DESIGN AND MANUFACTURING OF A PCB CUTTING MACHINE

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Abstract - *The aim of this project is to design and construct a PCB Cutting machine. The recent advancements in digital technology especially embedded systems have now enabled us to make designing and implementing the PCB cutting machine. This machine takes the PCB from the one side and will cut it into two separate pieces in required sizes and shape so that low-cost machines for Real time applications. This project presents a simple way of human work will be reduced and accuracy will be improve of cutting the PCB. The system will reduce the chances to getting hurt by the blades using the fabrication and covering. Cutting is the separation of a physical object, into two or more portions, through the application of an acutely directed force. Implements commonly used for cutting are the knife and saw, or in medicine and science the scalpel and microtome. However, any sufficiently sharp object is capable of cutting if it has a hardness sufficiently larger than the object being cut, and if it is applied with sufficient force. The design, development and manufacturing the cutting machine is to assist to cut the PCB in required length according to requirement.*

Key Words: Printed circuit board (PCB) plate, thin kerf Cutter, AC motor, Foot pedal etc.

1. INTRODUCTION

Printed Circuit Boards (PCB) which are widely used in electronics, automobile, medical applications. Printed Circuit Boards (PCB) appeared for the first time in the 50's. Since then the world went through many revolutions on the manufacturing processes. [4] Thus, semiconductor industry is one of the fastest growing industries in India. PCB is the heart of every electronic product. It is a thin board made of fibre glass, composite epoxy or other laminate material.[8] A printed circuit board (PCB) mechanically supports and electrically connects electrical or electronic components using conductive tracks, pads and other features etched from one or more sheet layers of copper laminated into and/or between sheet layers of a non-conductive substrate. Components are generally soldered onto the PCB to both electrically connect and mechanically fasten them to it. Alternatives to PCBs include wire wrap and point-to-point construction, both once popular but now rarely used. PCBs require additional design effort to layout the circuit, but manufacturing and assembly can be automated. Electronic computer-aided design software is available to do much of the work of layout. Mass-producing circuits with PCBs is cheaper and faster than with other wiring methods, as components are mounted and wired in one operation. PCBs can be single-sided (one copper layer), double-sided (two copper layers on both sides of one substrate layer), or multi-layer (outer and inner layers of copper, alternating with layers of substrate). [14]

Cutting is the separation of a physical object, into two or more portions, through the application of an actual directed force. Commonly used implements for cutting are knife and saw. Cutting is a compressive and shearing phenomenon, and occurs only when the total stress generated by the cutting implement exceeds the ultimate strength of the material of the object being cut. The simplest applicable equation is stress = force/area. The stress generated by a cutting implement is directly proportional to the force with which it is applied, and inversely proportional to the area of contact. Hence, the smaller the area (i.e., the sharper the cutting implement), the less force is needed to cut something. It is generally seen that cutting edges are thinner for cutting soft materials and thicker for harder materials. [1] Depaneling is a step easily overlooked in the printed circuit board (PCB) manufacturing process. The percentage of usable boards removed from a panel is known as production yield. Depanelization is simply removing individual PCBs from the array. [14] Several different methods are used to depanel PCB arrays:

- Breaking by Hand – Only appropriate for strain-resistant circuits.
- Saw – Can perform at high feed rates, cutting both V-grooved and non-V-grooved PCBs.
- Hand Cutter – Used on V-grooves. Best for cutting very large panels into smaller ones, this method is inexpensive and low-maintenance.
- Punching – A two-part fixture punches out single PCBs. Higher capacity, but higher maintenance and cost.
- Depaneling Router – Single boards are connected using tabs; the router bit mills out the tabs. Can cut arcs and turn at sharp angles, but capacity is lower.
- Laser – Low mechanical stress and precise tolerances, but has higher initial capital outlay.

Every method has its limitations in accuracy, cost, fission configuration and effect on the material. For example, heat may damage the quality of material properties. [14]

Manufacturing a PCB cutting machine requires a great deal of accuracy. [6] There are many innovations in carrier of PCB, installation and disengagement of carrier, transiting mode. Secondly, because cutter of foot-cutting machine is easily abraded, it must be amended frequently. So the height of cutter can be adjusted. Cutter can be disassembled very easily and expediently. [13] Cutting process of PCB is used to produce an appropriate dimension of PCB which is a common requirement across large number of industries and applications. Industries and applications that require huge volumetric production, the cutting time and the finishing of the board, rivals the cost of the process. [7] Productivity highly depends on the time required for cutting, including moving and settling the platform while machining. [11]

In order to improve the rate of qualified products and reduce cutting costs, it is necessary to further study the causes of defects and effective measures of the PCB cutting in its cutting process. It can be easily and expediently combined with any automated product line of PCB. [3]

2. LITERATURE REVIEW

It is seen that, over many years, industrial designers are working on the development of a state-of-the-art with a view to provide better clamping and handling characteristics and reliable operation. Now a days there are so many machine available in the market, which are used for processing of PCB. In these investigations various aspects of PCB cutting machine design such as, comfort, work-piece holding, safe handling, safety and reliability have been studied.

Dhirajkumar V. Patil, Nitin B. Naikwadi, Nikhil V. Patil, Nayan D. Sonawane, and Prof. Kunal U. Shinde [1] had studied about design and fabrication of portable PCB plate cutting machine. The recent advancements in digital technology especially embedded systems have now enabled us to make low cost machines for Real time applications. This project presents a simple way of designing and implementing an automatic PCB cutting machine. This machine works automatically and takes the PCB from the one side and will cut the PCB into the two separate pieces in required sizes and shape so that human work will be reduced and accuracy will be improved while cutting the PCB. The system will also reduce the chances of getting hurt by the blades using the fabrication and covering.

Rohit Choudhary, Sambhav, Sunny David Titus, Akshaya P, Dr. Jose Alex Mathew, Balaji N [2] had designed CNC PCB Milling and Wood Engraving Machine incorporates the plan and usage of a CNC (Computer Numerical Control) machine to make PCB (Printed Circuit Board) and wood etching machine in a solitary set up. The creation of this machine is to diminish the cost and multipurpose nature of machine. This venture manages the plan of programmed scaled down CNC machine for PCB drawing and processing. These advancement would be profoundly practical in contrast with that of customary manufacture hardware.

Heying Wu and Haiyan Zhu [3] had research on the common causes of defects and their prevention measures for rcf-type PCB mills production. Blade-type error, edge collapse cutaway, micro missing, four kinds of defect for RCF-type PCB mill production are deeply analyzed and their preventions measures are given detailed according to the author's many year's practice. These measures have been practiced and achieved better results. The research results can increase pass rate of such tools in the production and reduce production costs obviously, and owns with a special important using values and widely promoted significance.

Rodrigo Basniak, Marcio Fontana Catapan [4] represent the design of PCB milling machine. A better process is with milling and a CNC machine. There is a lack of CNC machines for this purpose, so this paper presents the development of a CNC milling machine for printed circuit boards with low manufacturing costs for domestic use. The customer requirements are obtained through a market research and then processed with the use of a QFD matrix to acquire the product requirements. A morphological matrix is then used to obtain all possible solutions for each requirement and they are analyzed with an algorithm to find the best concept for this product. With a functional prototype finished many tests are done to assure that all customer requirements were fulfilled.

Prabhanjay Gadhe, Vikas jangir, Mayur yede, Wasim-UI-haq [5] had designed and implementation of PCB using CNC, where the drill holes and the layout are automatically find out from an image of the circuit in EAGLE software. These paper mainly focuses on the design and implementation of automatic PCB milling and drilling machine using ARDUINO UNO. Further the drilling machine uses path planning through co-ordinate measurement machine method which is useful to make the system more stable and accurate.

Vishal G.Chhaya, Raviraj D. Gohil, Rohit R. Raval [6] had researched about design and manufacturing overview of PCB drilling machine. Drilling was done in the field of metal cutting for mechanical parts since; in this case, high precision and quality are needed. De lamination and extensive tool wear are major problems which drilling of composite materials are currently facing. In this paper we have focused on design and manufacturing of drilling machine to drill a small size hole on composite material like PCB.

Chirag R Prajapati, Prof. Dhaval P Patel, Mr. K.S.Parmar [7] had presented the modelling and analysis of frame structure of PCB drilling machine. Other processes for producing holes are punching and various other advanced machining processes. The cost of holes making is one of the highest machining costs. There are several types of drilling which are gun drilling, twist drill, and trepanning. The most common drill out of all is the conventional twist drill. The main objective of research paper is to reduce vibration of frame structure of PCB drilling machine. By applying propose material selection for structure and optimize dimension of structure from data of present PCB drilling machine and change geometry and material of structure.

M. M. Noor, M. M. Rahman, M. A. Hassan, Z. Ghazalli [8] had developed a cutting tool with mild steel for printed circuit board. The caprum as a trace to connect the electricity current to electronic component like resistors and capacitors. The normal way to cut the printed circuit board is using hand due to the sensitive material of PCB. By developing the cutter, it is easy to cut the printed circuit board with more accuracy and in efficient way without damaging the board. The performance of cutter that fabricates using mild steel is only average due to its hardness.

Xiaohu Zheng, Dapeng Dong, Lixin Huang, Qinglong An, Xibin Wang, Ming Chen [9] researched on fixture hole drilling quality of printed circuit board. The parameters involved in drilling quality are burr size, hole wall roughness et al. In this study, the drilling machinability of PCB fixture hole is studied, effects of drilling parameters on various parameters such as thrust force, quality etc. are discussed. The experimental results show that resin will be melted during the drilling process. Analysis of variance (ANOVA) is carried out for hole quality parameters. Desirability function method is useful for multiple response optimization to obtain the optimal tool geometry parameters.

Jitendra Singh, V. K. Jain, J. Ramkumar [10] had concluded the Fabrication of complex circuit on printed circuit board (PCB) using electrochemical micro-machining. Electrochemical micro-machining (ECMM) is an advanced machining process for machining of electrically conducting materials. In the present work, an experimental set-up for ECMM is used to fabricate complex circuits on a printed circuit board (PCB) by means of masking technique. After all the experiments have been completed, the circuit is compared with the main circuit which is fabricated by milling process and percentage error present in the circuit after the completion of process is evaluated.

Tsung-Ming Lo, Jieh-Shian Young [11] had studied the productivity for PCB Drilling by Laser Driller Machine. The goal is to reduce the process time required for a PCB work piece. Applicable techniques for reducing process time includes reducing the number of Galvo tiles, and path planning improvement for either tiles or holes. The non-crossing path approach proposed in this paper generates a shorter path for both platform positioning and drilled holes in tiles. Results show that the reduction method for the number of tiles and the non-crossing path algorithm for both tiles and holes can increase productivity by approximately 16~17%.

N. Sathyakumar, Kamal Prasath Balaji, Raja Ganapathi, S.R.Pandian [12] had developed three axis CNC PCB milling machine. Practical hands-on laboratory teaching and experimentation is necessary to improve learning in electronics. In this paper, a low-cost build-your-own (BYO) semi-automated three-axis PCB milling machine for double-sided PCB prototyping is developed using commercial components and open source hardware and free open source software, to provide students, teachers, and engineers an accessible and affordable resource for PCB prototyping. Also, the main problems encountered during fabrication of PCB have been mentioned and the different techniques used to solve them are discussed in detail.

From the above literature review, we studied the different processes which are performed on printed circuit board (PCB). The improvements which are needed to be done in these processes which will increase productivity and efficiency. The material for the different parts of machine which are to be selected so that maximum efficiency can be achieved as well as which provides smooth operation.

3. CONSTRUCTION

CLAMPING MACHANISM

While designing the clamping mechanisms, we had many of the options in front of us. We have two options for the cutting operation either we have to move the cutter against the stationary PCB or have to move PCB against the cutter at one position. As in first option, it is difficult to change the position of cutter which is required in case if required. So we selected second option in which PCB will move towards cutter. As the weight of PCB is very less, it is easy to move PCB and it seems very convenient.

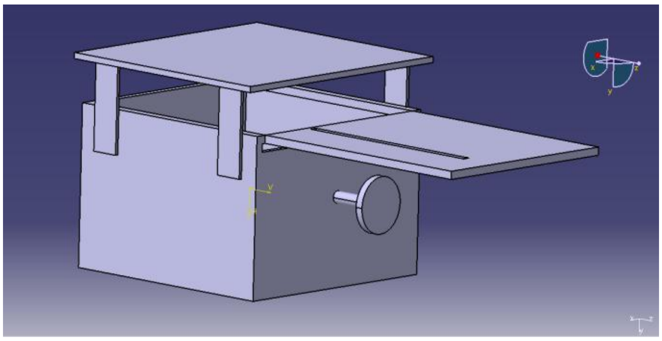

Figure 3.1: 3D CAD design of frame

There is a wooden board on which PCB is mounted and fixed for the operation. On these board there is a section cut so that cutter can rotate freely. In this we can also adjust position of cutter to some extent that maybe required in some case while cutting. Two flat rods are used to perfectly fix PCB so that it does not move in between cutting process. Graph paper is attached on the board for measurement of cutting of PCB. It is easy to clamp and unclamp the PCB before and after the process by using these technique.

The setup also consists of two sliders to which wooden board is attached and it is used for in and out movement of PCB. These sliders are ease with handling to operator and strong enough to slide it with the better efficiency.

4. DESIGN OF MACHINE COMPONENTS

4.1 DESIGN OF SHAFTS

Material Selected = 40C8 Steel
Ultimate Tensile Strength (Sut) = 580 MPa
Yield Strength (Syt) = 380 MPa
Permissible Shear Stress (tperm) = 0.3* Syt
tperm = 0.3*380
tperm = 114 MPa
Or
tperm = 0.18* Sut
tperm = 104.4 MPa
Taking minimum value from above
tperm = 104.4 MPa

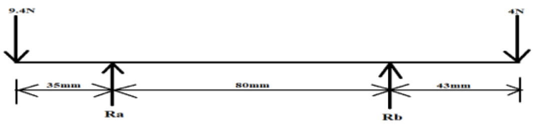

Figure 4.1: Loading diagram of shaft

As we know that, for belt and pulley.
$F_{c1} / F_{c2} = e^{\mu\theta}$
Here u = 0.3 (coefficient of friction for the belt and pulley.)
$\theta = 180 = \pi$
$F_{c1} / F_{c2} = e^{0.3*\theta}$
$F_{c1} / F_{c2} = 2.56$
$F_{c1} = 2.56 * F_{c2}$
Torque of motor
P1 = 2*3.14*NT/60
We have,
Motor Power = 50 Watt, N = 2800 RPM
50 = 2*3.14*2800*T/60
T = 0.17052 N-mm
Also,
$T = (F_{c1} - F_{c2}) * d_p/2$
$0.17052 = (2.56F_{c2} - F_{c2}) * 30/2$
$0.17052 = 1.56F_{c2} * 15$
$F_{c2} = 0.00729N$
$F_{c1} = 2.56 * F_{c2}$
$F_{c1} = 2.56 * 0.00729$
$F_{c1} = 0.0187N$

Total force taken by belt and pulley
$F = F_{c1} + F_{c2} + W$
F = 0.0187 + 0.00729 + 9.3
F = 9.4N
We know summation F = 0
RA + RB - F1 - F2 = 0
RA + RB – 13.4 = 0
Taking moment about A
∑ MA = 0
(-9.4 * 35) - (Rb * 80) – (F1 * 123) = 0
- RB * 80 = 821
RB = -10.2625 N
RA + RB – 13.4= 0
Putting value of RB, we get
RA = 23.67 N
Now to find maximum bending moment,
Ma = (9.4 * 35) = 329N-mm
Mb = (4 * 43) = 172N-mm
Maximum bending moment,
M_{max} = Ma = M = 329N-mm
$P = 2 * 3.14 * N * M_t / 60000$
$M_t = 0.1706$N-mm
Then Calculating equivalent torque,
$Te = \sqrt{(Kb * Mb)^2 + (Kt * Mt)^2}$
Kb = 1.5 and kt = 1
$Te = \sqrt{(493.5)^2 + (0.1706)^2}$
Te = 493.5 N-mm
Torque maximum
tmax = 0.75 * tperm
tmax = 0.75 * 104.4
tmax = 78.3 N/mm2
Diameter of Shafts
tmax = (16 * Te) / 3.14* d3
78.3 = 16 * 493.5 / 3.14*d3
d = 2.89mm
Assume FOS = 3
d = d * FOS
d = 2.89 * 3
d = 8.67mm
d ≈ 10mm

4.2 SELECTION OF SAW CUTTER

D = diameter of circular saw = 100 mm
R = 50 mm
N = 1960 RPM
n = No. of teeth = 100
F = Feed rate
B = Chip thickness
Circular pitch, P = (3.14*D) / n
P = (3.14* 100) / 100
P = 3.14 mm
P = 4 mm
Consider feed rate = 5 mm/sec
F = (b * n * N) / 12
b = (F * 12) / (n * N)
b = (F *12) / (100*1960)

b = 0.665
Taking b = 1.02 mm
Hence cutter is safe.

4.3 SELECTION OF BEARING

Bearing used = Ball Bearing
Quantity = 2 nos.
Bearing No. = 6002
Selection of bearing based on shaft diameter = 6002
Consider expected life of bearing = 10000
For bearing 6002,
C = 5590
C0 = 2500
Now,
L10 = (Lh10 * n * 60) / 106
Lh10 = 10000*1500*60 / 106
Lh10 = 900 million revolutions
Calculating Equivalent Dynamic Load
As, FR = 16.25N
FA = 0
$Pe = (V * X * F_R + F_A * Y) * K_a$
Pe = (1 *1 * 16.25 + 0 * Y) *1
Pe = 16.25 N
Now,
$L10 = (C / P_e)^{10/3}$
$C = (900)^{3/10} * 16.25$
C = 125.06 N
Cstd Greater than Ccal.
Hence Selected Bearing is safe.

4.4 DESIGN OF PULLEY

Specification for driving pulley:-
(1) Material: - mild steel (30C8)
Yield strength (Syt) = 400 N/mm^2
Ultimate strength (Sut) = 500 N/mm^2
(2)Standard Diameter (d):- 25.4 mm
Design procedure for Driven pulley (larger pulley):-
(Diameter of driven pulley / Diameter of driving pulley) = (input speed / output speed)
(D / d) = (n / N)
D = 30 * (2800 / 1960)
D = 42.85 mm
D ≈ 45 mm

4.5 SELECTION OF BELT

Service	Type of driven machine	Type of driving units		
		Operational hours per day (hr)		
		0-10	10-16	16-24
Medium duty	Belt conveyor, generator, line shaft, machine tool, presses, positive displacement pumps & vibrating screen.	1.1	1.2	1.3

Figure 4.2: Table of correction factor.

i) Determine (Fa) correction factor for industrial service Form Figure 4.2,
Select Fa = 1.1
ii) Determine Design Power
Design power = Fa * (transmitted power) kW
= 1.1 * 30*10^3
= 0.033kw
iii) Plotting point with design power on X-axis and input speed on Y-axis

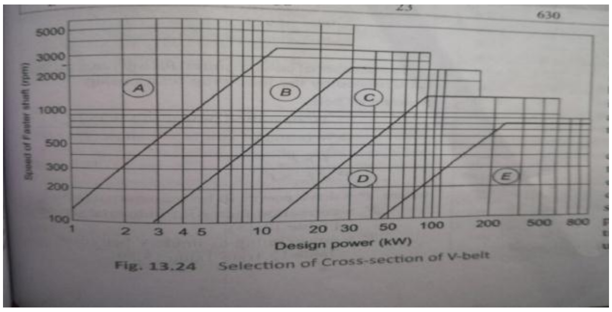

Figure 4.3: Figure of cross section of v belt

iv) Hence, Type A is selected as cross section of V-belt. As we use Type A cross section
V-belt, then diameters of pulleys should be less than 70 mm, Hence we have
D = 45mm
d = 30mm
C = 250mm
v) Length of V-belt
L = 2*C + (D+d) /2 + [(D - d)^2 / 4*C]
L = 2*0.25 + (0.045+0.03)/2 + [(0.045-0.03)^2 / 4*0.25]
L = 0.61 m

vi) Compare above value of L with preferred pitch length L Hence, standard length of belt L = 630mm… [Reference page no. 524, V. B. Bhandari] vii) Now, corrected center distance is given by, L = 2*C + (D+d) /2 + [(D - d)^2 / 4*C] L = 2*C + (45+30)/2 + [(45.30)^2 /4 *C] C = 259.48mm Determine the correction factor Fc for belt pitch length from the table Fc = 0.80… [Page no. 534, V. B. Bhandari]

viii) Calculate the arc of contact for the smaller pulley α_s = 180 – 2sin^{-1} [D – d / 2C] α_s = 180 – 2sin^{-1} [45 – 30 / 2*259.48] α_s = 176.69 Now determine the correction factor F_d for arc of contact F_d = 0.99... [Reference page no. 534, V. B. Bhandari]

ix) Determine the power rating P_r of single V belt Hence P_r = 1.5 … [Reference page no. 526, V. B. Bhandari]

x) No. of belt No. of belt = [P * F_a / P_r * F_c * F_d] No. of belt = [0.05 * 1.1 / 1.5 * 0.8 * 0.99] No. of belt = 1

5. WORKING

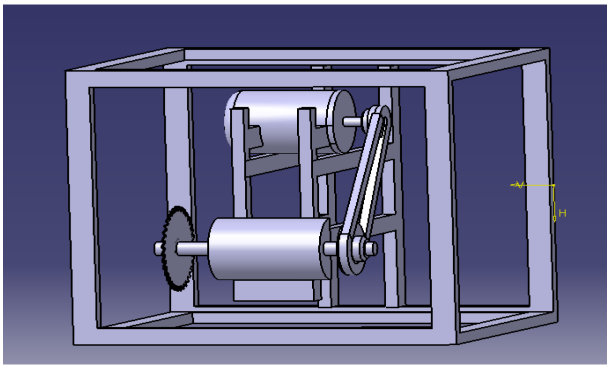

Figure 5.1: 3D model of working table

In the PCB plate cutting machine we have used thin kerf cutter blade because any sufficiently sharp object is capable of cutting if it has a hardness sufficiently larger than the object being cut. This cutter is mounted on the shaft which is supported and held in the two bearings this aids the machine easy removal of cutter after they are worn out. The cutter is arranged such that some portion of the cutter maintained above the work table surface for the purpose of the cutting. The cutter is mounted on the shaft with suitable distance at one end and pulley is mounted at the other end and in the region between the two bearings is mounted on the shaft in an assembly. The shaft on the overhang side has threading on it so that we can fix the cutter on the shaft with the help of nut after mounting them on shaft to have required grip and to transmit the torque from shaft to the cutter to cut PCB plate . Two slider is used to attached to the worktable for the pull and push movement of PCB plate. In the assembly acrylic glass is provided over a workbench so that it is easy for the worker to observe the operation and detect the error if it happened.

The table is covered with the plywood with proper slots for the cutters and other mountings for the purpose of safety of the user which will use the machine. The pulley is mounted on shaft at other end. The motor is placed at the bottom of the worktable on the support with proper padding. The motor which we have used is brushless motor for less noise and to avoid the vibrations associated with it while running. In motor standard size of pulley is mounted on the basis of specifications. The other size of pulley is mounted on the shaft connected to the motor. The rubber belt is mounted on the pulley mounted on the main shaft and the shaft of motor for the purpose of power transmission from motor to the shaft with the same speed of the motor.

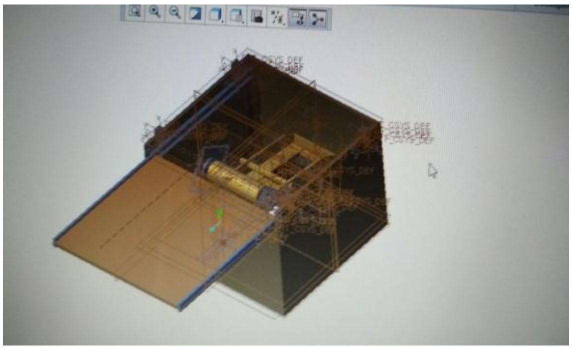

Figure 5.2: 3D model of working Machine

The clamping mechanism is used for the PCB plate to be hold properly during the cutting operation for safety of the operator. The PCB plate is first clamped in the clamping mechanism. The clamping mechanism has two flat metal rod is placed on the worktable for fixed the PCB plate with which he can slide the whole mechanism in slider. The PCB plate is just touched to the rod mounted on the worktable for the purpose of reference for the straight sliding of the PCB plate before fixing in the clamping mechanism. Once the PCB plate is fixed in the mechanism it is slide against the cutter. Hence the PCB plate is cut down into two pieces as per required size. While cutting the PCB plate against the cutter will also obtained good finishing. The clamping mechanism is the pulled back by sliding into slider so that it brings the portion of the PCB plate which is still to be cut in the machine towards the operator. Operator the again adjust the PCB plate in the clamping mechanism by touching the PCB plate to the reference point continues. If operator wants to adjust the cutter he can stop the machine and then change the distance between the cutter and work table by lever so as to get that proper cutting operation of PCB plate. The clamping mechanism provides ease and safety to the operator.

Figure 5.3: Actual working machine

6. RESULT

Sr. No.		Conventional PCB plate cutting machine	Designed PCB plate cutting machine
1	Time required to cut the PCB plate	More	Less
2	Chances to break the material	More	Less
3	Accuracy	Less	More

Table 6.1: Results of overall performance

From above table we get the result as,

Conventional PCB plate cutting machine has no proper clamping mechanism to cut the PCB plate due to that PCB scrap material has more produced and time required to cut the PCB plate is more.

So, accuracy required to cut the PCB plate is increased due to clamping mechanism for our designed machine compared to conventional machines. Also reduce the human effort to cut the PCB plate while machining. Now a days during the process of cutting, the machine creates more noise and vibration, due to design and development the machine becomes less noisy and safe for operator. Our main aim to reduce the time required to cut the PCB plate with accuracy is satisfied.

7. CONCLUSIONS

In our project we have designed the simplest and easiest model of PCB plate cutting machine and also manufactured it in the most efficient way and also cost required for our project is less as compared to other PCB plate cutting machine which are available in the market.

In this PCB plate cutting machine we can cut the PCB plate in the two pieces as per required dimension at minimum time of span. There are many significant benefits with clamping systems. The clamping mechanism provides ease and safety to the operator. The major advantage of clamping is that it significantly reduces the load and unload times compared to conventional manual clamping. The machine can work continuously therefore it increase the production rate. It reduces or eliminates the efforts of marking, measuring and setting of work piece on a machine and maintains the accuracy of performance.

8. FUTURE SCOPE

In this machine, we develop more and more modified technique with increasing the aesthetic look and economic consideration. But being the degree Engineers and having the ability to think and plan. But due to some time constraints, we only have thought and put in the report the following future modifications:-

Automated machines are more capable of getting more done, in less time, whilst remaining accurate. Ultimately, machines that are deployed in situations where extreme accuracy is needed, can reduce the margin of error. As an automated machine is designed and programmed to perform the same task repetitively, the accuracy and quality of circuit boards can be better and more consistent than hand-assembly. Automation allows you to preserve the likeliness for each board produced so you can expect consistent quality when you partner with an assembly service.

Electronic Design Automation (EDA) refers to the tools that are used to design and verify integrated circuits (ICs), printed circuit boards (PCBs), and electronic systems, in general. Over time, these early computer-aided drafting tools evolved into interactive programs that performed integrated circuit layout. EDA tools reduce development time and cost because they allow designs to be simulated and analyzed prior to purchasing and manufacturing hardware. Once a design has been proven through drawings, simulations, and analysis, the system can be manufactured. Applications used in manufacturing are known as computer-aided manufacturing (CAM) tools. CAM tools use software programs and design data (generated by the CAE tools) to control automated manufacturing machinery to turn a design concept into reality. With the rapid development of technology, printed circuit boards are now much easier to mass produce and assemble due to automation and machines Automated PCB assembly provides a wide range of benefits for businesses and sectors.

Solar power is the conservation of energy from sunlight into electricity, either directly using photovoltaic, indirectly using concentrated solar power or a combination. Concentrated solar power system use lenses or mirror and tracking system to focus a large area of sunlight into small beam. Solar cells can convert at least 30 percent of the sunlight they receive into electricity.

In our project we can use energy alternatives as solar energy:

- To solve energy deficiency problems and use of emission free clean energy at very low cost.
- Renewable clean power that is available every day of the year, even cloudy days produce same power.

- Virtually no maintenance as solar panels last over 30 years.
- Use batteries to store extra power for use at night.

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