A

Project Report

on

SMART GLASSES FOR MULTIMETER

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Under the guidance of

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JSPM's

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CERTIFICATE

This is to certify that Project Report entitled

Smart Glasses for Multimeter

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Is a record of bonafied work carried out by them in the Department of Electronics & Telecommunication Engineering, under my guidance in the fulfillment for the award of completion of final year of engineering in Electronics & Telecommunication Engineering of Savitribai Phule Pune University, Pune

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Smart Glasses for Multimeter

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Abstract

Working in the surrounding of high voltage areas is very risky job that can lead to accidental death. One main reason for the accident occurred because of carelessness of the worker himself. For example, a worker requires to check whether the fuse is damaged or not while the voltage is applied, and he by mistake connect the phase wire to the neutral using multimeter. The outcome of such incidents is that short circuit can occur, and that worker will get a one big an arc flash in his entire body. Usually, the worker faces troubles while testing/troubleshooting electrical works/PCB while locating samples on 2 points and looking at the exact time of the multimeter. This also takes a lot of time and leads to incorrect or improper measurements. To solve this problem that occurred, this project will be focused on how to keep focus on hands-on job when observing important data such as voltage readings on the multimeter. The idea for solving this difficulty is to design and develop devices that can display output digitally in front of the user's eyes so that he doesn't have to look here and there and there is less chance of losing focus. After doing some research, the most suitable device for this problem is smart glasses using Bluetooth. Hence, this project will include designing and developing smart glasses by studying and gaining a good idea from the previous researchers that are also making smart glasses for multiple purposes. Lastly, this project will build a model which is simple and cheap and is suitable for every level of community to use it.

Chapter 1: - Introduction

As the world is developing so fast and technologies are spreading rapidly smart glasses are presenting the brand-new concept in the technological field. In this paper a new system is projected called smart glasses for multimeter. The basic need of this system is to note down or see the readings of high voltage without losing the focus or the vision from the electrical appliances so that no damage will be bearable.

In the past few years, measuring electrical factors like voltage and current has been difficult and risky. Assessing high AC voltage by using convectional multimeter is risky as it could lead to an authentic accident like getting a shock. While measuring it, the one who is working looks at the samples and at the same time he has to look at the multimeter to see what the readings are displayed. During such measurements the probes can be disturbed also there is a chance of losing focus, due to this observer will take incorrect reading.

We are coming up with the solution for such a problem, that is a smart glass by which user can see readings and while using these glasses user doesn't have to look at DMM since readings will appear on smart glasses i.e., in front of his eyes. Also, this system is safe to use. This system is depended on Arduino micro pro for handling and showing output. OLED display is used for showing the voltage reading we measured. This OLED display is interfaced to controller using SPI (Serial Peripheral Interface). By making use of Bluetooth, it is feasible to develop the glass which is wireless so that voltage or current which is measured will occur on OLED display. The system is assembled to fit effectively on the ears of an individual and authorizes the individual to see the hardware simultaneously with the measured voltage, current and resistor.

Chapter 2: - Literature Survey

i. Smart- Glasses are the wearable computing device which can be attached to the spectacles or sunglasses of the user and can be paired with Smart Phones, via Bluetooth or Wi-Fi. In this paper, the authors are using the concept of Augmented reality to put a projection of user's smartphones notifications such as Date, time, incoming calls, text messages to the user's spectacles which acts as a virtual transparent screen to show those notifications while at the same time viewer can be interactive to surroundings without hindering his/her usual tasks in real-time. One of the uses of this device is to avoid accidents. Most accidents happen in the city due to the distraction caused by phone calls while riding. This could bedeveloped as a device that helps in delivering message notifications and navigates users through the helmet, causing lesser distractions thereby making it a safe ride. [16]

ii. Smart glasses demonstrated to be one of the advanced processing gadgets that unit people and machines. As of late, it is seen that smart glasses have been utilized in medical and gaming applications. Nonetheless, the highlights of smart glasses can contribute to its administration in different fields as well. In this paper, a study is carried out to investigate the conceivable use of smart glasses in estimating readings inside a live electrical board, the things that are inconvenient, and even risky on occasion, is turning away from your hands to peruse your multi meter. Since estimating high AC voltage utilizing conventional digital multimeter is very dangerous as it could prompt genuine mishaps. This paper represents a wearable wireless device so that user can see readings and this wearable device is the smart glasses. While utilizing these glasses user doesn't need to take a gander at DMM show since readings will be shown on smart glasses. Here we have utilized LiPo battery for power supply to microcontroller. OLED show is utilized for showing the voltage value we estimated. This OLED show is interfaced to controller utilizing SPI. With the assistance of Bluetooth we have made this glass wireless so measured voltage will show up on OLED display. [17]

iii. Work around high voltage areas is a very risky job that involves accidental death. One ofthe reasons for the accident occurred because of the negligence of the worker himself, forexample, an employee needs to check whether the fuse is broken or not while the voltageis applied, and he accidentally connect the phase wire to the neutral using a multimeter. The result will be a short circuit and one big arc flash in his entire body. To prevent this situation from occurring,

this project will be focused on how to keep focus on hands-on jobwhen viewing important data such as voltage value on the multimeter. The idea for solving this problem is to design and develop devices that can display output digital in front of the user's eyes. After doing some research, I found the most suitable device for this situationis smart glasses. Therefore, this project will be designing and developing smart glass by studying and earn a good idea from the previous researcher that also making the smartglasses. Lastly, this project will build as simple and cheap as possible for suitable to every rank of community to earn it. [20]

iv. About half a decade ago when the idea of smart glass technology was still promising, popular opinion had it that by the year 2020, this interactive technology would have gained so much advancement as a mainstream consumer product and these products became more fashionable, socially acceptable, and functional. However, the result from this study has shown that the smart glasses concept has been a rather slow one. Smart glasses are still not mainstream consumer products. Rather, they are specialized tools mainly adopted by the industry for various tasks despite their shortcomings. This paper investigates the field of smart glass technology, providing both an overview of existing products and their application, and also revealed 5 major areas in which smart glasses cannot be easily accepted as consumers product while providing a research road map for future research work in the usage and acceptance of smart glass technologies for consumers product. Smart glasses are wearable devices that have various sensors, an integrated processor and a display screen for visualization and interaction which leads to providing a view of both the physical world and virtual world (AR, VR) This extends the reach of smart glasses to sectors like medicine, gaming, corporate, sports, entertainment and many others which are focused more on engaging users. There is also a method to track the eyes of the user to determine what the user is looking at typically known as eye tracking technology. This helps the smart glasses to get some important information about the users interests and activities. Smart glasses could be used to create a better user experience while getting access to information and internet in a timely, accessible, and safe manner along with video streams, tracking eye movement to determine the state of an individual and the list goes on. Smart glasses fall under the category of smart wear which is a general term for combining everyday wear things with technology. Early prototypes of wearable smart devices emerged in the 1960s and devices embedded with this technology emerged in the 1970s and 1980s. The smart glasses can also be equipped with a camera for various purposes. Apart from manually

taking pictures, various personal experiences of the user can be captured, like the device can determine when the wearer is excited and then can take pictures or shoot videos automatically. The greatest benefit of this feature is that it can store sweetest memories of the user, which is stored in a video file, which can help the user to relive those moments whenever he/she wants. This file can be used in many ways as well, such as, it can act as a memory aid, it can also be used as evidence in case of crimes or simply for personal use. Also, if more and more people use such a device, then details of major events can spread around the world faster as pictures and videos will be taken automatically by the device in situations where users may not have time to take pictures and videos manually like in case of an earthquake. [14]

v. Smart glasses are wearable devices that have various sensors, an integrated processor and a display screen for visualization and interaction which leads to providing a view of both the physical world and virtual world (AR, VR) This extends the reach of smart glasses to sectors like medicine, gaming, corporate, sports, entertainment and many others which are focused more on engaging users. There is also a method to track the eyes of the user to determine what the user is looking at typically known as eye tracking technology. This helps the smart glasses to get some important information about the user's interests and activities. Smart glasses could be used to create a better user experience while getting access to information and internet in a timely, accessible and safe manner along with video streams, tracking eye movement to determine the state of an individual and the list goes on. Smart glasses fall under the category of smart wear which is a general term for combining everyday wear things to technology. Early prototypes of wearable smart devices emerged in the 1960s and devices embedded with this technology emerged in the 1970s and 1980s. The smart glasses can also be equipped with a camera for various purposes. Apart from manually taking pictures, various personal experiences of the user can be captured, like the device can determine when the wearer is excited and then can take pictures or shoot videos automatically. The greatest benefit of this feature is that it can store sweetest memories of the user which is stored in a video file, which can help the user to relive those moments whenever he/she wants. This file can be used in many different ways as well, such as, it can act as a memory aid, it can also be used as evidence in case of crimes or simply for personal use. Also, if more and more people use such a device then details of major events can spread around the world faster as pictures and videos will be taken automatically by the device in

situations where users may not have time to take pictures and videos manually like in case of an earthquake. [9]

vi. Smart glasses are computing devices worn in front of the eyes. Evidently their displays move with the user's head, which leads to the users seeing the display independently of his or her position and orientation. Therefore, smart glasses or lenses are the only devices which can alter or enhance the wearer's vision no matter where he/she is physically located and where he/she looks. There are three different paradigms of how to alter the visual information a wearer perceives.

Those three are introduced here.

- Virtual reality: The goal is to create a fully virtual world for the user to see, interact with and immerse into. The user sees this virtual world only, any other light sources are not affecting the eye. One significant difference to a simple screen is that the actions of the user affect the virtual world. In example movement affects what virtual content the user sees. A famous fictional example of a device creating a virtual world is the Holodeck from Star Trek.

- Augmented reality: The world is enhanced or augmented by virtual objects. The user can see the real world but also perceives virtual content created by a computing device and displayed by an additional light source which doesn't prohibit the perception of the real world. Interaction with those virtual objects is a way of communicating with computing devices.

- Diminished reality: Objects are subtracted from scenes by filtering the light reflected or emitted by those objects towards the eye. This is most often used in combination with augmented reality to replace the diminished objects by some virtual objects. Like other smart devices, smart glasses will often also have a camera. Significant differences to other camera devices are that the pictures or videos are taken from the user's point of view, there is no need for the user to hold the device in his hands and the vision of the user is not occluded. This camera can see what the wearer sees at any time. In combination with eye tracking technology the devices can determine exactly what the wearer is looking at. This allows the device to get crucial information about the user's interests, activities, surroundings, and

occupation. Those fundamental differences to other computing devices are what makes smart glasses unique and interesting. They enable new applications which couldn't be as easily realized with other devices. [12]

vii. The aim of this study is to review academic papers on the applications of smart glasses. Among 82 surveyed papers, 57 were selected through filtering. The papers were published from January 2014 to October 2020. Four research questions were set up using the systematic review method, and conclusions were drawn focusing on the research trends by year and application fields; product and operating system; sensors depending on the application purpose; and data visualization, processing, and transfer methods. It was found that the most popular commercial smart glass products are Android-based Google products. In addition, smart glasses are most often used in the healthcare field, particularly for clinical and surgical assistance or for assisting mentally or physically disabled persons. For visual data transfer, 90% of the studies conducted used a camera sensor. Smart glasses have mainly been used to visualize data based on augmented reality, in contrast with the use of mixed reality. The results of this review indicate that research related to smart glasses is steadily increasing, and technological research into the development of smart glasses is being actively conducted. [4]

viii. Over recent decades' smart glasses have gained increased attention in both the research arena and recently also in the consumer market, even though there is not yet a clear definition of what exactly smart glasses entail and underexposed perspectives are not represented. This study used a rapid review to assess the current understanding of smart glasses with the aim of defining them. Searches were performed across six databases, followed-up by a content-based evaluation of title and abstract. A total set of 14 relevant publications was identified to help arrive at a definition and characteristics of smart glasses. As a result, it was observed in both the research literature and in the public domain that many different names are used for smart glasses, and that in some cases there is unclarity about what constitutes smart glasses. Therefore, an adapted definition of smart glasses is developed based on the existing original rationale of ubiquitous computing and taking the current state-of-the-art knowledge into account. This article provides an overview of and suggestion for defining smart glasses from a social sciences' perspective to better inform researchers, developers, designers and companies who are involved in the design,

development, and research of smart glasses. [7]

ix. Among the recent inventions, smart glass is one of the wearable devices typically referred to be switchable glass that can handle a wide range of computing activities that an ordinary human cannot do. It is the amalgamation of technologies that help in converting the transparent nature of the hard glass into the translucent, mostly allowing the human to machine interactions. In this paper, insights into the smart glass and its design factors were highlighted. Moreover, its features and various commercially available smart glasses were carefully studied. Besides these, a survey on smart glass applications is made, and various possible new applications were explored. Unlike the possible applications, numerous challenges faced by the smart glasses were explored. [2]

Chapter 3: - Methodology

3.1 Aim: -

To develop and design a product that will reduce electric accident in high voltage surroundings and to help to note down accurate readings or seeing the reading of high voltage without losing the focus or the vision from the electrical appliances so that the user will be safe from electric shock or any other type of risks.

3.2 Objectives: -

i. To develop suitable optical system model and coding of Arduino for Data Glasses.
ii. To integrate between Bluetooth multimeter and Data Glasses.
iii. To test and analyze the Data Glasses system.
iv. To measure electrical parameters accurately.
v. To increase mobility of multimeter.
vi. To enhance observer convenience while measuring electrical parameters.
vii. To provide safety.

3.3 Block Diagram & Description: -

Arduino Pro Micro in this project is the brain for system which will control OLED display and Bluetooth HC05. And because of that, Arduino will require supply which is from LiPo battery. Next, based on the coding created, the Arduino has been programmed for receiving data at RX from BLE module. For this Project, the data receive is Voltage value from multimeter Bluetooth device. Next, Arduino will send the data to OLED display via SPI Bus in a way which users can easily read the data. Then, OLED will display the data which is Voltage value that also display at multimeter.

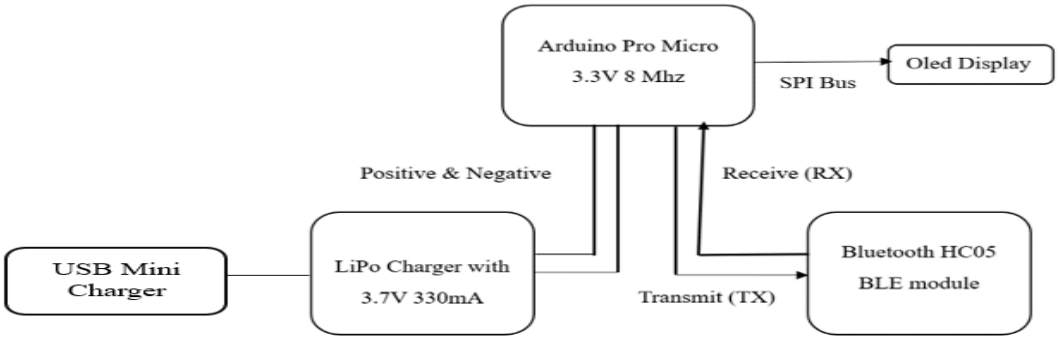

Fig. 3.1: Block Diagram of Proposed System

A. Arduino Pro Micro

To lighten the weight for this project, getting the smallest Arduino is needed. Therefore, the most suitable Arduino for this case is Arduino Pro Micro which weighsless than 2 grams. This mini type of Arduino used microcontroller board in view of ATmega328. Arduino Pro Mini has 14 advanced input/output pins. There are 6 pins for analogue inputs, 6 pins for PWM outputs and the others 3 is reset button, mounting pin headers and on-board resonator.

Fig. 3.2: Arduino Pro Micro

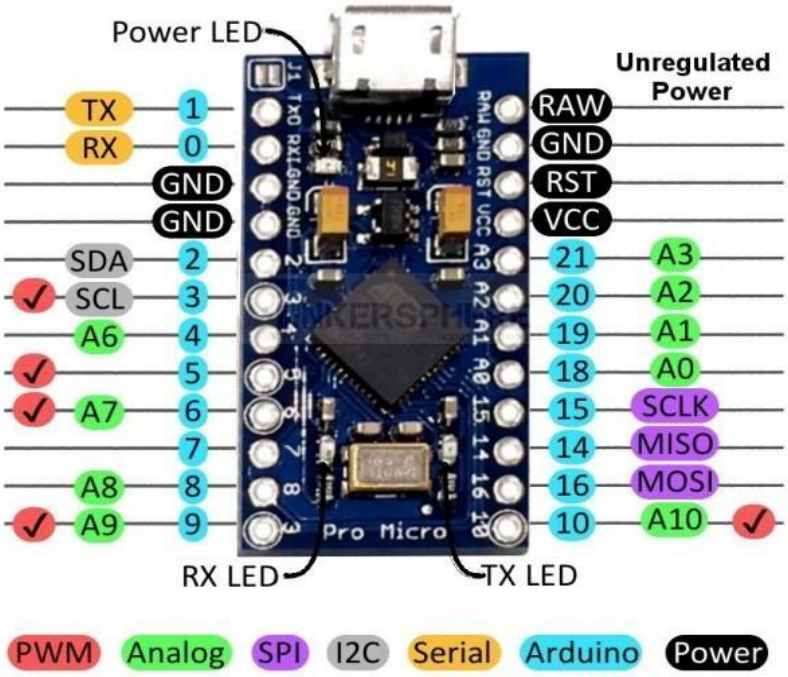

Fig 3.3: Pins of Arduino Pro Micro

Input and Output: -

Digital read functions, pin mode and input or output can be used in Pro Mini for each of the 14 digital pins on it. Internal resistor with 20k up to 50k Ohms and peak of 40 mA can be provided or received by each pin. A maximum of 40 mA and an internalpull-up resistor of 20-50 k Ohms can be provided or received by each pin.

Name	Pin	Function
External Interrupts	2 and 3	Any type of change in value and interrupt at low value can be triggered by configured these 2 pins.
PWM	3, 5, 6, 9, 10 and 11	Pin that allow for output of 8-bit PWM with analogue Write function.
SPI	10 (SS), 11 (MOSI), 12 (MISO) and13 (SCK)	For SPI communication support.
LED	13	Digital pin 13 has connection of built-in LED. It means that led will be on when the pin is high (voltage greater than 2.0V is present [3.3V boards]), and it is off when the pin is low

Table 3.1: Input and Output Pins of Arduino Pro Micro

Technical Specification: -

2.0 Microcontroller	ATmega328
Board Power Supply	3.35 -12 V (3.3V model) or 5 - 12 V (5V model)
Circuit Operating Voltage	3.3V or 5V (depending on model)
Digital I/O Pins	14
PWM Pins	6
UART	1
SPI	1
I2C	1
Analog Input Pins	6
External Interrupts	2
DC Current per I/O Pin	40 mA
EEPROM	1 KB
Flash Memory	32KB
Clock Speed	8 MHz (3.3V versions) or 16 MHz (5V versions)
SRAM	2 KB

Table 3.2: Specification of Arduino Pro Micro

B. Bluetooth HC05

For Arduino to receive Data from Bluetooth Multimeter, this project requires a Bluetooth module which can communicate with the Arduino. The version module that will be used is HC05 BLE. It is used for many applications like wireless headset, game controllers, wireless mouse, wireless keyboard, and many more consumer applications. It has range up to <100m which depends upon transmitter and receiver, atmosphere, geographic & urban conditions. It is IEEE 802.15.1 standardized protocol, through which one can build wireless Personal Area Network (PAN). It uses frequency-hopping spread spectrum (FHSS) radio technology to send data over air. It uses serial communication to communicate with devices. It communicates with microcontroller using serial port (USART).

Fig. 3.4: Bluetooth HC05

Bluetooth Pins: -

Fig. 3.5: Bluetooth HC05 Module Pin Diagram

Bluetooth serial modules allow all serial enabled devices to communicate with each other using Bluetooth.

It has 6 pins:

i. Key/EN: It is used to bring Bluetooth module in AT commands mode. If Key/EN pin is set to high, then this module will work in command mode. Otherwise by default it is in data mode. The default baud rate of HC-05 in command mode is 38400bps and 9600 in data mode.

   HC-05 module has two modes:

   a. Data mode: Exchange of data between devices.
   b. Command mode: It uses AT commands which are used to change setting of HC-05. To send these commands to module serial (USART) port is used.

ii. VCC: Connect 5 V or 3.3 V to this Pin.

iii. GND: Ground Pin of module.

iv. TXD: Transmit Serial data (wirelessly received data by Bluetooth module transmitted out serially on TXD pin)

v. RXD: Receive data serially (received data will be transmitted wirelessly by Bluetooth module).

vi. State: It tells whether module is connected or not.

HC-05 has red LED which indicates connection status, whether the Bluetooth is connected or not. Before connecting to HC-05 module this red LED blinks continuously in a periodic manner. When it gets connected to any other Bluetooth device, its blinking slows down to two seconds. This module works on 3.3V**.** We can connect 5V supply voltage as well since the module has on board 5 to 3.3 V regulator. As HC-05 Bluetooth module has 3.3V level for RX/TX and microcontroller can detect 3.3 V level, so, no need to shift transmit level of HC-05 module. But we need to shift the transmit voltage level from microcontroller to RX of HC-05 module. The data transfer rate of HC-05 module can vary up to 1Mbps is in the range of 10 meters**.**

Technical Specification: -

Bluetooth version	2.0 + EDR (Enhanced Data Rate)
Frequency	2.4 GHz ISM band
Modulation	GFSK (Gaussian Frequency Shift Keying)
Transmit power	Class 2 (up to 4 dBm)
Sensitivity	-80 dBm typical
Range	approximately 10 meters (or 33 feet) in open air
Profiles supported	SPP (Serial Port Profile), HID (Human Interface Device) and others
Operating voltage	3.3V to 5V DC
Operating current	less than 50mA
Standby current	less than 2.5mA
Sleep current	less than 1mA
Interface	UART (Universal Asynchronous Receiver/Transmitter)
Baud rates	1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200, 230400, and 460800
Operating temperature:	-20°C to 75°C (-4°F to 167°F)

Table 3.3: Specification of Bluetooth HC05

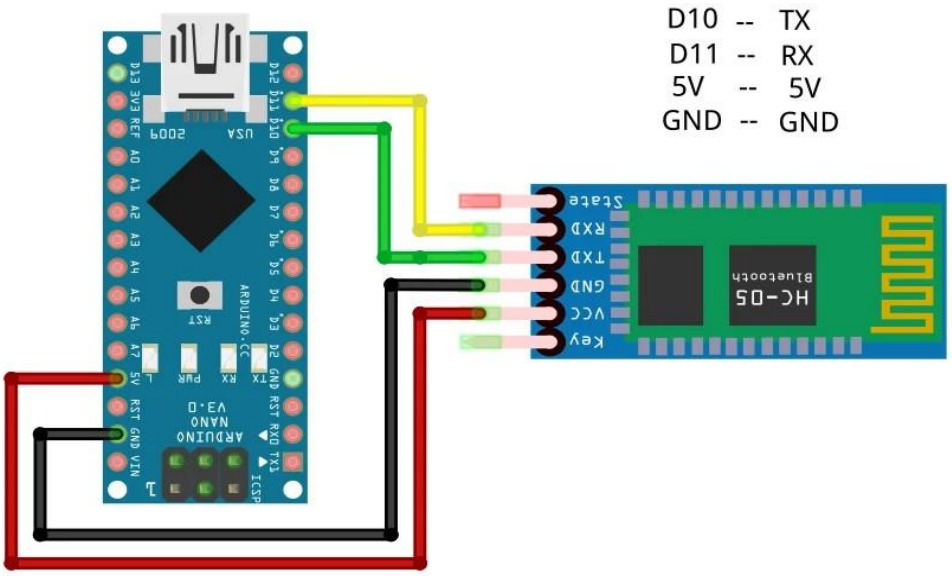

Fig 3.6: Connection between Bluetooth HC05 and Arduino pro micro

HC05 Bluetooth	Arduino Pro Micro
State	-
Rx	Tx (11)
Tx	Rx (120)
GND	GND(common ground)
+5V	Vcc (Both given to common power supply)
EN	-

Table 3.4: Connection between Bluetooth HC05 and Arduino pro micro

C. OLED Display

OLED is the most suitable display tool for this project because of its smalland light size. Besides that, Micro OLED offers high brightness which enables the imageto reflect to user's eye more clearly. OLED is Organic Light Emitting Diode that emits light in response to an electric current. OLED display works with no backlight so it can display deep black levels. It is small in size and light in weight than Liquid Crystal Displays. 128x64 OLED display is simple dot matrix graphic display. It has 128 columns and 64 rows which make it display of total 128x64 = 8192 pixels. By just turning on/off these pixels' led we can display a graphical image of any shape on it.

Fig.3.7: OLED Display

PIN DESCRIPTION:

Pin No.	Pin Name	Description
1.	Supply Voltage (Vcc, 5V)	Can be powered by either 3.3V or 5V
2.	Ground (GND)	Pin Ground
3.	Serial Clock(SCL)	Pin SCL of I2C interface
4.	Serial Data(SDA)	Pin SDA of I2C interface

Table 3.5: Pins of OLED Display

Available Interfaces for OLED:

OLED display module can be interfaced with microcontrollers using three interfaces given below:

i. 6800/8000 series compatible Parallel Interface: In this interface 8-bit data send/receive could be done through parallel lines i.e. D0-D7.

ii. I2C interface: In this interface, data send/receive could be done serially through SDA line.

iii. Serial Peripheral Interface: In this interface, data send/receive could be done serially through SDI and SDO lines.

Technical Specification: -

Display Type	OLED (Organic Light Emitting Diode)
Display Size	128x64 pixels
Display Driver	ssd1306
Display Colors	Monochrome (White), Yellow, and Blue
Operating Voltage	3.3V to 5V
Interface	I2C
Operating Current	~20mA

Table 3.6: Specification of OLED Display

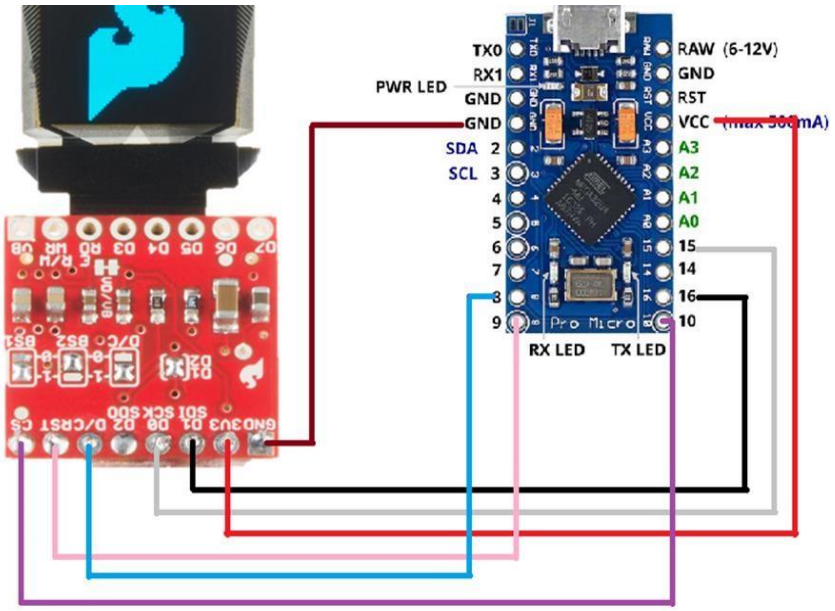

Fig.3.8: Connection between OLED Display and Arduino Pro Micro

MICRO OLED	ARDUINO PRO MICRO PIN
D1	16
D0	15
3V3	VCC
RST	9
GND	GND
D/C	8
CS	10

Table 3.7: Connection between OLED Display and Arduino Pro Micro

D. LiPo Battery

Because of its small and light characteristics, this battery is ideal for this Smart Glasses project that requires convenience for users to move freely. Besides that, users donot need to change the new battery because this battery is allowed to recharge it back. Lithium polymer battery known as rechargeable battery made up of lithium-ion technology. Compared to other lithium battery types, lithium polymer battery provides a higher energy. Besides that, they are being used in small and light applications such as cellular telephones handsets, radio or tablets computers. For charging part, the voltage for LiPo cell change from 2.7 to 3.0V for discharged while 4.20V for fully charged. The precise voltage ratings should be specified on product data sheets in order for user to not overcharge nor over- discharge under use of these LiPo cell. LiPo batteries are usually used on small application and higher energy that exceeds price reconsiderations such as power banks, tablet computers and mobile phones.

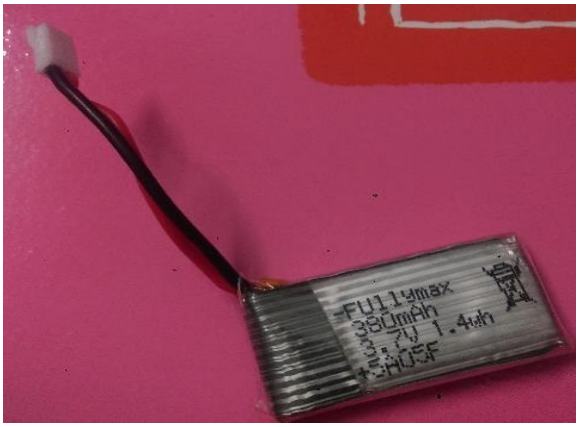

Fig. 3.9: LiPo Battery

Technical Specification: -

Battery model	KP 802540
Nominal voltage	3.7V
Charging voltage	4.2V
Nominal capacity	650mAh
Operating temperature	-10 to 55°C
Discharging cut-off voltage	3.2V
Charging current	1C (max)
Discharge current	15C (max)
Dimension	43mm(L) x 25mm(W) x 8mm(H)
Weight	10g

Table 3.8: Specification of LiPo Battery

E. USB Charger

This mini-USB charge will be used so that the battery of this project can be recharged unlike any other electronic device.

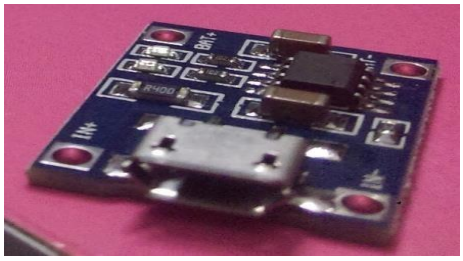

Fig. 3.10: USB Charger

The charger circuit that was use is USB 5V 1A TP4056 Lithium Battery Charger Module with Protection. This type charger circuit is the most suitable for this project because it can charge the LiPo batterylower than 5 volts safely. The current mAH that writes in LiPo battery means how long the battery can run in an hour. Therefore, the higher mAH of the battery the better. Below are the connection of this charger circuit to battery LiPo:

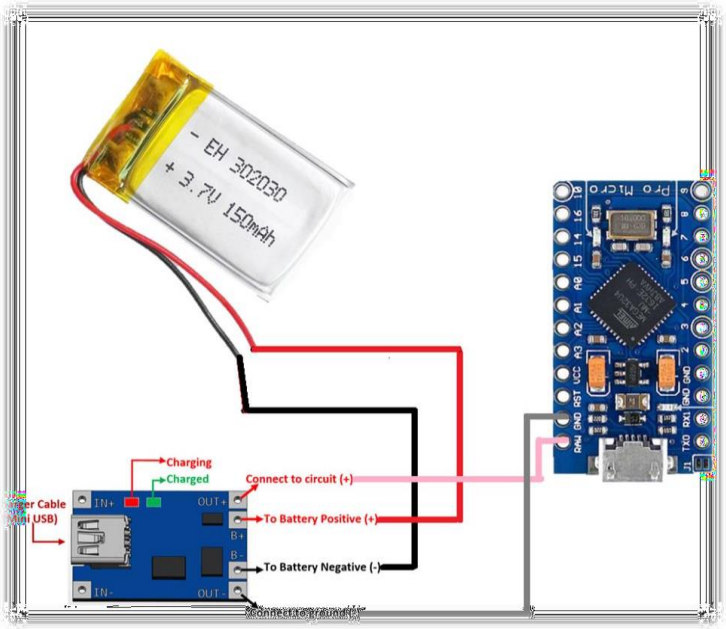

Fig. 3.11: Charger Circuit Connection

Technical Specification: -

Input Voltage	4.5V – 5.5V
Input Interface	Micro USB Port
Charging Method	Linear Charge
Full Charge Voltage	4.2V
Power	4.2W

Table 3.9: Specification of USB Charger

F. Mini Switch

This type of switch is required to make it easier for users to turn on and off for this project. A slide switch is a mechanical device that is commonly used for controlling an electrical circuit. It utilizes a simple sliding action to move the switch from an open position to a closed one, or vice-versa. As maintained-contact switches, slide switches remain in one state until manually actuated into another state.

Fig.3.12: Mini Switch

G. Jumper Wire

Jumper wire will be used in this project for making connection for each material such as Arduino Pro Micro, Bluetooth Module, Micro OLED, Mini USB Output Charger, LiPo Battery and Mini Slide Switch. Jumper wires are simply wires that have connector pins at each end, allowing them to be used to connect two points to each other without soldering. Jumper wires are typically used with breadboards and other prototyping tools in order to make it easy to change a circuit as needed.

Fig 3.13: Jumper Wire

Chapter 4: - Coding

4.1 Coding Program of Tx: -

```
#include <SoftwareSerial.h>
SoftwareSerial EEBlue(2, 3); // RX | TX
#define ANALOG_IN_PIN A0


// Floats for ADC voltage & Input voltage
float adc_voltage = 0.0;
float in_voltage = 0.0;


// Floats for resistor values in divider (in ohms)
float R1 = 30000.0;
float R2 = 7500.0;


// Float for Reference Voltage
float ref_voltage = 5.0;


// Integer for ADC value
int adc_value = 0;

void setup()

{
  Serial.begin(9600);
  EEBlue.begin(9600);  //Default Baud for comm is 9600. if
enable pin of HC05 is connected to 5v than baund rate is 38400
  Serial.println("The bluetooth gates are open.\n Connect to HC-
05 from any other bluetooth device with 1234 as pairing key!.");

}

void loop()

{
 adc_value = analogRead(ANALOG_IN_PIN);
 adc_voltage  = (adc_value * ref_voltage) / 1024.0;
 in_voltage = adc_voltage / (R2 / (R1 + R2)) ;
 EEBlue.write(in_voltage);
 Serial.print("in_voltage");
 Serial.println(in_voltage);
//EEBlue.write("A");
delay(500);


}
```

4.2 Coding Program of Rx: -

```
#include <SoftwareSerial.h>
SoftwareSerial EEBlue(2, 3); // RX | TX
#include <SPI.h>
#include <Wire.h>
#include <Adafruit_GFX.h>
#include <Adafruit_SSD1306.h>


#define SCREEN_WIDTH 128 // OLED display width, in pixels
#define SCREEN_HEIGHT 64 // OLED display height, in pixels
#define OLED_RESET     4 // Reset pin # (or -1 if sharing
Arduino reset pin)
#define SCREEN_ADDRESS 0x3C ///< See datasheet for Address;
0x3D for 128x64, 0x3C for 128x32
Adafruit_SSD1306 display(SCREEN_WIDTH, SCREEN_HEIGHT,
&Wire, OLED_RESET);
float a =0.00;

void setup()

{
  Serial.begin(9600);
  EEBlue.begin(9600);  //Default Baud for comm is 9600. if
enable pin of HC05 is connected to 5v than baund rate is
38400
  Serial.println("The bluetooth gates are open.\n Connect
to HC-05 from any other bluetooth device with 1234 as
pairing key!.");

if (!display.begin(SSD1306_SWITCHCAPVCC, SCREEN_ADDRESS))
  {
    Serial.println(F("SSD1306 allocation failed"));
    for (;;); // Don't proceed, loop forever
  }
  display.clearDisplay();

}


void loop ()

{

  // Feed any data from bluetooth to Terminal.
  if (EEBlue.available())
```

```
    {
       a= EEBlue.read();
       Serial.println(a );

     }

  display.setCursor(20, 10); //oled display
  display.setTextSize(2);
  display.setTextColor(WHITE);
  display.println("Voltage:");
  display.setCursor(25, 40); //oled display
  display.setTextSize(2);
  display.setTextColor(WHITE);
  display.print(a, 2);
  display.println(" V");
  display.display();
  //delay(500);
  display.clearDisplay();
  //display.display();


}
```

Chapter 5: - Hardware Design

5.1 Description of hardware used: -

Trying to build cheap Arduino Data Glasses for everybody. It's working, and now it can even help to avoid accidents. The challenge was, that It should be constructed out of common materials that can be found easily. The project is more about how to build the optical system for this HMD. One thing is clear, you cannot just place a screen in front of your eyes, because it will not be possible for them to focus it.

What's Inside and How Does It Work?

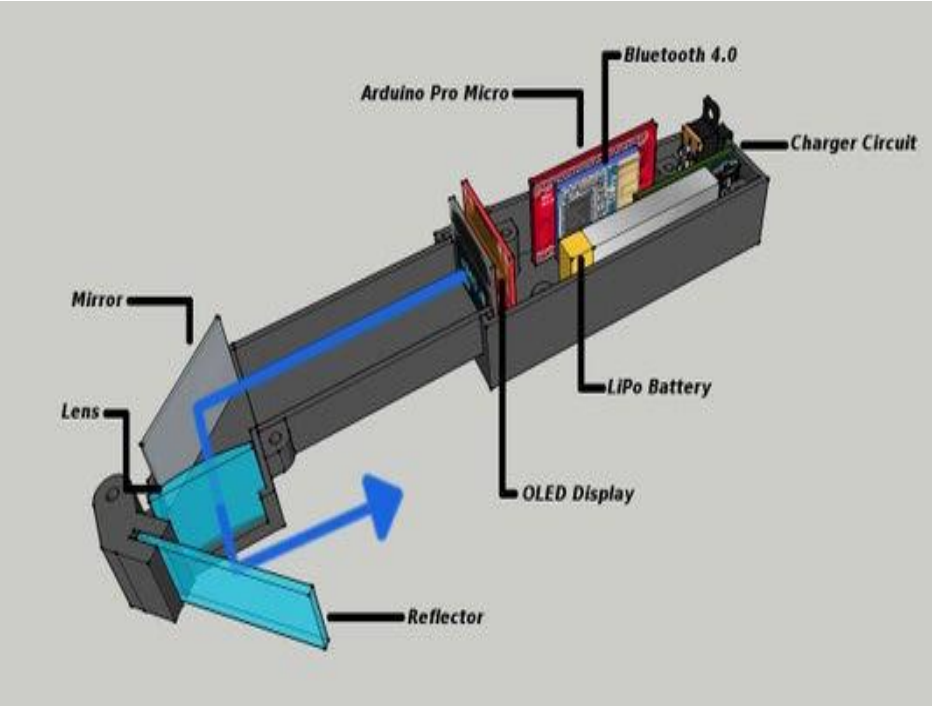

Fig 5.1: Final design of the system

Based on Fig 5.1, it shows the inside of our system. The Smart Glasses are developed by using Arduino pro micro along with combination of optical system. Arduino pro micro in this system will control the OLED display and Bluetooth HC05.

Next, Micro OLED will be used to display output data which has been set or programmed by Arduino. Bluetooth HC05 BLE Module was also to be used toenable connect between Arduino and multimeter via Bluetooth.

Mirror is used to reflect the output display of Micro OLED. Besides that, lens will be used to enlarge the data display from the mirror. Furthermore, LiPo battery was also used in this project as rechargeable battery.

How to use it? – Firstly, connect Bluetooth Multimeter to the device and after Bluetooth data is displayed on the OLED, it is then reflected over the mirror and will goes through the lens and users can see the picture in the little transparent glass.

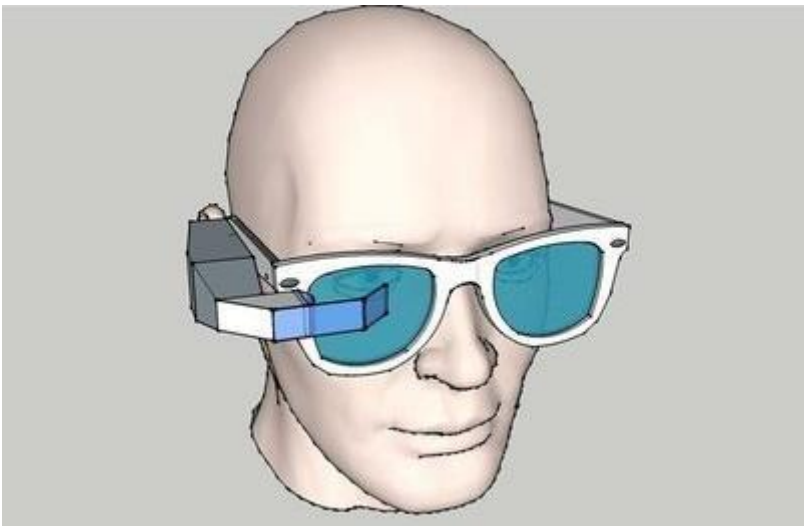

Fig 5.2: Prototype of Arduino Data Glasses

Chapter 6: - Software Design

6.1 Flowchart of proposed work –

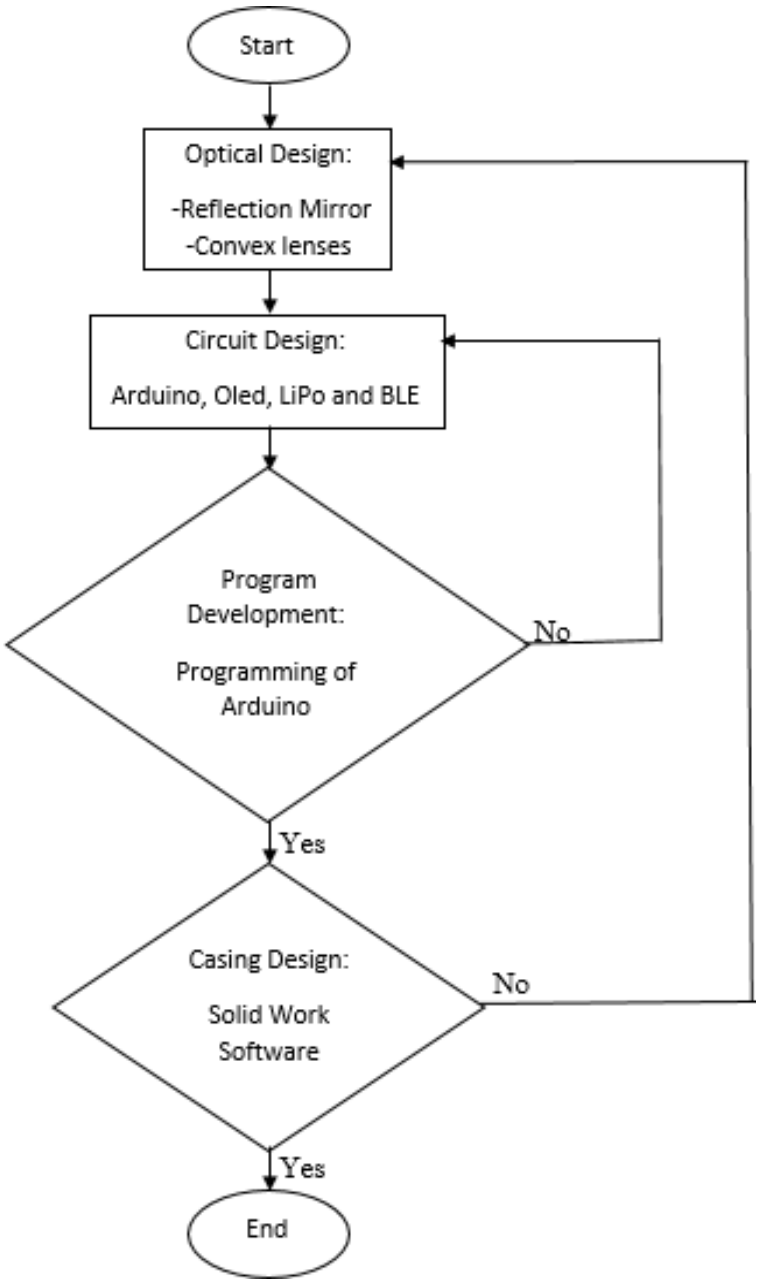

Fig 6.1: Flowchart of the proposed system

Fig 6.1 shows the flow chart of step by step to complete this project. Firstly, by finding the appropriate optical design that is able to display the image reflection clearlyin front of user's eyes. After doing some research, Arduino Smart Glasses will have used the combination of reflection mirror and convex lenses to display the image reflection. Nextis making circuit design that can receive data via Bluetooth and then display the data in digital form.

Next step is writing and applied a suitable code for Arduino in order to control OLED display and Bluetooth module. Lastly, making the casing design as a cover to theinternal circuit and also as a cover lightening the reflection light.

Chapter 7: -Testing and Results

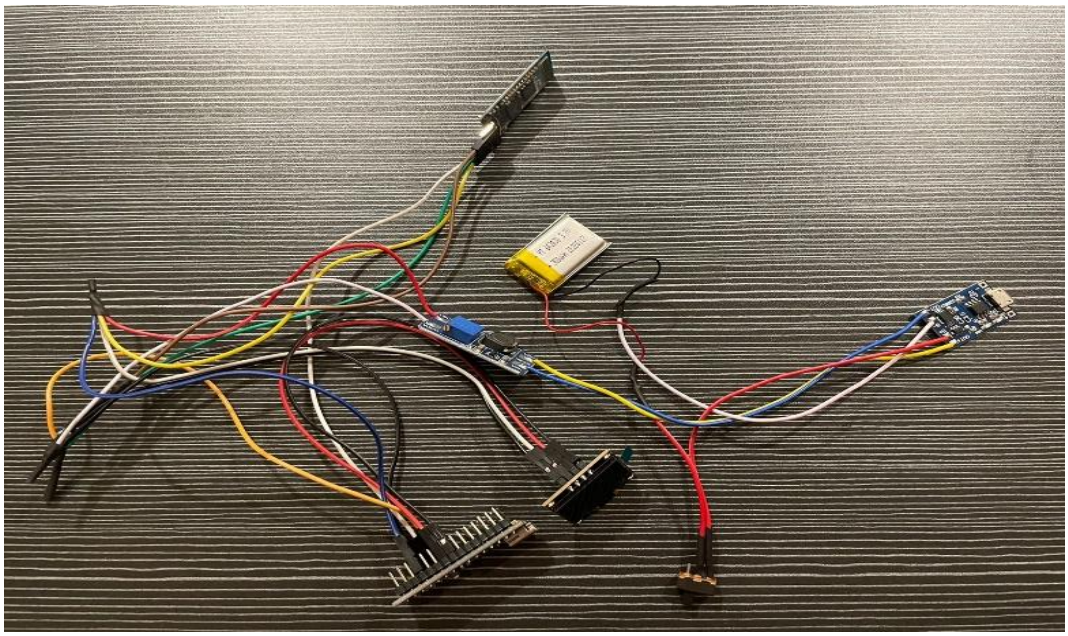

Fig 7.1: Hardware model when NOT connected to Multimeter

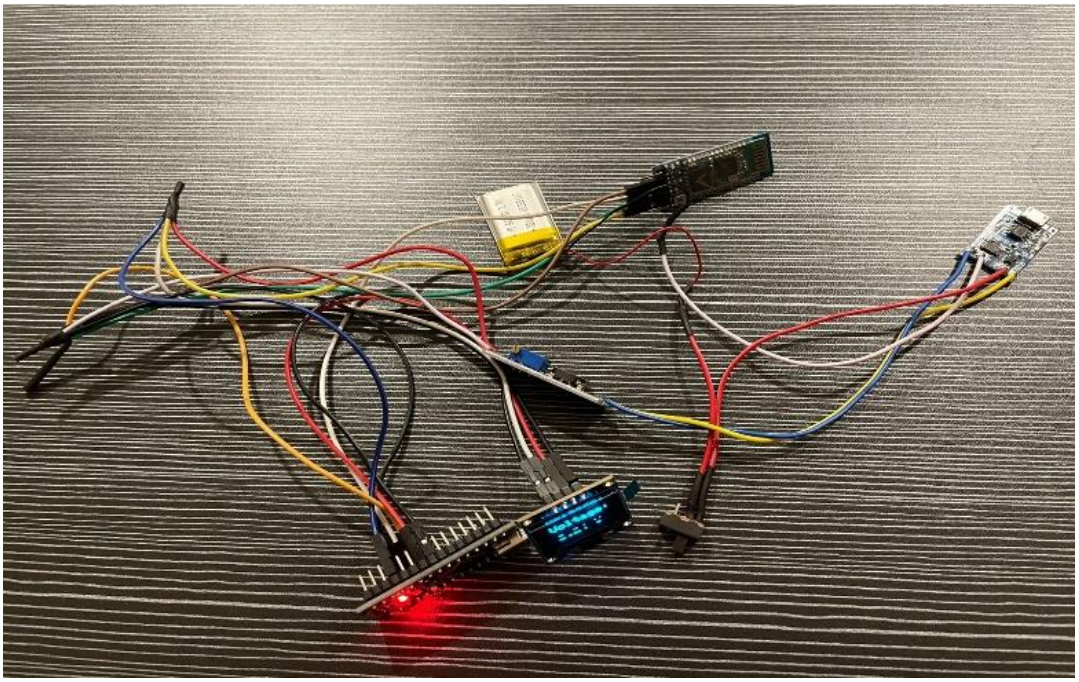

Fig 7.2: Hardware model when connected to Multimeter

Chapter 8: -Advantages

i. This system is lighter than traditional systems Easy-to-use multimeter.

ii. It improves the mobility of this system. You can move it easily from here and there.

iii. This system is more convenient for observers.

iv. As simple and cheap as possible for suitable to every level of community to earn it.

v. It is user friendly which can recharge back.

vi. It is safe as the user will able to read or see the output display of multimeter in front their eyes while doing their hands work especially in area of high voltage which is a very risky place.

Chapter 9: -Applications

i. College Labs: In industries there is lot of use of multimeter, so by using this system it provides mobility to workers and it is also time saving with more precision/accurate results.

ii. Industries: It provides safe usability to the students and also faculties and it makes easier for them to take readings as compared to the convectional one.

Chapter 10: -Conclusion

This project was developed to make devices that can display output digital in front of the user's eyes. Several methods had been used in studying and earned a good idea fromthe others researcher that also making the Smart Glasses. Optical design and circuit design had been developing as the main body for this data glasses project. Reflection mirror and convexlens, which is the excellent method for the optical design had been made in use. Arduino Pro Micro was used as brain to control the circuit which is Bluetooth module HC05 and Micro OLED. Charger circuit and LiPo battery are included as source for the electronic circuit to make this project use as a long-lasting useful tool. Lastly, casing for this project is made by3D printer. The goal of this project is to builds Head-Up display for high Voltage as simpleand cheap as possible for suitable to every rank of community to earn it. As the final resultfor this project, the user will able to read or see the output display of multimeter in front their eyes while doing their hands work especially in area of high voltage which is a verydangerous place. Besides that, the user can easily adapt this project as useful tools becauseit is a friendly user which it is able to recharge back and it has a switch to turn the deviceon and off. In addition, this device will automatically connect to the multimeter when theswitch is switched on and the multimeter Bluetooth communication is also open.

Chapter 11: -Future Scope

In the future we can connect the glasses to different devices through Bluetooth and specific actions can be done.

Chapter 12: -References

[1] Marie-Christin Ostendorp, Jan Charles Lenk, Andreas Lüdtk (2015) "Smart Glasses to Support Maritime Pilots in Harbor Maneuvers," Procedia Manufacturing, vol. 3, pp. 2840–2847.

[2] https://www.researchgate.net/publication/327051350_Wearable_Smart_Glass_Features_Applications_Current_Progress_and_Challenges

[3] Junya Kawaia, Hiroyuki Mitsuharaa, Masami Shishiboria (2015) "Tsunami Evacuation Drill System Using Smart Glasses," Procedia Computer Science, vol. 72, pp. 329–336.

[4] https://www.mdpi.com/2076-3417/11/11/4956

[5] Charlotte Romarea,b, Ursula Hass c, Lisa Skar (2017) "Healthcare professionals' views of smart glasses in intensive care: A qualitative study," Intensive and Critical Care Nursing, vol. 45, pp.66-71.

[6] Ken Bowron. Electrical Incident Safety Report 2016-17, 2017, Department of Mines, Industry Regulation and Safety.

[7] https://link.springer.com/article/10.1007/s41133-021-00053-3

[8] Jessica G. Shih, MD, Shahriar Shahrokhi, MD, FACS, FRCSC, Marc G. Jeschke, MD, PhD, FACS, FRCSC (2016) "Review of Adult Electrical Burn Injury Outcomes Worldwide: An Analysis of Low-Voltage vs High-Voltage Electrical Injury," . Journal of Burn Care & Research, vol. 38, no. 1, pp.e293-e298.

[9] https://turcomat.org/index.php/turkbilmat/article/download/669/467/1167

[10] Robert Holloway and Shreveport (2018) "Electrical distribution system" U.S. Patent

9,899,819. Robert J.Ward, Caleb R. Thompson, Brian L.Timmons (2018) “High Voltage Training Device and System and Method Thereof,” U.S. Patent Application 15/639,711.

[11] Giovanni Luca Amicucci, Maria Teresa Settino (2017) “Accidents with injuries or death during non-electrical work activities near overhead power lines,” In Environment and Electrical Engineering and IEEE Industrial and Commercial Power Systems Europe (EEEIC/I&CPS Europe), IEEE International Conference on, pp. 1-6.

[12] http://www.vs.inf.ethz.ch/edu/FS2014/UCS/reports/HermannSchweizer_SmartGlassesTechnologyApplications_report.pdf

[13] R. Andrew Wall, Tuomas Vallius, Pietila Pasi, and Keita Oka (2017) “Waveguide-based displays with anti-reflective and highly-reflective coating,” U.S. Patent 9,891,436.

[14] https://www.academia.edu/43464817/Issues_on_Smart_Glasses_Technology_Adoption

[15] David Alan Smith, Gregory A. Harrison, Gary E. Wiese (2014) “Head-mounted display apparatus employing one or more reflective optical surfaces” U.S. Patent 8,625,200.

[16] https://ijsrcseit.com/paper/CSEIT1949194.pdf

[17] https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3645375

[18] Alan Transon, Adrien Verhulst, Jean-Marie Normand, Guillaume Moreau, Maki Sugimoto (2017) “Evaluation of Facial Expressions as an Interaction Mechanism and their Impact on Affect, Workload and Usability in an AR game,” In VSMM 2017-23rd International Conference on Virtual Systems and Multimedia, pp. 1-8.

[19] Design and Development of Arduino Data Glasses by Muhammad Azmi Bin Ismaon in 2019 published by UTEM.

[20] R. Andrew Wall, Tuomas Vallius, Pietila Pasi, and Keita Oka (2017) “Waveguide-based

displays with anti-reflective and highly-reflective coating," U.S. Patent 9,891,436.

[21] https://electronoobs.com/eng_arduino_tut147.php

[22] https://www.instructables.com/Arduino-Data-Glasses-for-My-Multimeter/

Appendix A

Components List and Cost

Components	Quantity	Price (Rs)
9V Battery	1	25
Capacitor	1	10
Switch	1	15
Arduino Pro Micro	2	2*400 = 800
Bluetooth HC05	2	2*280 = 560
Voltage Sensor	1	70
Wire	2	2*30=60
3.7 LiPo Battery	1	120
MT3608	1	100
Battery Charger	1	60
0.96 OLED Display	1	250
Total		**2070**

Table Appendix A: Components List and Cost