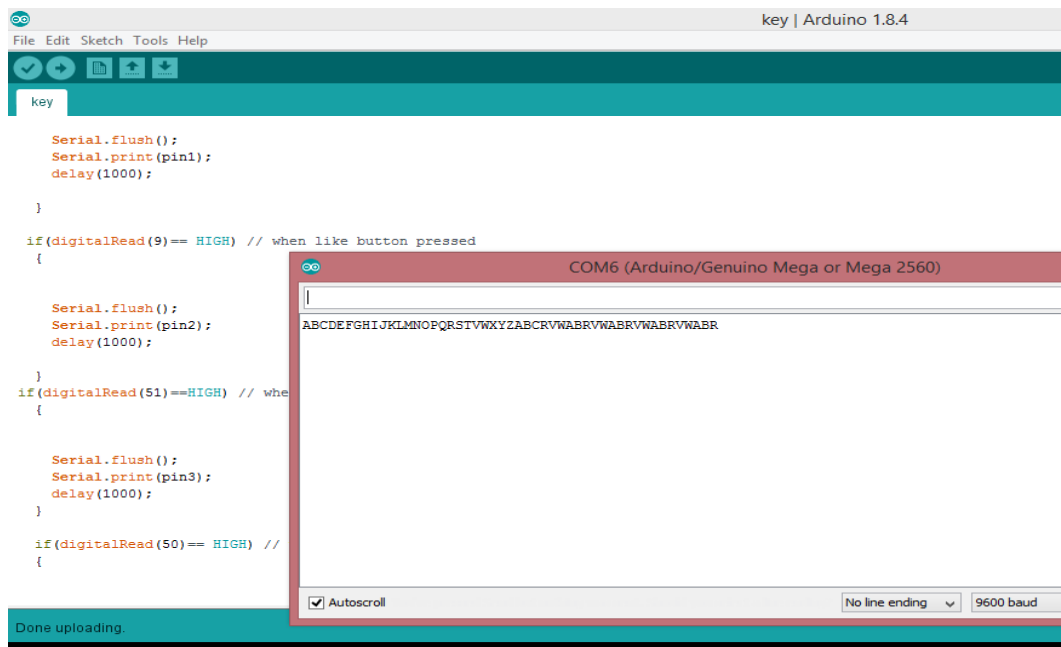


Figure 5.5: Print all letters on PC

3. The figure 5.6 show the connection of Bluetooth to the Arduino

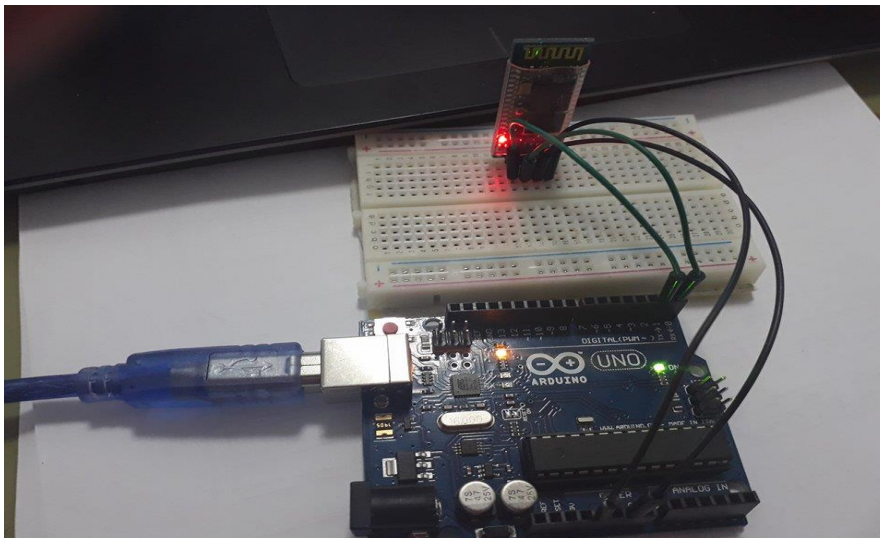


Figure 5.6:Bluetooth connect with Arduino

4. The figures 5.7, 5.8 ,5.9 show the setup of Bluetooth connection with PC.

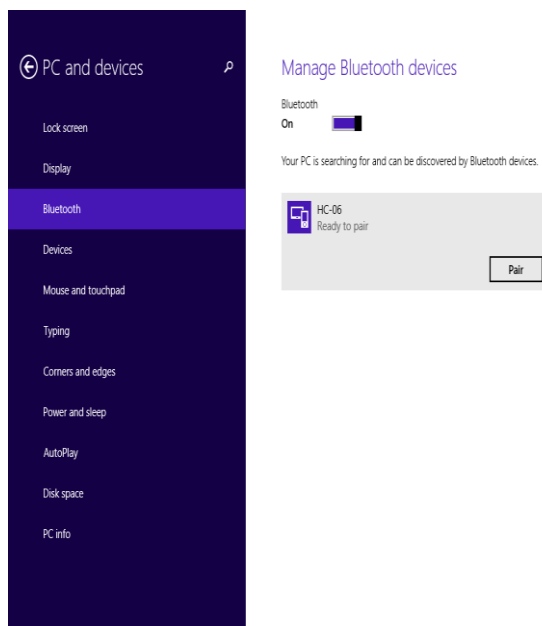


Figure 5.7: Bluetooth ready to pair

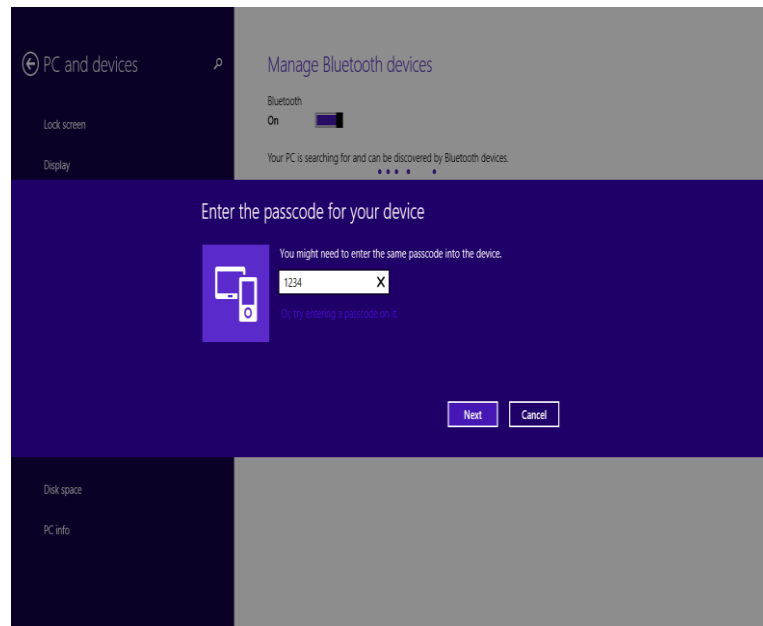


Figure 5.8: put the Bluetooth password

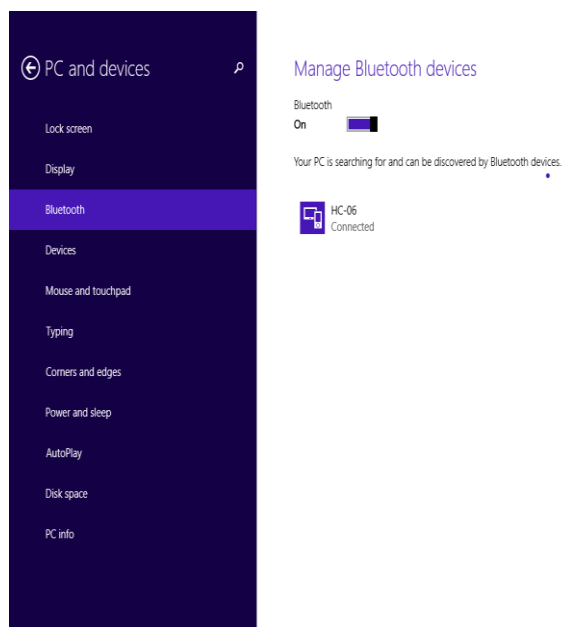


Figure 5.9: the Bluetooth connected.



# Chapter 6: Conclusion and Future Work

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## 6.1 Overview

## 6.2 Conclusion

## 6.3 future work

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## Chapter 6: Conclusion and Future Work

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### 6.1 Overview

In this chapter we will talk about the conclusion and future work.

### 6.2 Conclusion

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.

The keyglove provides an alternative and portable wearable input device and has inputs that are similar to that of a traditional keyboard. It is useful for people with disabilities and people who do their work with one hand Also it increases the working efficiency of these persons.

### 6.3 future work

In education many wearable devices have been created to improve the teaching and learning experiences in many countries , such as could developing keyglove to support both English and Arabic inputs. However, it can be easily reprogrammed later to support more languages, and Braille characters can be added to the glove to help blind people print easily. Also the keyglove can be used to control mouse movement , and control a cursor through different hand orientations and finger presses.

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## References

- [1] Electronic Projects Components Available Worldwide, <https://www.pjrc.com/teensy/>, 2017, [Online; accessed 4-April 2017].
- [2] Electronic Projects Components Available Worldwide, <https://www.keyglove.net/media/developerinterview>, 2017, [Online; accessed 4-April-2017].
- [3] Massimo. Arduino Mega. <https://www.arduino.cc/en/Main/arduinoBoardMega> , 2017 [Online; accessed 4-April-2017].
- [4] Olimex. arduino bluetooth. <https://arduino-info.wikispaces.com/BlueTooth-HC05-HC06-Modules-How-To>, 2017. [Online; accessed 13-November2017].
- [5] SparkFun, <https://www.sparkfun.com/products/10121>, 2017, [Online; accessed 7-April-2017].
- [6] Allied Wire & Cable, <http://www.awcwire.com/faq-hook-up-wire.aspx>, 2017, [Online; accessed 7-April-2017].
- [7] Alpha Wire, <http://www.alphawire.com/en/Products/Wire/Hook-Up-Wire>, 2017, [Online; accessed 7-April-2017].
- [8] SparkFun, <https://www.sparkfun.com/products/102>, 2017, [Online; accessed 22-April-2017].
- [9] Electronic Projects Components Available Worldwide, [https://cdn.solarbotics.com/products/support\\_software/teensyduino.html](https://cdn.solarbotics.com/products/support_software/teensyduino.html), 2017, [Online; accessed 2-May -2017].