AMERICAN INTERNATIONAL UNIVERSITY BANGLADESH

Faculty of Engineering

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Laboratory Title: **Introduction to PCB Layout Design and Designing a sample PCB Layout.**

Experiment Number: **_03_** Due Date: **__15/06/2022__** Semester: **_Summer 2021-2022_**

Subject Code: **EEE2209** Subject Name: **ENGINEERING SHOP** Section: **D**

Course Instructor: **NUZAT NUARY ALAM** Degree Program: **EEE**

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Introduction to PCB Layout Design and Designing a Sample PCB Layout.

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Abstract*—A printed circuit board (PCB) or printed wiring board (PWB) is a conductive and insulating laminated sandwich construction. PCBs have two distinct purposes. The initial step is to solder electronic components to predefined positions on the outer layers. The second is PCB design, which is the process of creating reliable electrical connections (and also reliable open circuits) between the component's terminals in a regulated way. Each of the conductive layers has an artwork pattern of conductors (similar to wires on a flat surface) that offers electrical connections. Vias, plated-through holes that allow connectivity between layers, are added in another manufacturing process. The PCB schematic, then, is the first part of designing a printed circuit board. It's a pictorial representation, either written or on a computer, that utilizes agreed-upon symbols to describe circuit connections. It also indicates the components that will be used and how they are connected. The PCB design process uses layout software to describe electrical connections on a printed circuit board by combining component placement and routing.Proteus is used to simulate, design and drawing of electronic circuits. It was invented by the Labcenter electronic.With the use of this engineering software, you can construct and simulate different electrical and electronic circuits on your personal computers or laptops.There are numerous benefits to simulate circuits on proteus before make them practically.

Keywords: *PCB Design, Schematic Diagram, PCB Layout, 3d Visualizer, Proteus Software*

I. INTRODUCTION

A printed circuit board is a hard framework that houses electrical circuitry made up of traces, which are embedded metal lines, and planes, which are bigger metal sections. Electronic components are soldered to metal pads on the top, bottom, or both layers of the board. These pads are linked to the circuitry on the board, allowing the components to be connected. A single layer of circuitry, circuitry on the top and bottom, or numerous layers of circuitry stacked together might make up the board. PCB is a acronym of Printed Circuit Board that helps in connecting the electronics components with pads, tracks and lines incorporated on a laminated copper sheet. It is considered as an insulating material which can be developed using epoxy on which copper layer is laminated.In order to get rid of end to end wiring and make the circuit design hassle free, first PCB was developed by Australian Engineer Paul Eisler. With the passage of time demands of electronics became prevalent, this made professionals think they should come up with an ideal solution that made the electronics cheap and incorporated in a lesser space.This was the start of PCB that revolutionized the electronics industry with lots of innovation and productive ideas.Mostly, PCBs are composed of composite material, composite epoxy and fiber glass. These are the most common components used in electronics devices that makes the circuit design sophisticated and compact. PCBs come in different layers and multiple designs. PCBs used in simple electronics are composed of single layer. Most compact and advanced hardware like graphics card and motherboard are composed of multi layers PCBs. PCBs are not associated with computers only, they are widely used in advanced electronics including digital cameras, cell phones, TV, scanners and automatic control systems.[1]

II. SIGNIFICANCE OF PRINTED CIRCUIT

Electronic circuits are always implemented on a printed circuit board (PCB). Every electronic product has its own PCB design, yet there are many different components and devices to choose from, and no one can state that every component is present in every electronic circuit.

At first glance, a PCB can be thought of as a simple component that has little bearing on the functioning of an electrical device. This is true for circuits when the PCB just adds a process for connecting the components. However, as the circuit's complexity grows or it must operate at high frequencies, special issues arise. Radiation

phenomena, power distribution concerns, and connection speed limits might all be examples of these unique issues. As the importance of this component of a circuit grows, various scientific investigations on PCB design and development technologies are being conducted. Power dissipation capability, PAD characteristics, electrostatic emissions, PCB design in 3D, relationships with new packages, antennae implementation on the PCB, high-speed circuits, and quality control are some of the subjects of relevance here. In summary, the PCB is critical for an electronic device, and the complexity of today's electronics necessitates its use.[2]

III. DESIGNING PROCESS OF A PCB

Depend on the printed circuit board manufacturer, there are numerous ways available for designing PCBs. This circuit board design can be manufactured as bulk using several machines in PCB fabrication industries including drilling, punching, plating and final fabrication processes that are performed through highly automated machines. Laser drilling with CNC machines, automatic plating machines, strip etching machines, and use of optical inspection equipment, flying probe testers for electrical testing of printed circuit board processes result in high-quality PCBs (with a greater production yield)

Draw the schematic circuit diagram with the PCB layout software such as Proteus software and Multisim software. This type of PCB design software contains a library of components that can be used to build the circuit. It is also possible to change the circuit design's position and then to modify it according to your convenience and requirement. Here we have selected Proteus software to design the circuit and its procedure is as follows:

- Open the Proteus design software.
- A window with a menu bar appears.
- Click on the file menu.
- Select 'new design' from the drop-down menu.
- Click on the library menu.
- Select 'pick devices/symbol' from the drop-down menu.
- Select a relevant comment by double-clicking on it, so that the component appears on the window.
- Add all the components and draw the circuit with proper connections as shown in the figure.
- Enter the rating of each component according to the requirement.

PCB design is broken into two main categories: schematic capture to create the circuitry connectivity in a diagram, and then PCB layout to design the actual physical circuit board.

The first step is to develop the library Proteus parts that we will need for the design. This will include schematic symbols, simulation models, footprints for PCB layout, and step models for 3D printed circuit board display. Once the libraries are ready the next step is to create the logical representation of the circuitry on a schematic. Proteus tools are used to place the symbols on a schematic sheet, and then connect them together to form the circuitry.

At the same time circuit simulation is run to verify that the design will work electrically the way it is intended to. Once these tasks are completed, the schematic tools will send their connectivity data over to the layout tools.

On the layout side of PCB design, the schematic connectivity is received and processed as nets that connect two or more component pins together. With an outline of the intended board shape on the screen, the layout designer will place the component footprints into their correct locations. Once these components are optimally organized, the next step is to connect the nets to the pins by drawing the traces and planes between the pins. The Proteus tools will have design rules built into them that prevent the traces of one net from touching another net, as well as governing many other widths and spaces needed for a complete design. Once the routing is complete, the design tools are used again to create manufacturing drawings and the output files that the manufacturer will use to build the board.

IV. APPLICATIONS

1: PCBs are widely used in industrial machinery for many useful applications. Thick copper PCBs are a great replacement of thin copper PCBs in many situations. Thick copper PCBs are suitable for many applications including motor controllers, industrial load testers and high current battery chargers. There are many software to make PCB design, however, if you are involved in embedded system you may like designing PCB in Proteus Ares.

2: Latest technology used in most of the electronics uses less power than their prior editions, making it economical and widely used in medical field. Most of the advanced medical equipments use high density PCBs that provide compact and smallest design possible. Small size and light weight of PCB beautifully replaces the old traditional equipments and becomes an ideal choice for medical field. These devices are useful for a range of applications from small component

like pacemaker to large complex machine like X-Ray machines and CAT scanner.

3: Aluminum backed PCBs are widely used in LED based lighting systems which encompass low power consumption and high level of efficiency. These PCBs are capable of transferring heat from one point to another and are considered as a step ahead from standard PCBs. These PCBs are the back bone of basic lighting solutions and LED applications.[3]

4: Automotive and aerospace industries are widely surrounded by vibration environment, this is where flexible PCBs come into play. These PCBs can withstand high vibrations and severe environments due to their flexible and compact design. They can house in tight spaces like instrument gauge and instrument panel. Being a light weight makes it an ideal choice for making manufacturing parts of transportation industries.
That's all for today. I hope you have enjoyed the article. Our mission is to keep you updated with useful information so you keep coming back on our site. [4]

V. SIMULATION & RESULTS:

I. Schematic Capture:

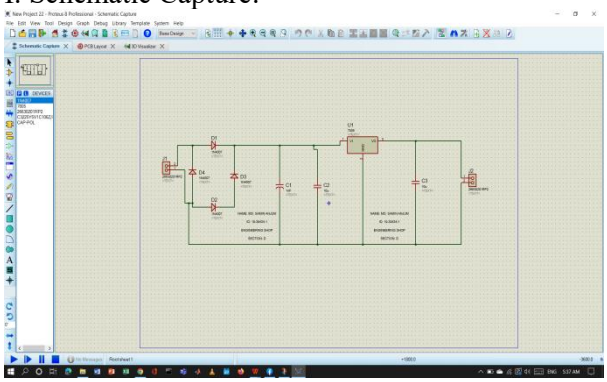

Fig: 01

II. PCB Layout:

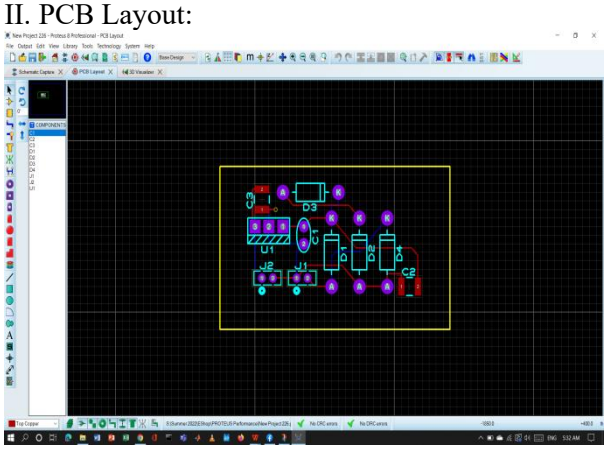

Fig: 02

III. 3D Visualizer

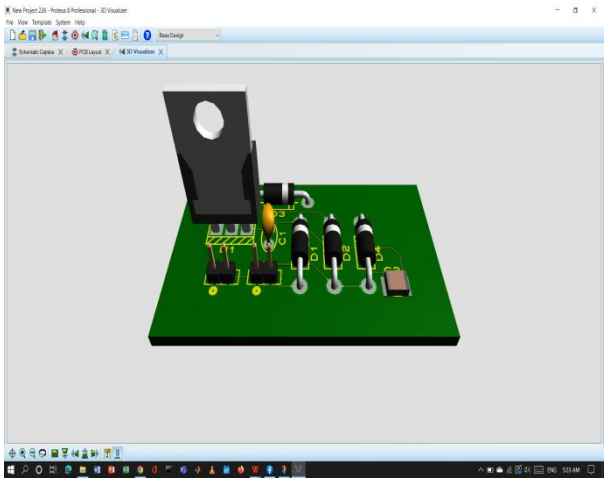

Fig: 03

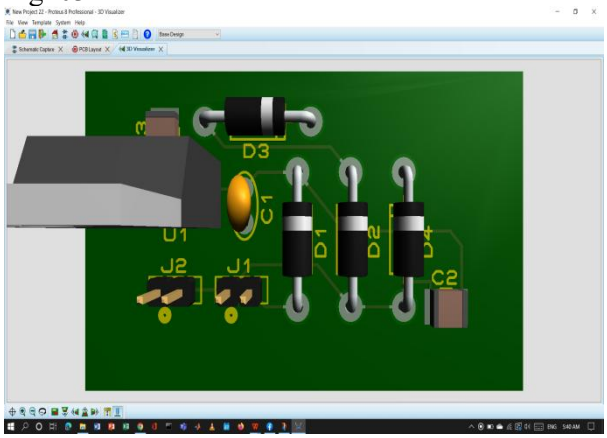

Fig: 04

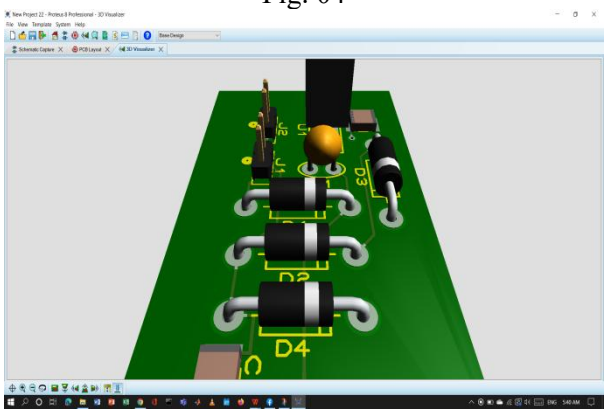

Fig: 05

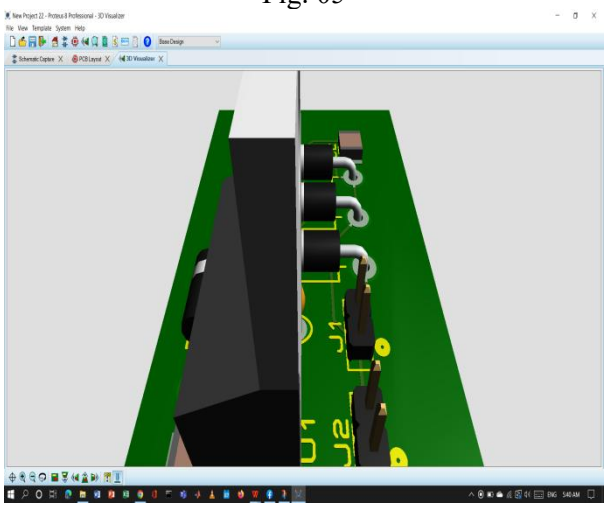

Fig: 06

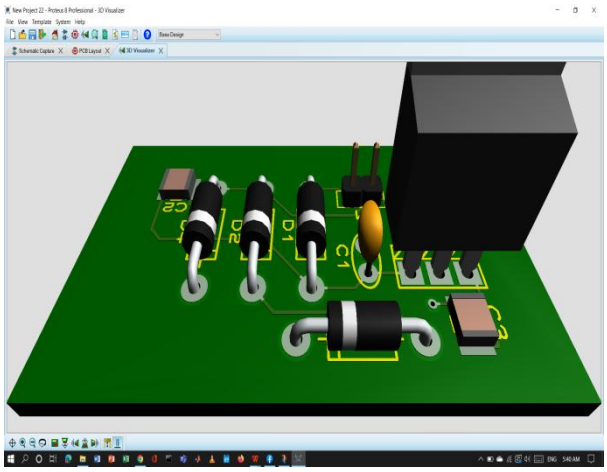

Fig: 07

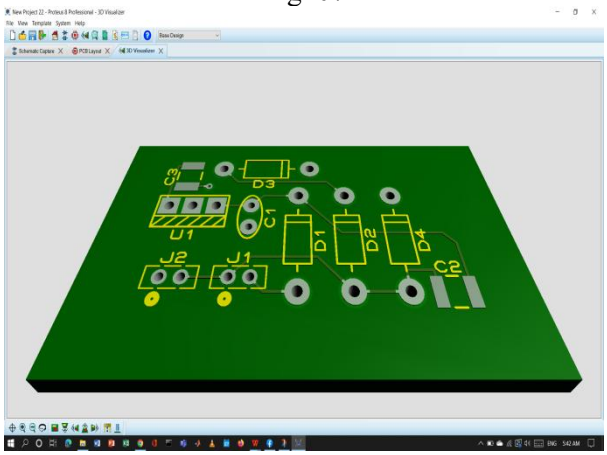

Fig: 08

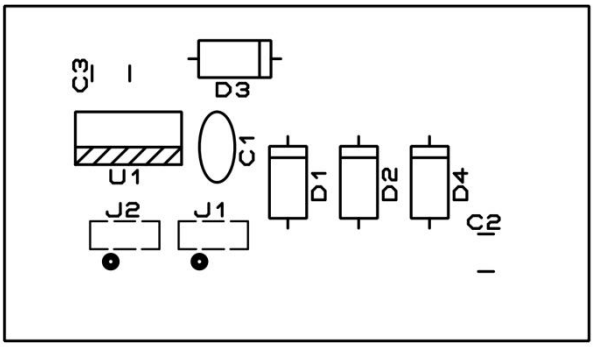

Fig: 09

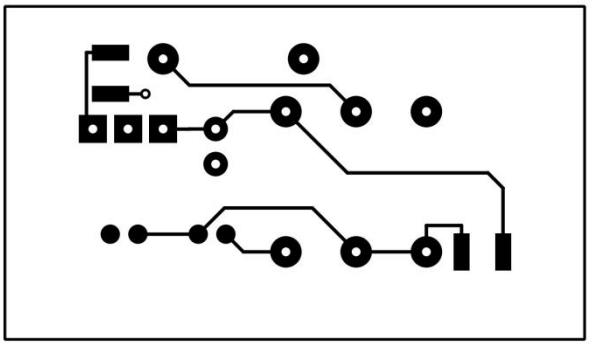

Fig: 10

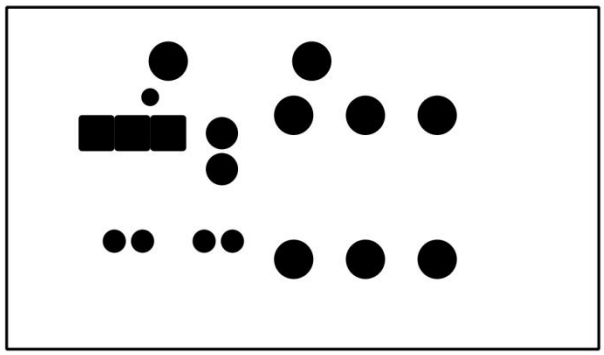

Fig: 11

VI. CONCLUSIONS

The design of printed circuit boards is not usually taught in the Bachelor or Master of Science degree in electronics engineering. However, it is a fundamental element of the electronic product. Its has several specific features that make it necessary to raise the Learing methodology by properly combining the theoretical learning, the computer practices and the personal work of the students. The learning of the design of printed circuits can be combined with other subjects that might be useful to provide the schematic circuit to design. Moreover, basic knowledge of the manufacturing process of electronic products must also be learnt.

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