Palestine Polytechnic University
College of IT and Computer Engineering
Computer System Engineering Department

Project Title:

Electronic Component Tester

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الإهداء

إلى المعلم الاول وشمعة هذا الكون المنيرة على مر الزمان

سيدنا وحبيبنا "محمد عليه الصلاة والسلام"

الى من رضاهم من رضا ربي..

إلى من نَّور بالحنان دربي..

إلى كل اسم يبدأ بالألف و ينتهي بالياء..

إلى الشموع التي احترقت لتضيء دربي..

إلى العيون التي سهرت معي الليالي..

أمي...أبي

إلى من هم أقرب ألينا من روحنا

إلى من شاركونا حضن الام وبهم نستمد عزتنا وإصرارنا

إخوتنا...أخواتنا

إلى من آنسنا في دراستنا وشاركنا همومنا

إلى من سرنا معهم الدرب وعانقنا النجاح سوية

أصدقاؤنا

إلى روح والد زميلنا نديم العطاونة- **محمود العطاونة**- رحمه الله

إلى الذين رسموا بدمائهم حدود الوطن.. الذين لهم المجد يركع

الشهداء

إلى الذين يقبعون خلف القضبان.. عمالقة الثورة..

إلى كل الأحبة والأصدقاء..

إلى كل من سال دمه من جرحى وشهداء..

إليهم جميعاً نهدي هذا العمل.

الشكر والعرفان

إلهي لا يطيب الليل إلا بشكرك ولا يطيب النهار إلا بطاعتك.. ولا تطيب اللحظات إلا بذكرك.. ولا تطيب الآخرة إلا بعفوك.. ولا تطيب الجنة إلا برؤيتك جل جلالك.

رسولنا من بلغت الرسالة وأديت الأمانة.. ونصحت الأمة.. عليك أفضل الصلاة والسلام.

نتقدم بجزيل الشكر والامتنان إلى جامعتنا **" جامعة بوليتكنك فلسطين"** التي احتضنتنا طوال فترة دراستنا في كلية هندسة الحاسوب وتكنولوجيا المعلومات.

ولابد لنا ونحن نخطو خطواتنا الأخيرة في الحياة الجامعية من وقفة نعود إلى أعوام قضيناها في رحاب الجامعة مع **أساتذتنا** الكرام الذين قدموا لنا الكثير باذلين بذلك جهودا كبيرة في بناء جيل فنتقدم بجزيل الشكر والتقدير لهم جميعا.

وقبل أن نمضي نقدم أسمى آيات الشكر والإمتنان والتقدير والمحبة إلى مشرفينا الاستاذ **عليان ابو غربية** والاستاذ **وائل التكروري**، اللذان تفضلوا بالإشراف على هذا المشروع فجزاهما الله كل خير ولهما منا كل التقدير والاحترام على جهودهما الطيب في سبيل تعليمنا.

نتقدم بجزيل الشكر والإمتنان إلى الاستاذ **علاء التميمي** الذي ساعدنا في طباعة لوحة مشروعنا داخل مختبرات الجامعة.

وصولاً **لأهلنا الاعزاء** والذين لولاهم لما وصلنا لما نحن فيه اليوم، والذين لطالما تحملونا واخذوا بايدينا لبر النجاح، فلكم أولياء أمورنا الشكر والتقدير، والفخر والعز، ها أنتم زرعتم واليوم تحصدون وإيانا نجاحنا.

لا ننسى أيضا **اصدقائنا ورفاق الدرب**، زملائنا الذين لطالما اشتركنا واياهم الهموم والافراح وتركوا فينا أجمل الذكريات وزرعوا فينا بذرة الحياة وتعلمنا من مواقفنا معهم كيفية البدء بمواجهة التحديات ومصاعب الحياة.

وفي النهاية نتقدم بجزيل الشكر والعرفان إلى كل من ساهم في إنجاز هذا العمل المتواضع.

Abstract

The component tester used to check if electronic components used in projects are functional or not.

This project used small and low-cost components to build a system that detects the defected components in laboratories and electronics shops. It consists of PC application, USB Cable, Arduino Mega 2560, sockets and PCB board.
The component tester is built by connecting Arduino Mega microcontroller with components sockets, each component has a special socket to test it on board, the PC application is connected to Arduino Mega via USB cable to make it work as the interface allowing user to choose specific component and show the user the steps to connect a component to the tester and show the result of testing.

At the end of the project, it has achieved all its objectives and implement components tester based on Arduino Mega, using PC application as interfaces to provide the easiest environment for the user and giving the opportunity to choose specific components to test, also it is expected to produced a business product that can be supplied to electronic stores and electrical/electronic labs in universities.

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Chapter 1

Introduction

1.1 Overview of the Project

Electronic components /modules are used in almost all electronic projects, which are used today. Projects can contain different types of components on it like (display units, input units, sensors, motors and jumper wires).

Before implementing a design and connecting electronic components to any designed systems it is a must to ensure that these components are functional and because most of the components in the market are not guaranteed or may be damaged after using it. There must be a device to verify these components easily, in addition some components needs a special testing circuit and to write a program and upload it to a microcontroller to check whether it works or not. That makes us think deeply to work on this idea which can solve all these problems using low cost and obtainable elements.

1.2 Motivation and Importance

The electronic components are very important to use for students and teachers for making experiments and projects. To make sure all the components are functional; because most of the components in the market are not guaranteed or and with the probability of being defected, we need the tester to verify it. In fact, some components may need a special circuit and write a code to check whether they work or not and this takes more effort and time for testing. That motivates us to think deeply about how to solve this problem by exploiting available resources and very daily used devices to support the education and the experiments by designing and implementing a low cost, easy to use and available for all users especially students. This project can also be used by the owner of electronics shops to make sure all the components are functional which at the end saves effort and time.

1.3 Objectives

The main objective of this project is to build a device with suitable size, reasonable cost and user-friendly to detect defective components using:

1. An application on PC as the interface (choose the type of component and view the result of the test, and show the user the steps to connect a component on the device) connect with Arduino Mega by USB.

2. Arduino Mega 2560 to connect sockets and test components.

3. Special sockets for each component on board.

4. Some components may need special circuits to check whether they work or not.

1.4 Description of the Project

This project is mainly built to test electronic components by connecting them to the Arduino Mega. It consists of hardware part which includes a special socket for each component built on a board (PCB) connected with Arduino Mega to process data, and connected with PC via USB cable.

The Java-developed application acts as GUI to allow user to choose the name of components then show the user the correct socket for each component and steps of how to connect each component on specific socket and testing steps then show the result after complete testing. The software part and hardware part are working together to provide the result of testing.

Result of testing component can be classified into two classes:

- Result of testing seen on component itself and no need to show result in application, i.e., LED, LCD 2X16.
- Result of testing shown on application i.e., jumper wires, ultrasonic sensor

1.5 Problem Statement

1.5.1 Problem analysis

This project was mainly built to solve the problem of defective or malfunctional electronic components when purchased from stores or after their frequent use in projects and laboratories, and the testers in the market are difficult to use and are limited in the number of components that can be tested. In this way, all previous problems are solved and the tester becomes available for all people.

1.5.2 List of Requirements

The system should have the following requirements:

1. Special sockets for each component on board.
2. Some components may need special circuits to work like resistors, wires.
3. PC application as user interface, it should meets the following needs:
   - Show the user a menu to choose the component name for testing.
   - Show the user the correct socket for each component and steps to connect components on the specific socket and testing steps.
   - Show the result after completing testing.

1.5.3 Expected results

At the end of the project, it is expected to achieve all its objectives and design and implement the components tester based on Arduino Mega, using PC application as interfaces to provide the easiest environment for the user and giving the opportunity to choose specific components to test.

The component tester is inexpensive, user friendly and is a business product to use by using the PC Application as the interface (choose the type of component and view the result of the test, and show to user steps to connect component on the device) connect with Arduino Mega by USB.

1.6 Overview of the rest of report sections

Report consists of six chapters; the following is a brief description of the topics that are covered in each chapter:

Chapter 1: Introduction

This chapter presents general idea about the project and its importance, and also motivation and importance, objectives, short description of the system, and Problem Statement (Problem analysis, list of requirements, expected results).

Chapter 2: Theoretical Background

This chapter talks in more details about the basic component used in the project, theoretical background, literature overview, and design constraints.

Chapter 3: Design

This chapter details the design concepts and shows the general block diagram of the system, schematic diagrams, and explains how system works.

Chapter 4: Software and Hardware Implementation

This chapter describes the implementations of the software and the hardware components that are used in this project, such as the circuit connection, microcontroller, the IDEs used to build the project codes, and the user interface.

Chapter 5: Validation and Testing

In this chapter, we will describes and discusses the steps, results of the implementation, and testing of the hardware and software parts.

Chapter 6: Conclusion

In this chapter gives information about conclusion and provides for more feature that can be done in the future.

Chapter 2

Background

2.1 Overview

This chapter describes briefly the theoretical background of the project, literature overview, short description of the hardware and software parts that are used in the system.

2.2 Theoretical Background

This section will provide some information about some used technologies in the project.

2.2.1 Printed Circuit Board (PCB)

A printed circuit board is an electrical circuit whose components and conductors are contained within a mechanical structure. Conductive features include copper traces, pads, heat sinks, or conductive planes. The mechanical structure is made with insulating material laminated between layers of conductive material. The overall structure is plated and covered with a non-conductive solder mask and silkscreen to legend electronic component location.

Electronic components are added to the outer layers of the printed circuit board when all the layers have been etched and laminated together. Surface mount parts are automatically applied with robots and through-hole parts are manually placed. All the pieces are then soldered onto the board using techniques such as reflow or wave soldering. The final assembly is plated after which the solder mask and silkscreen legend are applied [1].

2.2.2 Arduino

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs light on a sensor, a finger on a button, or a Twitter message and turn it into an output activating a motor, turning on an LED. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the

Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing.

Arduino was born at the Ivrea Interaction Design Institute as an easy tool for fast prototyping, aimed at students without a background in electronics and programming. As soon as it reached a wider community, the Arduino board started changing to adapt to new needs and challenges, differentiating its offer from simple 8-bit boards to products for IoT applications, wearable, 3D printing, and embedded environments. All Arduino boards are completely open-source, empowering users to build them independently, and eventually adapt them to their particular needs. The software, too, is open-source, and it is growing through the contributions of users worldwide. [2].

2.3 literature Overview

There are no component tester devices in the markets similar to our proposed device, but there are component tester devices only for one type of component, and also few projects and scientific researches about a similar topic like IC tester.
This section shows studies and projects that handle and implement IC Tester, and lists their features, and limitations. In addition to make a comparison between our project and Mobile-Based Digital IC Tester (implemented in PPU).

2.3.1 IC testers in the markets

This section will show the most famous IC tester in the markets, their features and limitations.

Kitek Universal IC Tester

Figure 2.1 :Kitek Universal IC Tester

Features:

Can test more than 1500+ ICs, tests a wide range of Digital IC's such as 74 Series, 40/45 Series,8085, 8086, Z80 ,8255, 8279, 8253, 8259, 8251, 8155, 6264, 62256, 8288 and 8284, tests a wide range of Analog IC's such as Op-amps, Timers, Transistor Arrays, Analog switches, Opto-couplers, ADC, DAC, Voltage Regulator, etc, tests 7- Segment display of common cathode and common anode type, auto search facility of all Digital ICs amd 40 pin DIP ZIF socket, 50 cherry keys Keypad and 16X2 LCD Display [3].

Limitations:

Very expansive, very heavy, not portable, limited to IC family only.

2.3.2 Scientific Theoretical IC testers projects

This section discusses some scientific theoretical IC testers projects, summarize them.

2.3.2.1 Mobile-Based Digital IC Tester

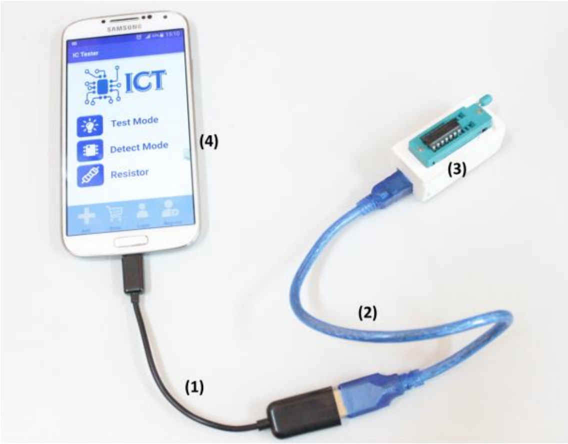

Figure 2.2 :Mobile-Based Digital IC Tester

•Authors:

- Amany Taweel.
- Sundos Mujahed.

• Year: 2017

• University: Palestine Polytechnic University.

• Summary:

This project is mainly built to test digital ICs by connecting them to the Android mobile. It consists of a hardware part which includes an inventive socket and Android mobile connecting to each other by OnTheGo (OTG) cable to make the mobile act as the host to be the main processor, and the software part which is a built-in Android application and a website [4].

2.3.2.2 Development of PC-Based Digital IC Tester Using Bluetooth

•Authors:

- Yusri Mohammad.
- Ahmad Badarudin.

• Year: 2015

• University: University Technical Malaysia Melaka

• Summary:

This project focuses on how to design and develop an IC tester using microprocessor and PC. It consists of PC, PIC 16F877A (The main processor), Bluetooth and ZIF. It is Small and friendly user tester [5].

2.3.3 Comparison

This section shows a comparison between our electronic component's tester and the IC testers projects in PPU which are mentioned in section 2.3.2.

	Mobile-Based Digital IC Tester	Electronic Components Tester (our project)
Microcontroller	Arduino Nano.	Arduino Mega 2650.
Number of sockets	One socket.	15 sockets.
User interface	Mobile application.	Desktop application.
Main processor	Smart phone.	Microcontroller (Arduino Mega).
Components Tested	Digital IC.	Electronic components.
Type of cable	OTG cable	A to B USB cable.

2.4 System Hardware Components

In this section we illustrate the hardware components we will use to build the system, why we choose them and how some of them work:

1.Personal computer (PC): it must use an windows operating system and support USB cable feature.

2. A to B USB cable (USB printer cable): the Mega 2560 automatically draws power from the USB cable and connects the board to a computer (send and receive data).

3.Printed Circuit Board (PCB): is used to connect electronic components using conductive tracks, pads, and other features etched from copper sheets laminated onto a non-conductive substrate.

4.Arduino Mega 2560: is the main processor, simply connect it to a computer with a USB cable, and it provides a substantial number of I/O pins (54 digital I/O pins, 16 analog inputs) and program space as well.

5.Sockets: we use different types of sockets each socket for a special component.

2.5 System Software Components

2.4.1 Software Tools

1.Java editor (NetBeans): used to develop the PC interface application. (run + development).

2.Arduino IDE: used to program Arduino mega microcontroller. (development)

2.4.2 Used programming Languages

• Java.

• Arduino C/C++.

2.6 Design constraints

- The port of the component tester must not be busy.
- Only one component added to the tester at a time.
- Follow the steps of the test shown in the user interface.
- The component must be placed in its socket in the specified direction.
- The component tester must not disconnect from the PC during the test.
- The disconnect button in the user interface must not press when the test is running.

Chapter 3

System Conceptual Design

3.1 Overview

This chapter discusses the conceptual design of the system, it shows a system requirement analysis, a block diagram of the system, flow charts, and a schematic diagram.

3.2 Brief description of the System

Our system designed to test electronic components by connecting them to the Arduino Mega. It consists of a hardware part which includes a special socket for each component built on a board (PCB) connected with Arduino Mega to process data, and connected with PC via USB cable. The software part which is a built-in java act as the interface. The software part and hardware part are working together to provide the result of testing.

3.3 Design Options

During our work, we've encountered many alternatives. These include:

1. **Microcontroller or Microcomputer Options:**
   - First Design Option: Use Arduino microcontroller.
   - Second Design Option: Use Raspberry pi microcomputer.
   - Chosen Design Option: The first approach was chosen because it provides more input-output pins, and our project simply does not need a microcomputer for less processing also in terms of cost Arduino is lower in cost than RPi.
2. **Arduino Options:**
   - First Design Option: Use Arduino Mega 2560.
   - Second Design Option: Use Arduino Uno.
   - Chosen Design Option: The first approach was chosen because it provides a substantial number of I/O pins (54 digital I/O pins, 16 analog inputs) and program

space as well. And there’s no denying that this board brings performance with the running of an ATmega2560.

3. **Board Options:**
    - First Design Option: Use Printed Circuit Boards (PCB).
    - Second Design Option: Use breadboards or perfboard with wires soldering.
    - Chosen Design Option: The first approach was chosen because it is more widely used. The reason is simple enough (Compact size and saving of wire, the components are fixed).
4. **User interface Options:**
    - First Design Option: Use a PC application.
    - Second Design Option: Use mobile application.
    - Chosen Design Option: The first approach was chosen because it is an easy-to-use environment, available in places where users can use this project (laboratories, electronic shops), and more interactive.
5. **The components selected for tested:**

The components in the projects are divided into several groups and the most common and widely used were chosen, after consulting laboratory supervisors and some owners of stores selling electronic components, these groups are display units, input units, sensors, motors, and jumper wires.

The following are the list of components that can be tested by the system:

- LEDs (2.7 - 3.3 V).
- Seven segments (common anode).
- IR Sensor Module Obstacle Detection (2-30 cm).
- LDR.
- LCD 2×16.
- Ultrasonic sensor (hcsr04).
- LED Matrix 8×8(red matrix).
- Servo motor (9g, mg996r).
- DC Motor(3-5v).
- DIP Switch (2,4,8 or 10 pins).

- Humidity temperature sensor (DHT11/22).
- Bluetooth Module(hc06).
- Push buttons (normally open, normally close).
- Speaker (8 ohm).
- Buzzer(3-5v).
- Jumper Wire (male to male, male to female, female to male).
- 4×4 keypads.

3.4 Systems diagrams

3.4.1 Block diagram

The PC application acts as the interface to enable the user to choose the component, then identifies the correct socket for each component and explains the steps of how to connect each component to the specified socket and the testing steps. Then sends the name of the component to the Arduino Mega via USB cable, then the Arduino runs the specific code for the selected component (send data), The component will respond to this code either in a correct manner so it will be a good one or not so that it is defective.

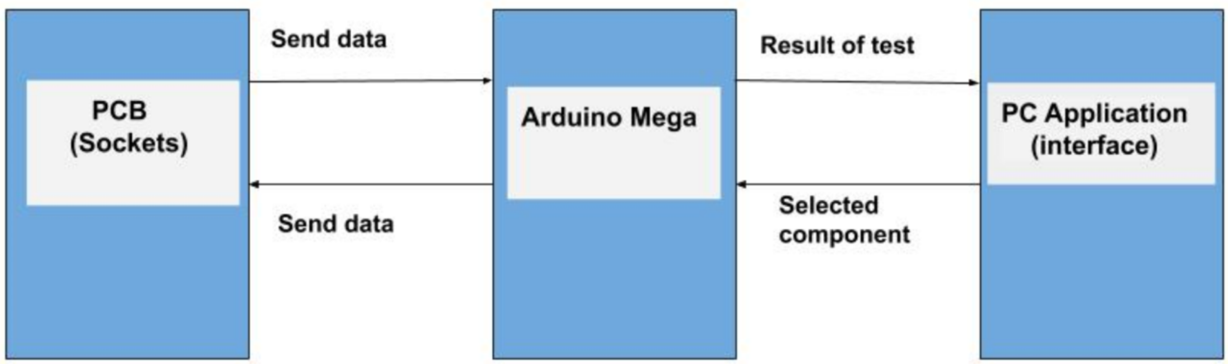

Figure 3.1: Block diagram

3.4.2 Schematic diagrams

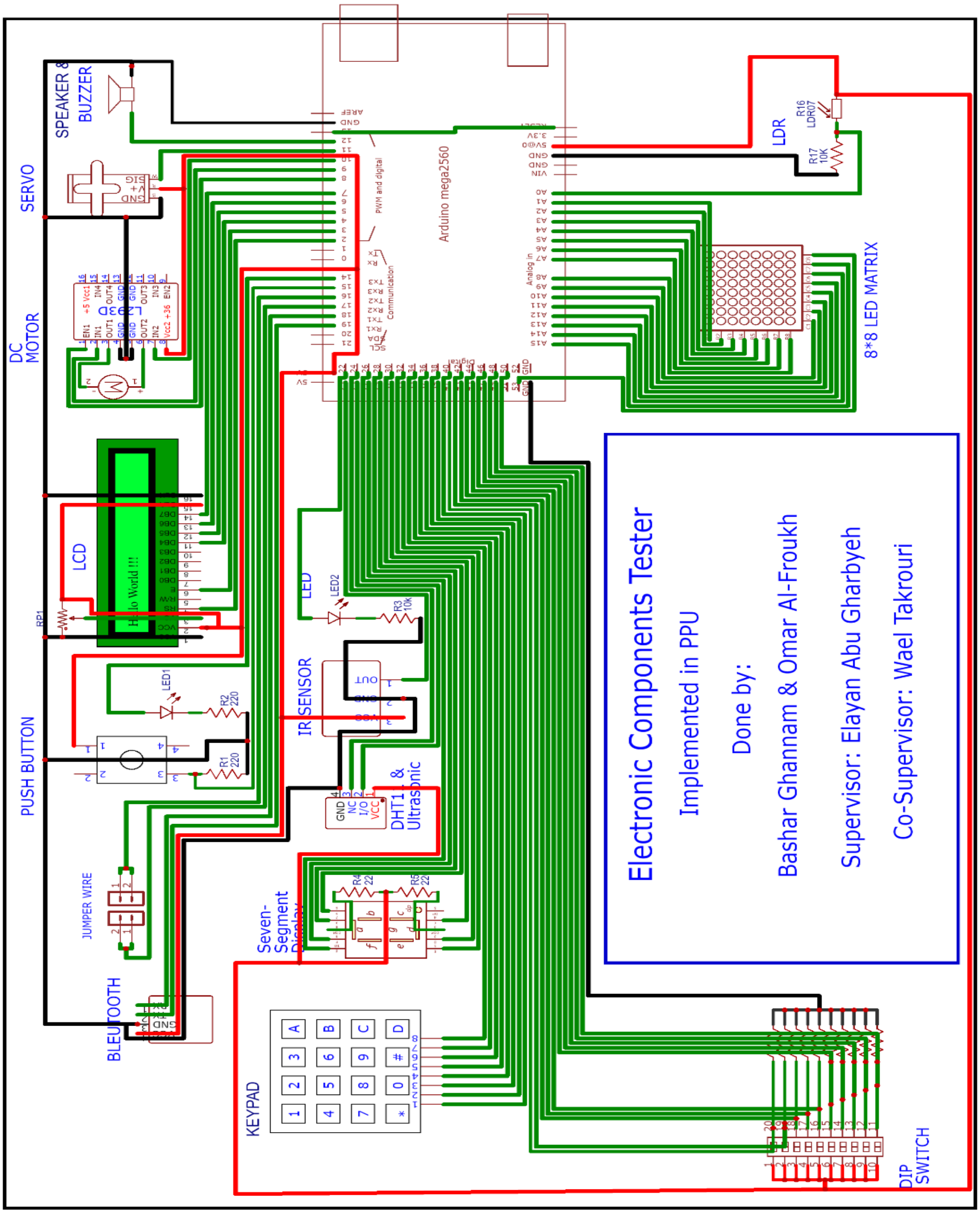

Figure 3.2: Schematic diagrams

3.5 System Flowchart

The first step in the system is to connect the component tester to PC then open the PC application, and after that choose the name of component to be tested, the system will verify that the component name has been chosen, then shows the user the correct socket for each component and the steps to connect each component on the appropriate socket and the testing steps then show the result after completing testing. The software part and hardware part are working together to provide the result of testing, and result of testing component can be classified into two classes the first results shown to user directly on component from changing the current state i.e., running, emitting (visual), and the second display the status good or defected to user in user interface (not visual).

Figure 3. 3: Flowchart

Chapter 4

Software and Hardware Implementation

4.1 Overview

This chapter describes the implementations of the software and the hardware components that are used in this project, such as the circuit connection, microcontroller, the IDEs used to build the project codes, and the user interface.

4.2 Software Implementation tools

This section will provide some information about the main programs and software technologies used in our project:

4.3.1 NetBeans IDE (User Interface)

Is a free and open-source integrated development environment for application development on Windows, Mac, Linux, and Solaris operating systems. The IDE simplifies the development of web, enterprise, desktop, and mobile applications that use the Java and HTML5 platforms [6]. In our project, we used NetBeans IDE to build a user interface (choose the type of component and view the result of the test, and show the user the steps to connect a component on the device as show in figures 4.1-4.7) using Java programming language.

- The user interface allows searching for all available ports on the personal computer as show in figure 4.1.

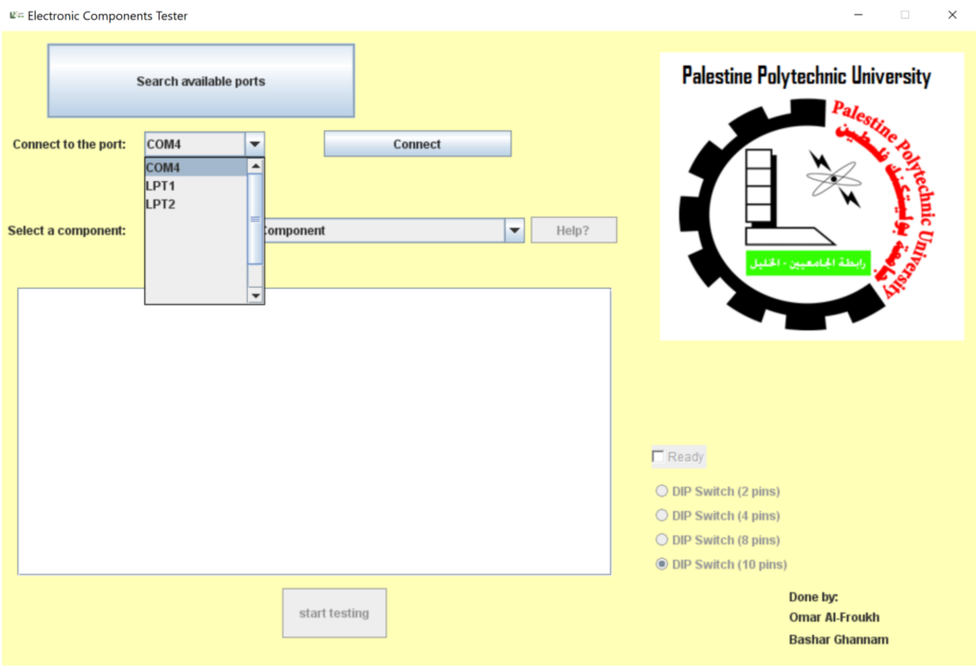

Figure 4.1: Search and view available ports

- The user interface allows selecting a specific port and connects with it as show in figure 4.2.

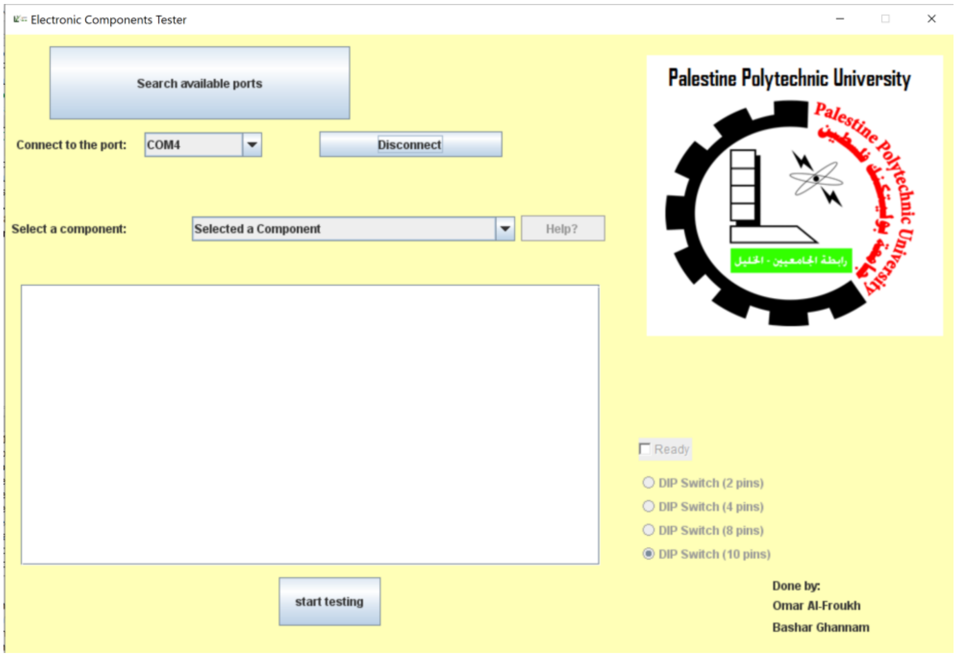

Figure 4.2: Select and connect with port.

- The user interface views all names of components available to test as show in figure 4.3.

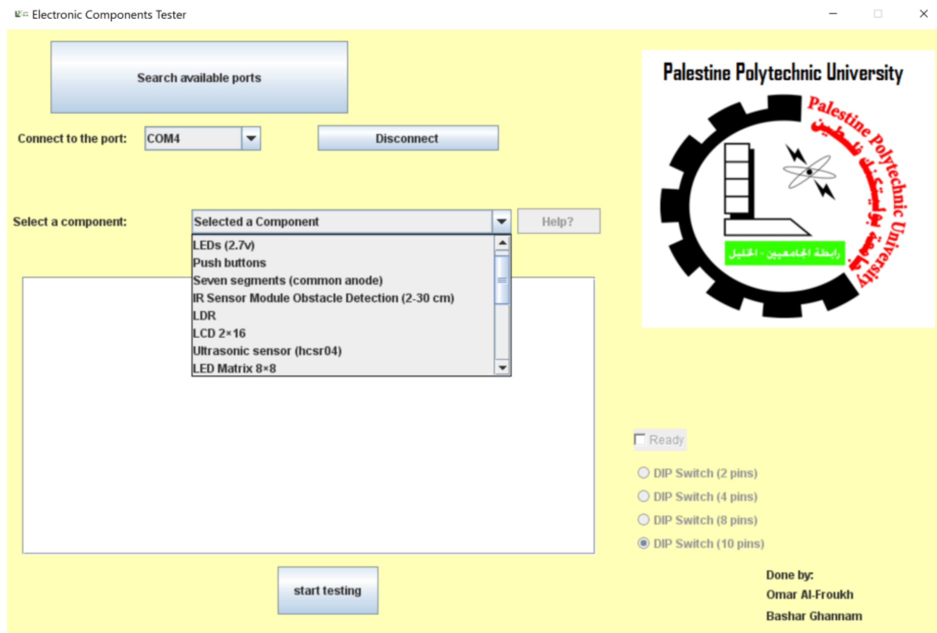

Figure 4.3: View all names of components available to test.

- The user interface views the steps to connect a component in a special socket as show in figure 4.4.

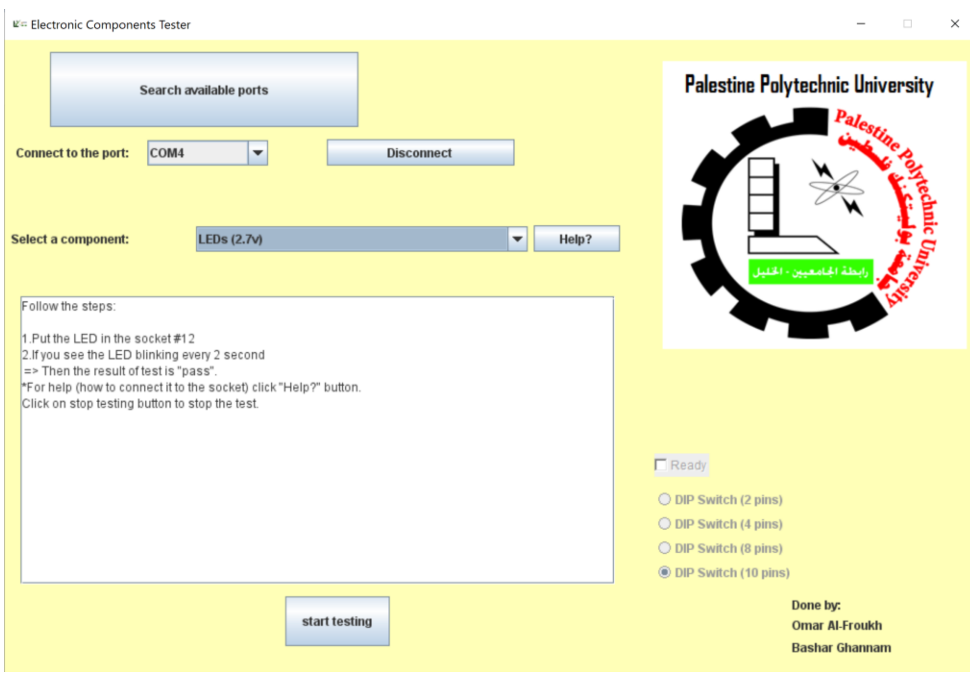

Figure 4.4: View the steps to connect a component in special socket.

- The user interface views images on how to connect a component in a special socket as show in figure 4.5.

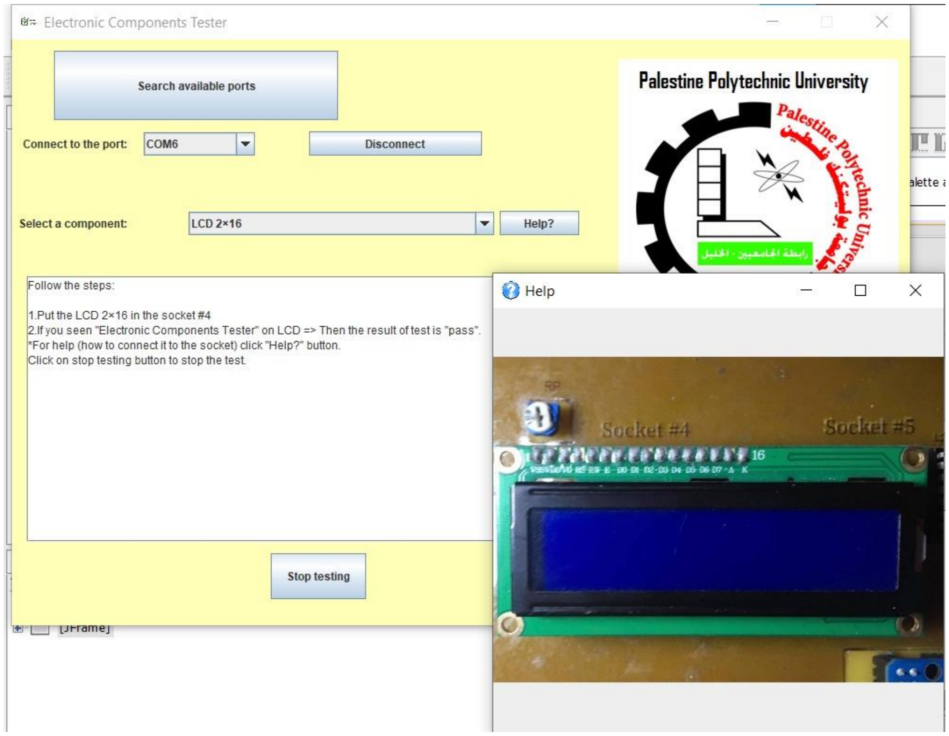

Figure 4.5: View image to how connect a component in special socket.

- The user interface allows to Stop testing (if this result visual) as show in figure 4.6.

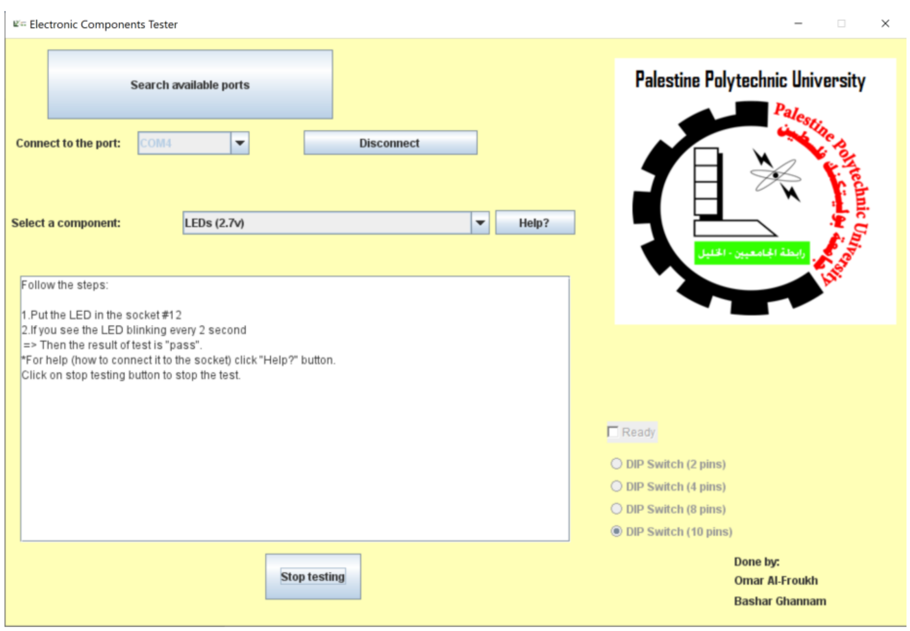

Figure 4.6: Stop testing (if this result visual).

- The user interface views the result of the test (if this result not visual) as show in figure 4.7.

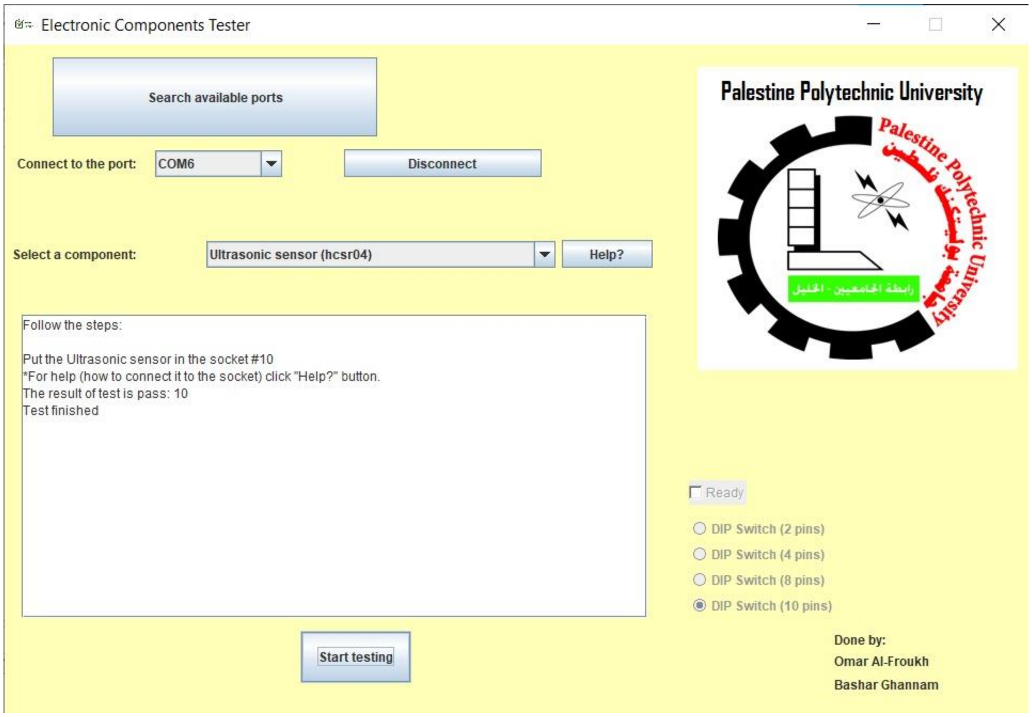

Figure 4.7: View the result of test (if this result not visual).

4.3.2 Arduino IDE (Arduino Software)

The open-source Arduino Software (IDE) makes it easy to write code and upload it to the board. This software can be used with any Arduino board [7]. In our project, we used Arduino IDE to writing code (each component owns part from code to test it is functional or not) then make sure there are no errors to upload the program into Arduino Mega.

4.3.3 EasyEDA (PCB designer)

Is an easier and powerful online PCB design tool that allows electronics engineers, educators, students, makers, and enthusiasts to design and share their projects [8]. This is a design tool integrated LCSC components catalog and PCB service that helps users to save time to make their ideas into real products. In our project, we used EasyEDA to design circuits then use this design to print it into PCB.

4.3 Hardware Implementation

This section will provide some information about the hardware implementations done through our project:

4.3.1 Hardware development

Hardware development passed through three phases as the following:

1. **Testing the circuit**

In order to make sure that the circuits are work well we first tested the circuits in breadboards, as show in figure 4.8.

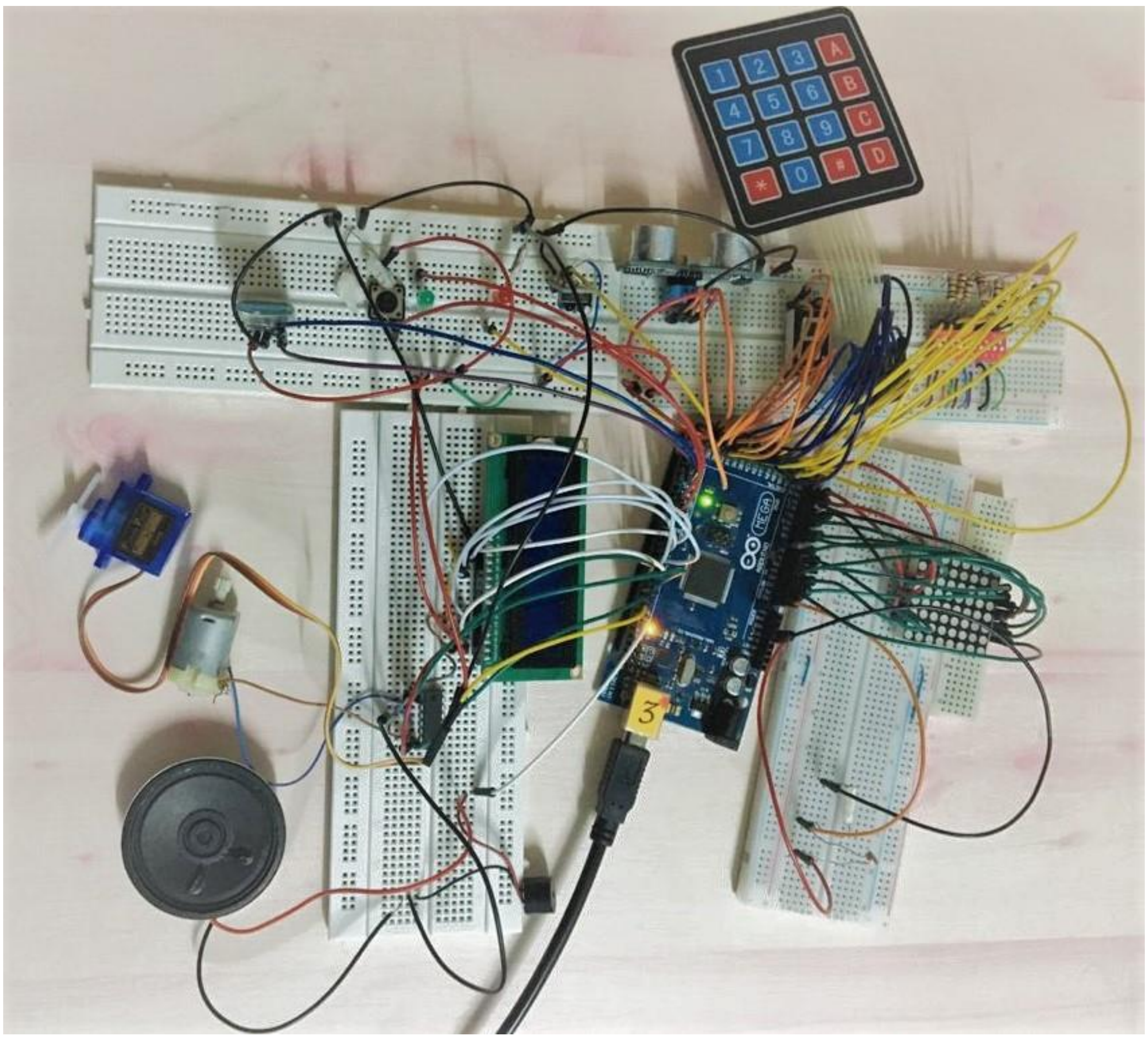

Figure 4.8: All circuits in breadboards

2. **PCB design.**

- First, design the schematic circuits in EasyEDA, as show in figure 3.2 from chapter 3.
- Second, covert these schematics into PCB design, as show in figures 4.9 & 4.10.

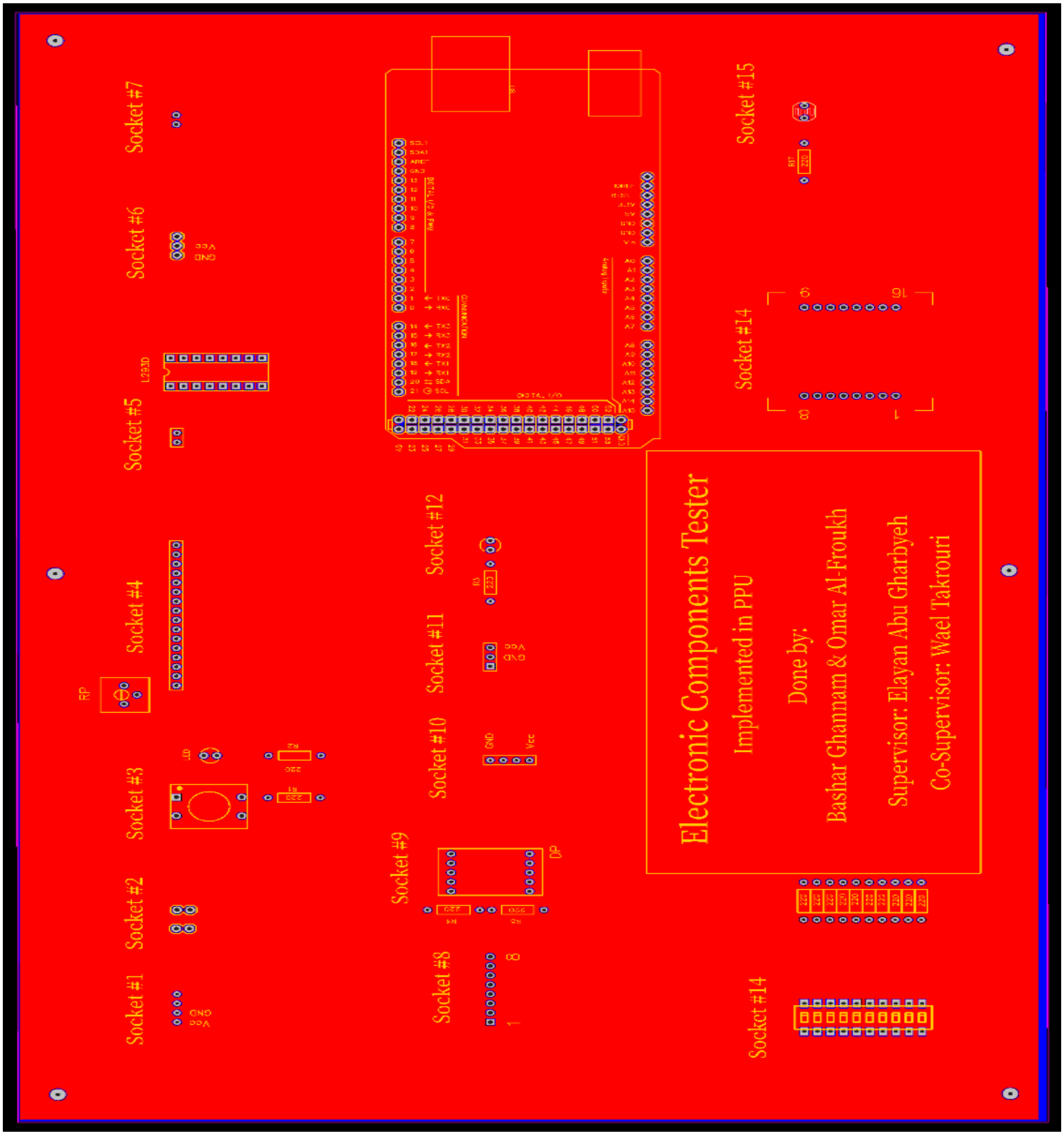

Figure 4.9: Top layer PCB design.

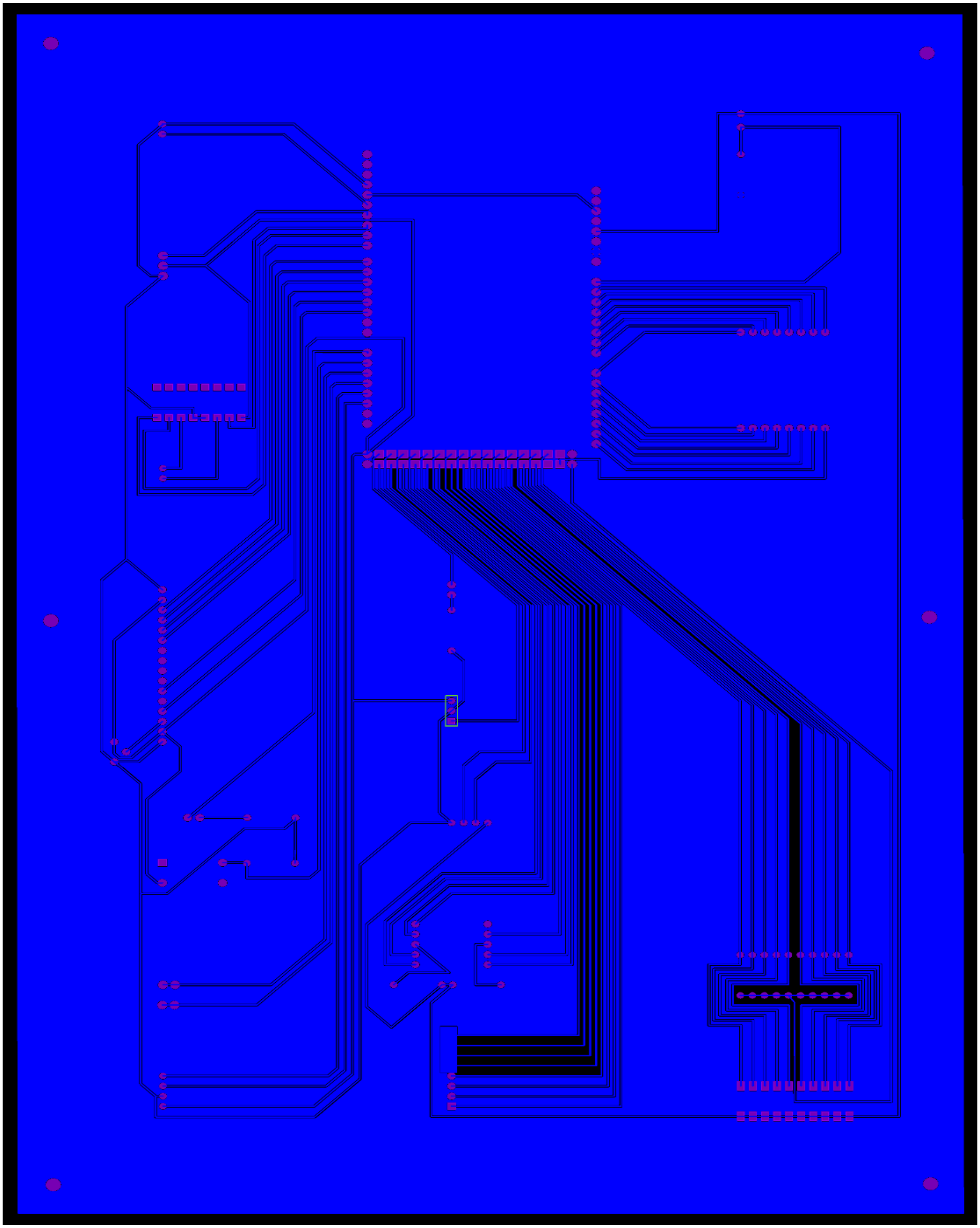

Figure 4.10: Bottom layer PCB design.

- Third, print the above circuits in the PCB printer to get the desired PCB, as show in figure 4.11.

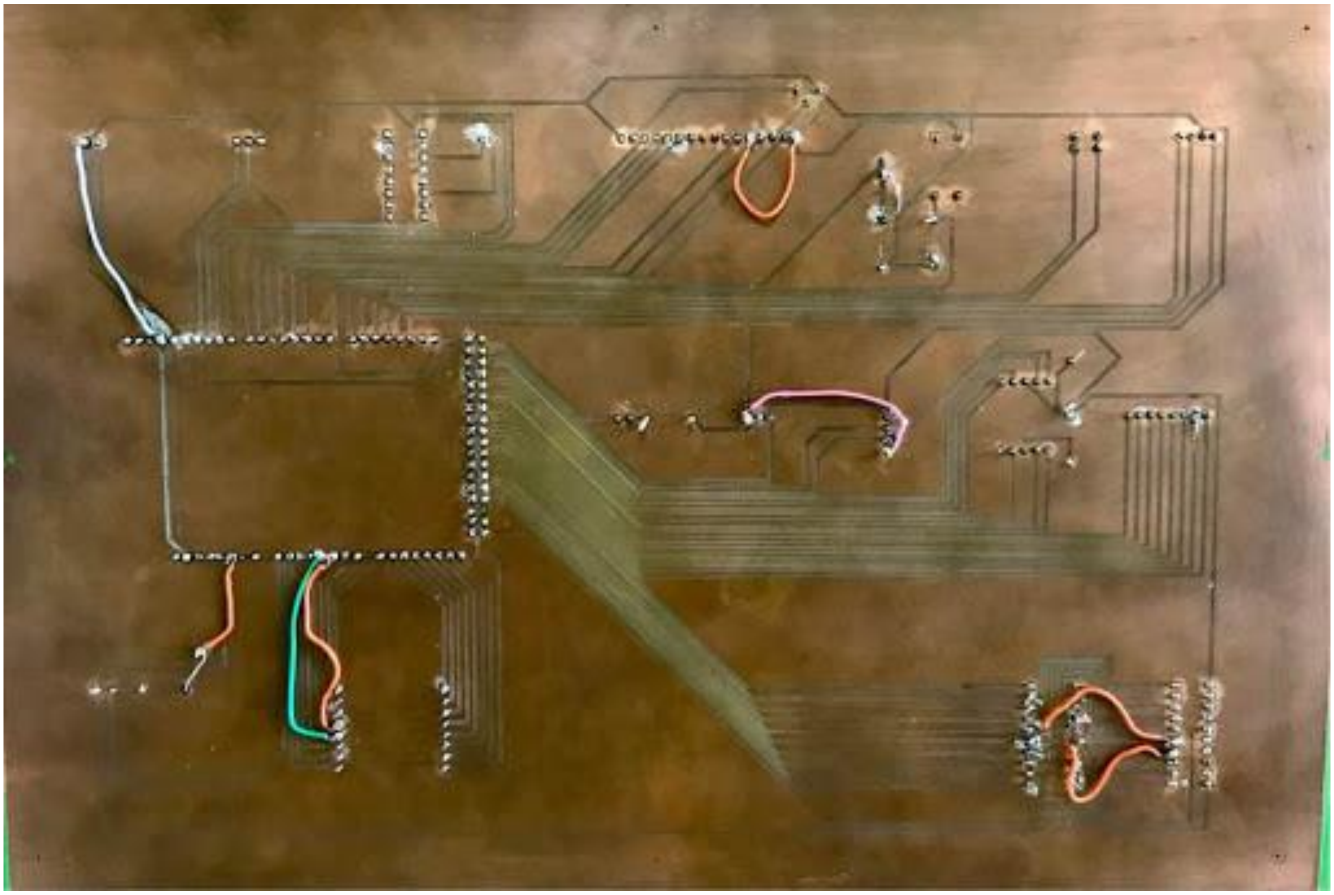

Figure 4.11: Bottom layer of PCB.

3. Welding sockets on PCB.

The final step is to welding the sockets in the printed circuit boards, as show in figure 4.12.

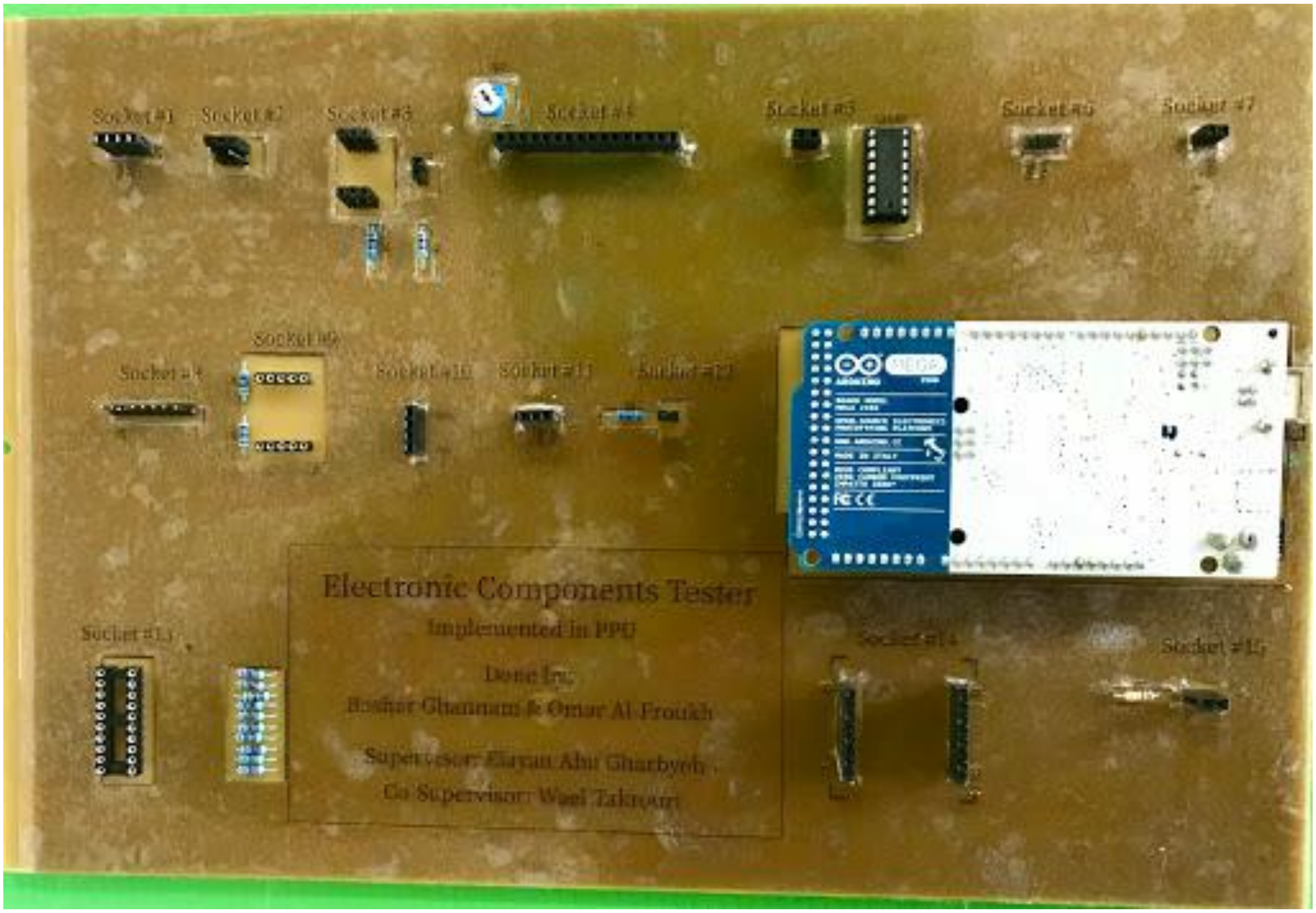

Figure 4.12: Top layer of PCB.

4.3.2 Connecting electronic component tester to the PC

Each component has a special socket to put the component on it to testing. After connecting components tester with PC via A to B USB cable and choose the name of the component to be tested, then sending binary data via A to B USB cable between PC and Arduino Mega, finally Arduino Mega interact with the special socket for component chosen and processing data and sending the result to a PC application, in this way the testing operation is done.

The Figure 4.13 below shows the project with its elements, cable, and how they are connected to each other:

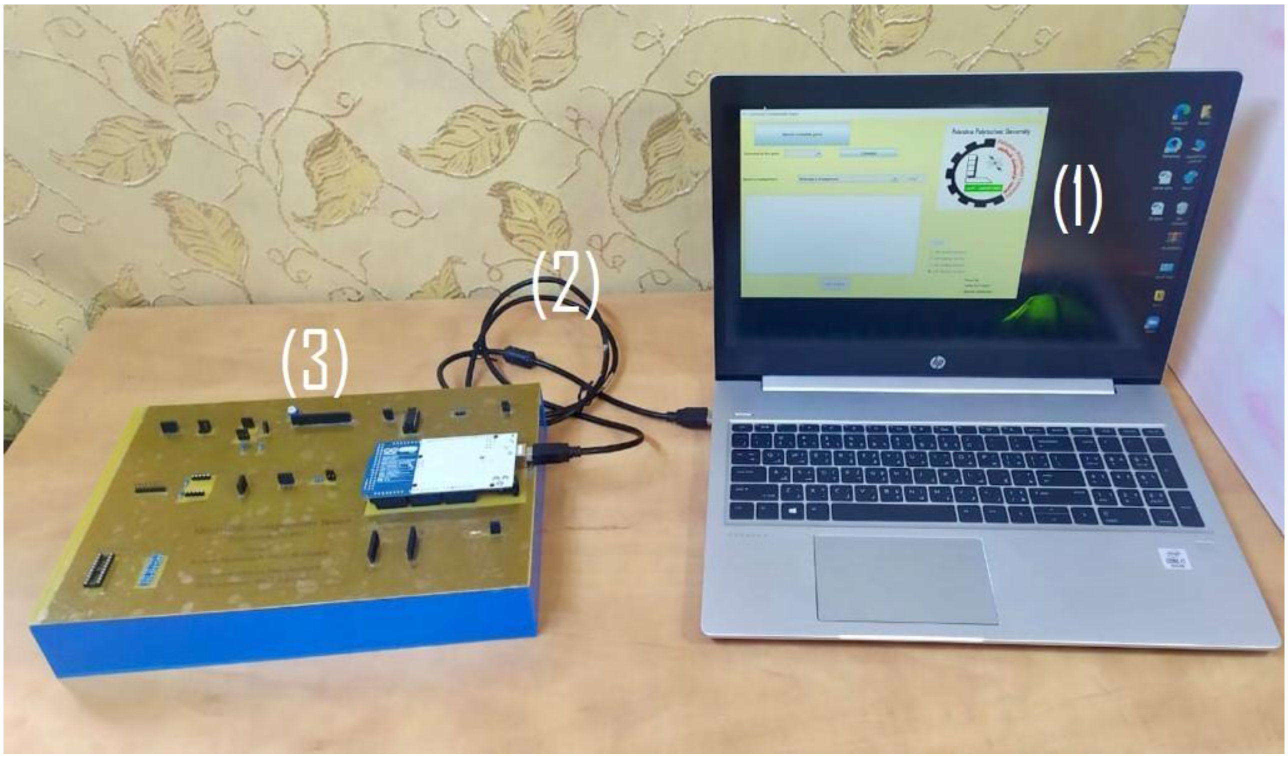

Figure 4.13: Connecting electronic component tester to the PC.

The numbers in the image in Figure 4.13 shows:

(1) PC: Contain application user interface (java application).

(2) A to B USB cable: For connection and supply the components tester with power.

(3) Electronic component tester: Contain Arduino mega as the main processor and special sockets for each component as containers.

4.4 Connecting all Together

The whole system for this project includes the PC application and components tester. In components tester all sockets connecting with Arduino Mega via copper traces in the bottom layer on the PCB. The components tester connected to the PC application via connecting the A to B USB cable between PC, and Arduino Mega which contain code uploaded from Arduino IDE.

After connecting the components tester to the PC. Arduino Mega after that sending and receiving data with the PC application via serial port establish by PC application using java library javaxcomm.

In this way, to do any test. User needs to choose from the menu in the PC application the name of the component they need to test. Then the application shows to the user hints about the selected component which socket fits with it and the correct direction to put it in that socket. Then the PC application sends the selected name to the Arduino Mega which runs the function for the selected component. Finally, there are two types of results for the test is done, the first type which the user should be recognized when the state of the component change such as 8*8 LED matrix blinking every second. The second type the result appears in the PC application such as the keypad when clicking on any button the value of its view in the PC application.

Chapter 5

Validation and Testing

5.1 Overview

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

5.2 Units testing

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

5.2.1 Hardware Testing

After completing the phase of welding the sockets in the PCB, and make sure that all the copper traces conductor between the correct pins and the Arduino Mega pins using a Multimeter device, and then make sure that all the sockets fit the components that will be placed on it.

5.2.2 Software Testing

In this section, we will describe the ways to test the software that we used to implement our system. The software includes the following:

5.2.2.1 Arduino code Testing

We write code for each component to ensure that it works correctly (if the component is functional the result of the test is good, but if it is not functional the result of the test is defect), then all the components codes collected in one file, each of them in one function.

5.2.2.2 PC application Testing (User interface)

The PC application contains many elements, each of them has a different function, and make sure that each one works according to what is expected of it, which are as follows:

- **Search available ports button:** search for available ports in the PC, and view them into ports menu.
- **Connect button:** connect user interface with selected port for component tester from ports menu.
- **Start testing button:** start testing for selected component from components menu.
- **Help button:** View the correct direction to put the component into specific socket by real image.
- **Text area:** View the steps of test and way for put selected component into specific socket and view the result of test if the result not visual or how to know if component functional if the result visual.
- **Ready check box:** we use it in some component need to double test.
- **Dip switches radio buttons:** in dip switch test we need to determined number of dip switches.

5.3 Component testing

In our project, we test 17 components of different groups, each one of them in a different way, the expected result for each component if it is functional as following:

- **LEDs (2.7v):** the LED will light up continuously every 2 seconds.
- **Push buttons:** when push the button, The LED beside it will light up.
- **Seven segments (common anode):** all segment will light up continuously every 2 seconds.
- **IR Sensor Module Obstacle Detection (2-30 cm):** the test will be pass after two steps:
    - First: do not place any obstruction in front of the sensor (not detect).
    - Second: do place any obstruction in front of the sensor (detect).
- **LDR:** the test will be pass after two steps:
    - First: turn on the powerful light above the LDR sensor.
    - Second: Cover the sensor.
- **LCD 2×16:** The text "Electronic Component Test" will be displayed on tested LCD.
- **Ultrasonic sensor (hcsr04):** return to user interface result of test is pass if the distance to Arduino Mega is 10 cm.

- **LED Matrix 8×8:** all LEDs will light up continuously every 2 seconds.
- **Servo motor (9g, mg996r):** the servo motor will goes from 0 degrees to 180 degrees then go back to 0 degrees.
- **DC Motor(3-5v):** accelerate from zero to maximum speed clockwise then decelerate from maximum speed to zero anticlockwise.
- **DIP Switch (2,4,8 or 10 pins):** the test will be pass after two steps:
    - First: put all switches in the one side
    - Second: put all switches in the other side
- **Humidity temperature sensor (DHT11/22):** return to user interface result of test is pass if the humidity value is 35-90% and temperature value is 10-40 C̊.
- **Bluetooth Module(hc06):** we used "AT" command to test it, so if the result of test is pass if Arduino Mega received "OK".
- **Speaker (8 ohm):** If user hear a beep from speaker then the result of test is pass.
- **Buzzer(3-5v):** If user hear a beep from buzzer then the result of test is pass.
- **Jumper Wire (male to male, male to female, female to male):** the result of test is pass if jumper wire is conductor.
- **4×4 Keypads:** when clicking on any button the value of its view in the user interface.

5.4 Integration Testing

After ensuring that all the parts (PC application and components tester) are working well, we started assembling and integrating the parts with each other to make the system ready to work.

Chapter 6

Conclusion

6.1 Overview

In this chapter, we will conclude the challenges, final result and future work of our project.

6.2 Challenges

We faced several problems while working on the project either on Software and Hardware like:

- We used a very small wire width (0.35 mm) to come across between the pins and also limit the size of the PCB, so we had difficult when printing it.
- During welding the sockets, we encountered many problems due to their proximity to each other, which led to damage to some welding pins, so we had to use external wires to solve the defect.
- After the labels were printed on the top layer of the PCB, the print quality was low, so we had to add external labels to solve this problem.
- We had to use Java application instead of processing application due to the difficulty of developing a user interface that meets the needs of our project.
- We had to use a JDK 32-bit instead of 64 bits in order to be able to do a search on the ports available on the PC.

6.3 Final result

At the end of this project, we are very glad to say it achieved all its objectives. Now we have a many socket each of them special for specific component, all socket connected with Arduino Mega which is able to connect with PC and make a testing and show the result.

The electronic component tester is inexpensive, user friendly and is a business product to use by using the PC Application as the interface (choose the type of component and view the result of the test, and show to user steps to connect component on the device) connect with Arduino Mega by USB.

We are very proud of this great achievement to be the first in the world of its type.

6.4 Future work

We suggest to expand our project, for examples:

- Support more version of components and new components.
- Be able to connect it to another operating systems as IOS, android, etc.
- Be able to connect it by Bluetooth.
- Expand it to be a product for sale in the electronic markets.

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