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Automatic Pneumatic Sheet Metal Feeding and Cutting Machine

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Abstract: ***Today in the rapid competition of the industries to get the best quality of the product in the minimum required time is the main aim of industries. To get the best quality and maximum production most advanced machines are used. But there are no facts that use only the advanced machines, to maintain their performance is real requirement of the industries, also to give proper facilities to the workers with good environmental condition and to reduce their efforts is one of the objects to achieve the best quality and high production. Sheet metal is simply a metal formed into thin and flat pieces. It is one of the fundamental forms used in metal working and can be cut and bent into a variety of different shapes. Countless everyday objects are constructed of the material. Thicknesses can vary significantly, although extremely thin thicknesses are considered foil or leaf, and pieces thicker than 6 mm (0.25 in) are considered plate. Sheet metal also has applications in car bodies, airplane wings, medical tables, roofs for buildings (Architectural) and many other things. Sheet metal of iron and other materials with high magnetic permeability, also known as laminated steel cores, has applications in transformers and electric machines. There are three primary procedures in Layout. They are Parallel, Radial, and Triangulation. The major aim to our experiment is to study about pneumatic control system, study about double acting cylinder, study about the advantage of pneumatic hand operated valve and study about high speed blade. We are using scissors for simple sheet metal cutting. It is a manual method so that sheet metals are to be wasted sometimes because of mistakes happened such as wrong dimensions etc., and also even a simple cutting may take long time. We are using a pneumatic system for sheet metal cutting in an easy way. It is operated by a pneumatic hand lever of two ways control valve. Control valve is operated by a compressor.***

Keywords: Pneumatic, Automation, Sheet Metal, Pneumatic, Valve, Cutting Machine

I. INTRODUCTION

Pneumatics, from the Greek (pneumatikos, coming from the wind) is the use of pressurized gases to do work in science and technology. Pneumatics was first documented by Hero of Alexandria in 60 A.D., but the concept had existed before then. Pneumatic products represent a multi-billion dollar industry today. Pneumatic devices are used in many industrial applications. Generally appropriate for applications involving less force than hydraulic applications, and typically less expensive than electric applications, most pneumatic devices are designed to use clean dry air as an energy source. The actuator then converts that compressed air into mechanical motion. The type of motion produced depends on the design of the actuator. Pneumatics is employed in a variety of settings. In dentistry applications, pneumatic drills are lighter, faster and simpler than an electric drill of the same power rating (because the prime mover, the compressor, is separate from the drill and pumped air is capable of rotating the drill bit at extremely high rpm). Pneumatic transfer systems are employed in many industries to move powders and pellets. Pneumatic tubes can carry objects over distances. Pneumatic devices are also used where electric motors cannot be used for safety reasons, such as mining applications where rock drills are powered by air motors to preclude the need for electric motors deep in the mine where explosive gases may be present. Pneumatic cylinders are generally less expensive than hydraulic or electric cylinders of similar size and capacity. Sheet metal is available in flat pieces or as a coiled strip. The coils are formed by running a continuous sheet of metal through a roll slitter. The thickness of the sheet metal is called its gauge. Sheet metal is a metal formed into thin and flat pieces. It is one of the fundamental forms used in metal working and can be cut and bent into variety of different shapes. Sheet metals are available in flat pieces or as a coiled strip. The thickness of the sheet metal is measured in gauge. Commonly used steel sheet metal ranges from 30 gauges to 8 gauges. The larger the gauge number, the thinner the metal. Sheet metals has wide range of applications in car bodies, airplane wings, medical tables, roofs of buildings and many other things. Sheet metal of iron and other materials with high magnetic permeability are known as laminated steel cores. The shearing machine is most important in sheet metal industry. In most of the small scale industries, hand sheet cutters are used, which requires human effort to cut down the sheets. It can be replaced by a pneumatic cutting machine which can cut the sheet metal at a faster rate and in a convenient way.

In shearing operation, the pressure exerted by the punch, causes the plastic deformation of the sheet metal. Since the clearance between the die and punch adjacent to the cutting edges this causes the fracture to start on both sides of the sheet and the sheet is sheared.

A. Problem Statement

The human efforts in sheet metal cutting are high and the material used for manufacturing of the metal is costly. Therefore it should be used very effectively. Therefore, this project is proposed to solve the above problem to minimize the human efforts and to avoid the wastage of the wires.

B. Objectives

The main objective of the present project is to automate the system.

1) To cut with high accuracy.
2) To achieve this, microcontroller based system is incorporated in this project.
3) This system controls the feed and performs the cutting action via pneumatic means.
4) To reduce the power consumption during machining.
5) To reduce the scrap of HSS blades.
6) This type of m/c provides work practically at low cost, low maintenance, low capital investment in less space

II. LITERATURE REVIEW

In shearing or cutting operation as or blade descends upon the metal, the pressure exerted by the blade first cause the plastic deformation of the metal. Since the clearance between the two blades is very small, the plastic deformation takes place in a localized area and the metal adjacent to the cutting edges of the blade edges becomes highly stressed, which causes the fracture to start on both sides of the sheet as the deformation progresses and the sheet is sheared. In dentistry applications, pneumatic drills are lighter, faster and simpler than an electric drill of the same power rating, because the prime mover, the compressor, is separate from the drill and pumped air is capable of rotating the drill bit at extremely high rpm. Pneumatic transfer systems are employed in many industries to move powders and pellets. There are many sheet metal cutting processes. Laser sheet metal cutting process is one of them. Many researchers have investigated experimentally the effect of various process parameters on the different quality characteristics in the laser cutting of different categories of materials. Rajaram have found the influence of laser power and feed rate (cutting speed) on the kerf width in the laser cutting of 1.27 mm thick 4130 steel. Joseph Bramah patented the hydraulic press in 1795.While working at Bramah. Henry Mausdlay suggested cup leather packing. Because it produced superior results, the hydraulic press eventually displaced the steam hammer from metal forging. Hydraulic power was used extensively in Bessemer steel production. Hydraulic power was also used for elevators, to operate canal locks and rotating sections of bridges. Some of these systems remained in use well into the twentieth century. Harry franklin was called the "Father of Industrial Hydraulics" by ASME**.** Pneumatics was first documented by Hero of Alexandria in 60 A.D, but the concept had existed before then. Pneumatic devices are used in many industrial applications. Generally appropriate for applications involving less force than hydraulic applications, and typically less expensive than electric applications, most pneumatic devices are designed to use clean dry air as an energy source. A pneumatic system is a system that uses compressed air to transmit and control energy. In the big industries sheet metal cutting machines are very much important to cut the sheet metal as a large amount. As a simple pneumatic sheet metal cutting machine could not afford much in these big industries. It works for simple sheet metal cutting.

A. Pneumatic System

Pneumatic systems form the most primitive and distinct class of mechanical control engineering. They are classified under the term 'Fluid Power Control', which describes any process or device that converts, transmits, distributes or controls power through the use of pressurized gas or liquid. In a pneumatic system, the working fluid is a gas (mostly air) which is compressed above atmospheric pressure to impart pressure energy to the molecules. This stored pressure potential is converted to a suitable mechanical work in an appropriate controlled sequence using control valves and actuators. Pneumatic systems are well suited for the automation of a simple repetitive task. The working fluid is abundant in nature and hence the running and maintenance cost of these systems are exceptionally low.

B. Working Principle

The sheet metal will be fed through feed rollers. The gear arrangement on the rollers is meshed with the DC motor, which feeds the sheet. The inductive proximity switch/sensor will be used, it detects the metal sheet and also records the sheet length as the sheet passes over it. After detection, this information is sent as an input to the microcontroller circuit containing series of relays. The microcontroller carries out the computations according to the coding done on it. The output from the microcontroller will be sent to electrically controlled solenoid valve. The valve control the actuator to actuate according to the signal received.

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DC motor meshed with the gear arrangement on the feed rollers receives input from the proximity switch, which will start/stop accordingly. This system provides provision to enter number of sheets along with the required length which is needs to be cut.

C. Material Selection

The proper selection of material for the different part of a machine is the main objective in the fabrication of machine. For a design engineer it is must that he be familiar with the effect, which the manufacturing process and heat treatment have on the properties of materials. The Choice of material for engineering purposes depends upon the following factors:

- Availability of the materials.
- Suitability of materials for the working condition in service.
- The cost of materials.
- Physical and chemical properties of material.
- Mechanical properties of material.

The mechanical properties of the metals are those, which are associated with the ability of the material to resist mechanical forces and load. We shall now discuss these properties as follows:

A. Strength	B. Plasticity
C. Stress	D. Ductility
E. Brittleness	F. Malleability
G. Toughness	H. Resilience
I. Elasticity	

When a part is subjected to a constant stress at high temperature for long period of time, it will undergo a slow and permanent deformation called creep. This property is considered in designing internal combustion engines, boilers and turbines.

1) *Frame:* The frame is made up of mild steel material. Because, mild steel is readily available in market and is economical to use. It has good mechanical properties such as high ductility and high toughness. Mild steel has carbon content ranging from 0.15% to 0.25%. The ultimate strength and compressive of this steel increases with increase in the carbon content.
2) *Shearing Blade:* The shearing blade is made up of high speed steel material. The blade has to withstand the high cutting forces and this can be achieved by using high speed steel as a blade material. High speed steel offers reliable toughness and it retains good wear resistance. A typical composition is: 18% of tungsten, 4% of chromium, 1% of vanadium, 0.7% of carbon and the rest is iron.
3) *Hardness:* It is a very important property of the metals and has a wide verity of meanings. It embraces many different properties such as resistance to wear scratching, deformation and machinability etc. It also means the ability of the metal to cut another metal. The hardness is usually expressed in numbers, which are dependent on the method of making the test.

The hardness of a metal may be determined by the following test.

- Brinell hardness test
- Rockwell hardness test
- Vickers hardness (also called diamond pyramid) test and
- Share scalar scope.

D. Methodology of Design & Analysis

A parameter study is done to evaluate the most crucial parameters for FE analysis of axial ball bearings. The parameters that are evaluated are mesh density, contact stiffness, osculation, load level, geometrical nonlinearity and material nonlinearity. The studies are performed by means of the FE software Ansys. The accuracy of finite element analysis depends on different parameters such as element type, boundary condition and how the loads are applied etc. Therefore the FE model is nothing else but an approximate realization of the reality. The parameter study can be done by physical tests. However it will increase the cost, time and resources consumed and therefore FE analysis is more suitable choice, at least for parameter evaluation.

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III.SYSTEM DESIGN & COMPONENTS

In our attempt to design a special purpose machine we have adopted a very a very careful approach, the total design work has been divided into two parts mainly;

- System design
- Mechanical design

System design mainly concerns with the various physical constraints and ergonomics, space requirements, arrangement of various components on the main frame of machine no of controls position of these controls ease of maintenance scope of further improvement; height of m/c from ground etc.

In Mechanical design the components are categorized in two parts.

- Design parts
- Parts to be purchased.

For design parts detail design is done and dimensions thus obtained are compared to next highest dimension which are readily available in market this simplifies the assembly as well as post production servicing work. The various tolerances on work pieces are specified in the manufacturing drawings. The process charts are prepared & passed on to the manufacturing stage .The parts are to be purchased directly are specified & selected from standard catalogues.

A. System Design

In system design we mainly concentrate on the following parameter:

1) *System Selection Based on Physical Constraints:* While selecting any m/c it must be checked whether it is going to be used in large scale or small scale industry in our care it is to be used in small scale industry so space is a major constrain .The system is to be very compact it can be adjusted to corner of a room. The mechanical design has direct norms with the system design hence the foremost job is to control the physical parameters so that the distinction obtained after mechanical design can be well fitted into that.
2) *Arrangement of various components:* Keeping into view the space restriction the components should be laid such that their easy removal or servicing is possible moreover every component should be easily seen & none should be hidden every possible space is utilized in component arrangement.
3) *Components of system:* As already stated system should be compact enough so that it can be accommodated at a corner of a room. All the moving parts should be well closed & compact A compact system gives a better look & structure.
4) *Man –m/c Interaction:* The friendliness of m/c with the operation is an important criterion of design. It is application of anatomical

Following are some e.g. of this section

a) Design of machine height
b) Energy expenditure in hand operation
c) Lighting condition of m/c

5) *Chances of Failure:* The losses incurred by owner in case of failure of a component are important criteria of design. Factor of safety while doing the mechanical design is kept high so that there are less chances of failure there over periodic maintenance is required to keep the m/c trouble free.
6) *Servicing Facility:* The layout of components should be such that easy servicing is possible especially those components which required frequent servicing can be easily disassembled.
7) *Weight of Machine:* The total weight of m/c depends upon the selection of material components as well as dimension of components. A higher weighted m/c is difficult for transportation & in case of major break down it becomes difficult to repair.

B. Mechanical Design

Mechanical design phase is very important from the view of designer as whole success of the project depends on the correct deign analysis of the problem.

Many preliminary alternatives are eliminated during this phase. Designer should have adequate knowledge above physical properties of material, loads stresses, deformation, and failure. Theories and wear analysis, He should identify the external and internal forces acting on the machine parts

These forces may be classified as;

1) Dead weight forces
2) Friction forces
3) Inertia forces
4) Centrifugal forces
5) Forces generated during power transmission etc.

Designer should estimate these forces very accurately by using design equations .If he does not have sufficient information to estimate them he should make certain practical assumptions based on similar conditions which will almost satisfy the functional needs. Assumptions must always be on the safer side.

C. Components

1) *Microcontroller Atmega 328P:* The Arduino Uno development board is based on the Atmel ATmega328, an 8-bit, 16 MHz microcontroller with 14 digital input/output (I/O) pins, 6 of which are capable of pulse-width modulation (PWM), as well as a 6-channel, 10-bit analog-to-digital converter. Digital communication capabilities include UART TTL serial, SPI serial and two-wire interface serial (I2C). The Arduino development platform features a cross-platform, Java-based IDE as well as a C/C++ library which offers high-level access to hardware functions.

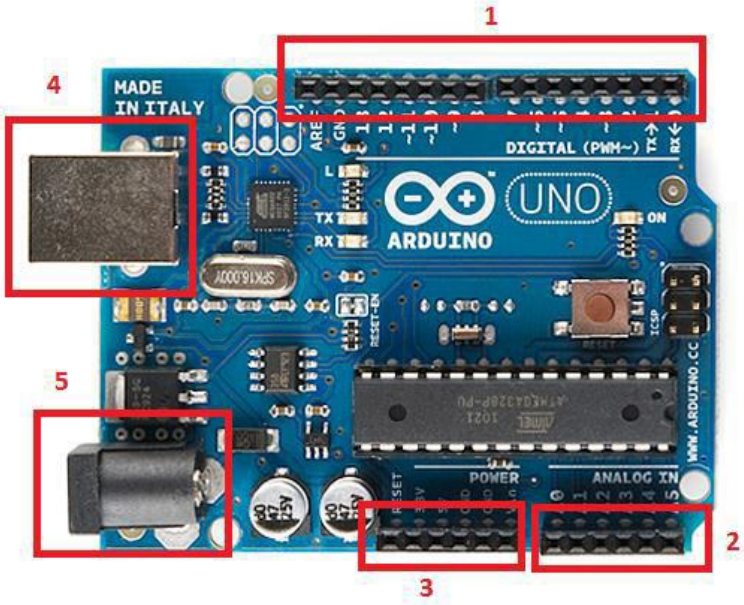

Fig. 1 ATmega328P

2) *Software Used - ARDUINO IDE 1.6.5:* The Arduino Integrated Development Environment (IDE) is a cross-platform application (for Windows, macOS, Linux) that is written in the programming language Java. It is used to write and upload programs to Arduino compatible boards, but also, with the help of 3rd party cores, other vendor development boards. The source code for the IDE is released under the GNU General Public License, version. The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub *main ()* into an executable cyclic executive program with the GNU tool chain, also included with the IDE distribution. The Arduino IDE employs the program *avrdude* to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware. By default, avrdude is used as the uploading tool to flash the user code onto official Arduino boards. Arduino IDE is a derivative of the Processing IDE however as of version 2.0, the Processing IDE will be replaced with the Visual Studio Code-based Eclipse Theia IDE framework.

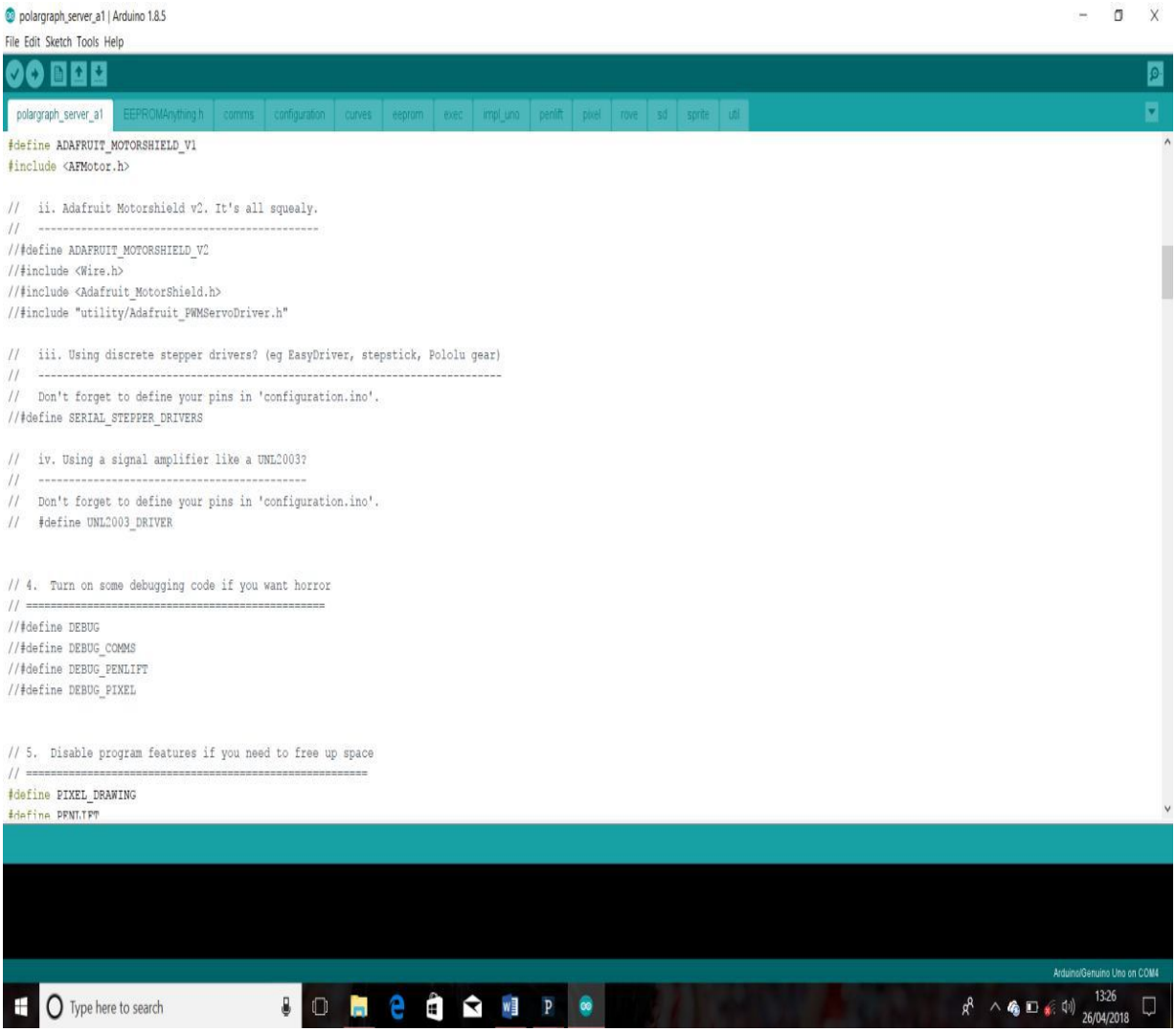

Fig. 2 Program of Arduino IDE 1.6.5

3) DC MOTOR: A DC motor consists of a mechanical device, a coil, a rotor and an electrical switch with brushes. Opposite polarity between the 2 magnetic fields within the motor cause it to show. DC motors area unit the best style of motor and area unit utilized in unit appliances, like electrical razors, and in electrical windows in cars. The DC motor may be a machine that transforms electrical energy into energy in kind of rotation. Its movement is made by the physical behavior of electromagnetism. DC motors have inductors within, that manufacture the field to generate movement.


Fig. 3 D. C. Motor

4) *5 X 2 Solenoid Valve:* Solenoid valve is a management unit that, once electrically energized or de-energized, either shut off or permits fluid flow. The mechanism takes the shape of a magnet. Once energized, a field builds up that pulls a plunger or pivoted coil against the action of a spring. 5/2 approach may be a 5 port, 2 position valve which will place a fluid or air into one finish of a double acting device still as permitting the opposite finish vent to exhaust. Direct acting area unit coil valves that area unit activated strictly by the magnetic attraction forces within the valve and don't depend on fluid to assist. The direction control valve is used to control the direction of air flow in the pneumatic system. The figure shows electrically controlled solenoid valve. A solenoid is a device that converts electrical energy into straight line motion and force. Solenoid may be of push type or pull type. The push type solenoid is one in which the plunger is pushed when the solenoid is energized electrically. The pull type solenoid is one in which the plunger is energized.

Fig. 4 (5 X 2) Solenoid Valve

5) *Double Acting Cylinder:* Double-acting cylinder includes a port at every finish, provided with hydraulic fluid for each the retraction and extension of the piston. A double-acting cylinder is employed wherever an external force isn't on the market to retract the piston or it is used wherever high force is needed in each directions of travel. Double-acting cylinders (DAC) use the force of air to maneuver in each extends and retract strokes. The cylinders are the devices which use the power of com- pressed air to produce force in a reciprocating linear motion. In this project, double acting pneumatic cylinder in used as shown in figure. It develops pressure in both extend and retract strokes. The moving member inside the cylinder is piston which moves forward and backward due to the high pressure of air. The cylinder top and lower plate are flanged together by means of bolts and nuts. The bottom of the cylinder is also flanged with end covers for the movement of the piston in reciprocating manner.

Fig. 5 Double Acting Cylinder

6) *Compressor:* A compressor is a mechanical device that increases the pressure of a gas by reducing its volume. An air compressor is a specific type of gas compressor. Compressors are similar to pumps: both increase the pressure on a fluid and both can transport the fluid through a pipe. An electric compressor is a device that converts power (using an electric motor, diesel or gasoline engine, etc.) into potential energy stored in pressurized air. By one of several methods, an air compressor forces more and more air into a storage tank, increasing the pressure. When tank pressure reaches it upper limit, the compressor shuts off.

7) *Polyurethane Tubes:* Polyurethane tubes are used to transfer pneumatic fluid i.e. compressed air. Polyurethane has the best properties of plastic and rubber. It offers abrasion and tears resistance, high tensile strength and elongation values, and has low compression. A pipe is a tubular section or hollow cylinder as shown in figure, usually of circular cross-section is used mainly to convey substances which can flow through it (liquids, gases, slurries, powders etc.).It can also be used for structural applications.

Fig. 6 Polyurethane tubes

8) *Rollers:* Rollers are used to support the sheet passing through them. These rollers hold sheet metal plate stiff and pass forward with help of automation through given feed. These rollers are electronically operated with help of dc motor. The electronic roll feeding is an integral part of almost every modern conveyor fed press and punch, and is frequently implemented as a stand-alone, electrically driven machine unit. Mechanical components of a complex construction in the roll feeding are replaced by intelligent units.

Fig. 7 Rubber rollers

9) *LCD*

a) LCD has 2 Power Sources

b) VCC and GND are at 1 and 2 NO. Pins of LCD. Used to drive the LCD 3mA current consumption.

c) VCC and GND are at 15 and 16 NO. pins of LCD used to drive the backlight of LCD 100 mA current

d) Total current consumption = 3mA + 100mA = 103 mA

e) So, in order to reduce the current requirement we are connecting a 330 ohm resistance in series with the backlight pin VCC. This reduces the current consumption (100mA / 330ohm =0.303 mA).

Therefore new total current consumption = **0.303Ma**

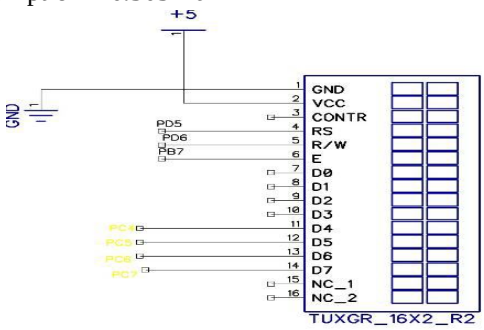

Fig. 8 Pin Diagram of LCD

TABLE I
LCD Pin Description

Pin No.	Symbol	Function
1	GND	GROUND
2	VCC	+ 5 V
3	CONTRAST	GND
4	E	ENABLE
5	RS	REGISTER SELECT
6	R/W	READ WRITE
7	DB0	DATA LINE
8	DB1	DATA LINE
9	DB2	DATA LINE
10	DB3	DATA LINE
11	DB4	DATA LINE
12	DB5	DATA LINE
13	DB6	DATA LINE
14	DB7	DATA LINE
15	VCC	+ 5 V
16	GND	GND

10) *Relay:* A relay is an electrically operated switch. It consists of a set of input terminals for a single or multiple control signals, and a set of operating contact terminals. The switch may have any number of contacts in multiple contact forms, such as make contacts, break contacts, or combinations thereof. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal.

There are basically two types of relay NO and NC:

- *Normally Open Contact (NO)* – NO contact is also called a make contact. It closes the circuit when the relay is activated. It disconnects the circuit when the relay is inactive.
- *Normally Closed Contact (NC)* – NC contact is also known as break contact. This is opposite to the NO contact. When the relay is activated, the circuit disconnects. When the relay is deactivated, the circuit connects.

Fig. 9 Relay

11) *Proximity Sensor:* A potentiometer is a three-terminal resistor with a sliding or rotating contact that forms an adjustable voltage divider. A potentiometer has a simple operation. It basically consists of a variable resistor, which changes its value as the current increases. This resistor has three terminals to which the voltage to be measured is connected. One at each end and a third connection to a slider. This control will allow us to increase or decrease resistance. The value between the connections can be varied by turning the moving part of the potentiometer.

IV. DESIGN CALCULATIONS

Required Parameters

1) Motor Support

a) Fixed at the height of 340mm
b) Length = 10cm
c) Width = 1cm

2) Dc Motor

a) Rpm = 30
b) Shaft = 20mm

3) Main Shaf

a) Diameter= 25.4mm

A. Press Force Calculations

Calculation for Aluminium Sheet:
Press force = cutting force + stripping force
Perimeter, L =31.41 mm. (For D = 10mm)
If Sheet thickness, t = 1mm.
Maximum tensile strength of aluminium, Tmax = 180 N/mm2.
Total cutting force = L x t x Tmax = 31.41 × 1 × 180 = 5654.86 N.
Stripping force = 15% of the cutting force = 848.229 N.
Press force = Cutting force + Stripping force = 5654.86 N + 1350 N = 6503 N.

B. Reduced Punch Force Calculations

Force required is reduced which can be seen by the formula,
F = Fmax.K.tK.t+1
Where,
F = Reduced force after providing shear in Newton (N)
Fmax = Maximum force required to punch the sheet of thickness t in Newton (N)
K = Percentage Penetration
t = Thickness of sheet in mm
I = Amount of shear given to the tool (in terms of t) in mm

1) Aluminium Sheet

For I=t/5 & K=0.6 F=0.75Fmax
For I=t/4 & K=0.6 F=0.705Fmax
For I=t/3 & K=0.6 F=0.643Fmax
For I=t/2 & K=0.6 F=0.545Fmax
For I=t/1 & K=0.6 F=0.375Fmax

We are taking selecting empirical relation as, F=0.375Fmax
Therefore, I = t/1 and K = 0.6 and F= 0.375Fmax
Therefore,
F = 0.375 X 6503 N
F = 2500 N
Therefore reduced force after giving shear to the punch is 2500 N.
We are selecting the punching force range from 2000N – 2500N.

C. Pneumatic Cylinder Calculations

For Double Acting Cylinder
For Extension Stroke (Working Stroke)
F = P x A
Where, F = Punching Force
P = Working Pressure
A = Area of the cylinder
Therefore,
2500 = (12 x 10^5) x (π/4 x D^2)
D = 25mm
Therefore we are selecting 25mm x 40mm double Acting Cylinder from catalogue.

D. Motor Calculation

Type: - DC Motor
Power = V×I
Where, Volt = 12V
Amp =7.6 amp
Power = 12×7.6
Power = 85 watt

V. SYSTEM DESIGN IN CATIA AND ANSYS

A. Design

The machine is basically made up of mild steel

1) Reasons

a) Mild steel is readily available in market.
b) It is economical to use.
c) It is available in standard sizes.
d) It has good mechanical properties i.e. it is easily machinable.
e) It has moderate factor of safety, because factor of safety results in unnecessary wastage of material and heavy selection. Low factor of safety results in unnecessary risk of failure.
f) It has high tensile strength.
g) Low co-efficient of thermal expansion.

2) Properties of Mild Steel: M.S. has carbon content from 0.15% to 0.30%. They are easily wieldable thus can be hardened only. They are similar to wrought iron in properties. Both ultimate tensile and compressive strength of these steel increases with increasing carbon content. They can be easily gas welded or electric or arc welded. With increase in the carbon percentage weld ability decreases. Mild steel serve the purpose and was hence was selected because of the above purpose.

B. Design in CATIA

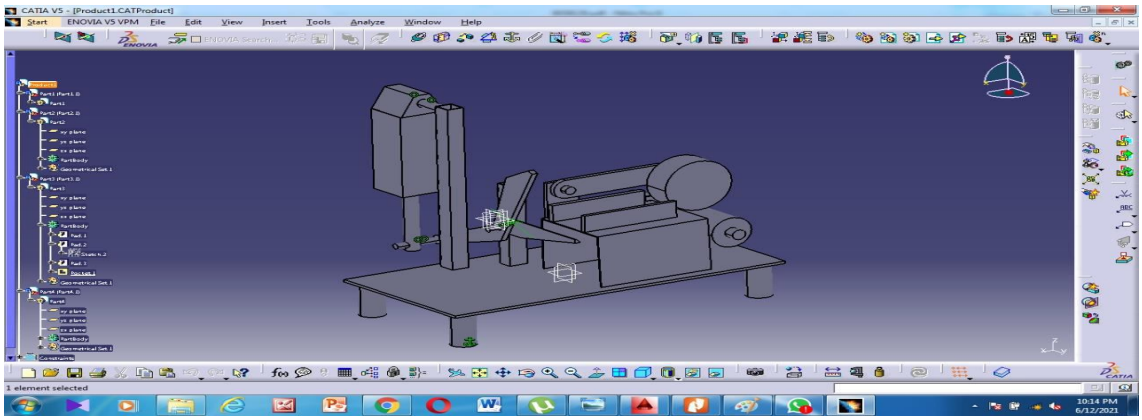

Fig. 10 Isometric View of the Model in CATIA

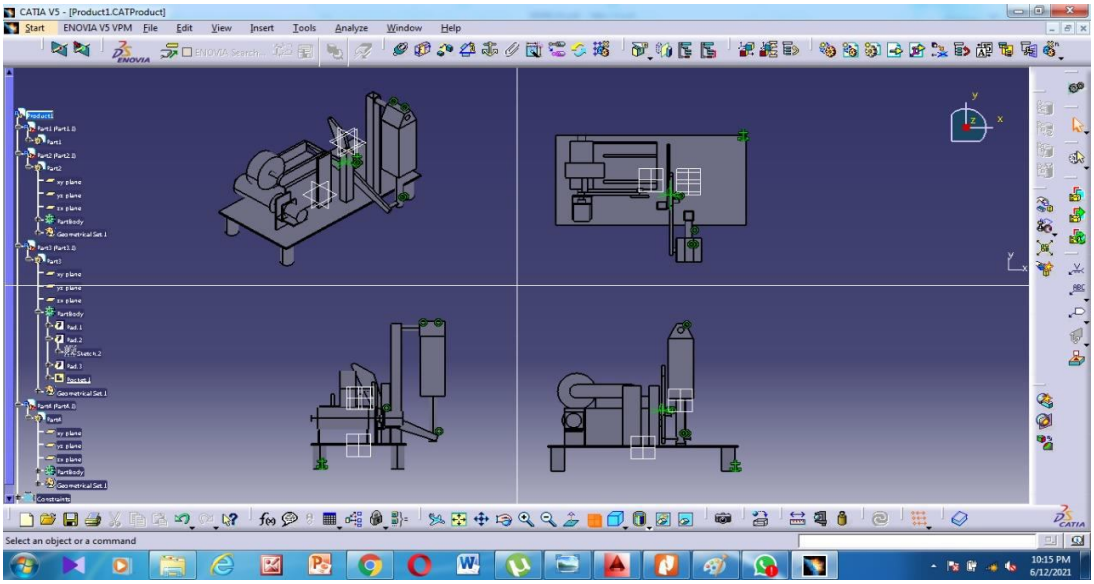

Fig. 11 Different Views of Model in CATIA

C. ANSYS

ANSYS is commercial, general purpose FE software which has been on the market since 1971. It can be used in several applications for example to study the thermal heat flow, fluid flow, magnetic fields, acoustics/vibrations and last but not least structural mechanical problems.

1) *Contact in ANSYS:* A handful of ways to handle contact are available in ANSYS. However, the one described here is penalty based contact since it provides short calculation times and therefore is used.
2) *Penalty Based Contact:* When a penalty-based contact is used, ANSYS adds a spring coefficient (k factor) when two surfaces come in contact with each other, in order to prevent penetration and to transfer load. However penetration will occur in order to transfer force, which is not the case in reality. Therefore the penalty-based methods are sensitive to the choice of the spring coefficient. The spring coefficient ANSYS uses during calculations is the product between the "normal stiffness factor" specified by the user and a reference factor calculated by the program. An additional aspect (apart from the accuracy) to consider when selecting the "normal stiffness factor" is the convergence behaviour. A stiffer contact will result in more calculation iterations, since bouncing might occur.
3) *Asymmetric Behaviour:* A contact condition can be either symmetric or asymmetric. When the contact condition is symmetric none of the surfaces can penetrate each other, while when the contact is specified as being asymmetric only one of the surfaces is prevented from penetrating the other i.e. the contact surface cannot penetrate the target surface but the opposite is possible. Figure illustrates the importance of selecting the correct contact pair.

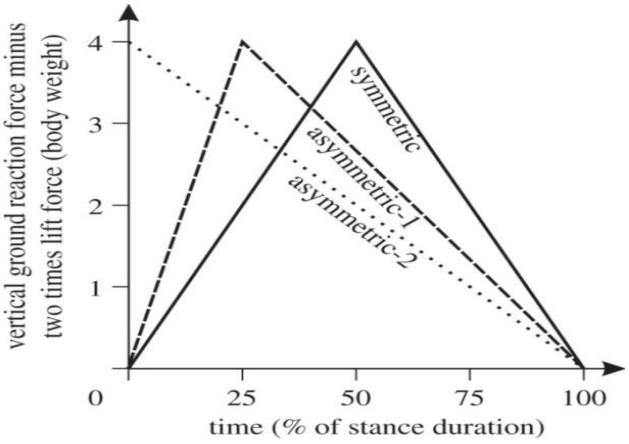

Fig. 12 Asymmetric behaviour

4) *Bilinear Stress-Strain Curve:* In context of the license version used, ANSYS tender a bilinear approximation of the stress-strain relationship as in fig. 13. The bilinear stress-strain curve requires two input values, yield strength and tangent modulus. The yield strength is the value when plastics straining occurs and the tangent modulus is the slope of the stress-strain curve after yielding.

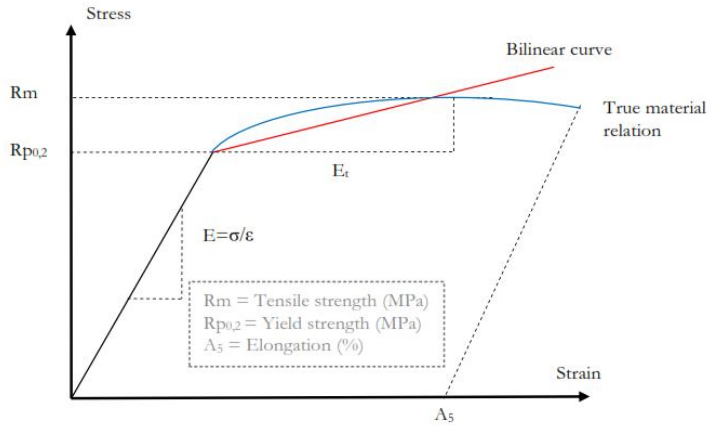

Fig. 13 Relationship between Stress & strain

5) *Meshing Controls:* ANSYS offers several tools to control the meshing procedure. The mesh densities of the whole model can be controlled by global settings for relevance centre in three steps: course, medium or fine. Method is a meshing control that provides the possibility to select different elements shapes. The different elements that are available are: tetrahedron or quadrilateral. Tetrahedron elements are triangular pyramid like elements with 10 or 4 nodes and quadrilateral elements are cube elements with 20 or 8 nodes.

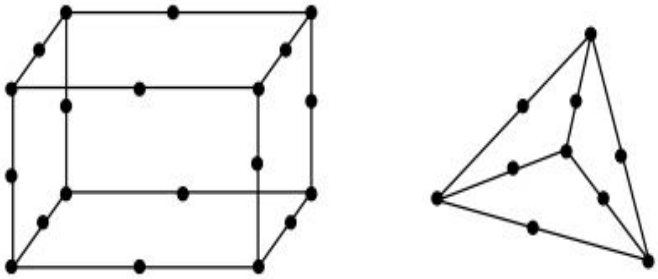

Fig. 14 Meshing Details

6) *Sizing:* Sizing is a meshing control that provides the possibility to mesh with different mesh densities at selected regions. By meshing fine in the area of interest and using coarse mesh in the remaining parts one is able to reduce CPU time and memory usage. There are a couple of ways to select the region of a sizing control available in ANSYS. The region can be a surface. This will produce a fine mesh (or actually a mesh with the size specified) on the surface only. The region can also be an entire body which will produce a fine mesh all over the body. If a contact region is to be analysed, ANSYS offers the possibility to specify the mesh size in the contact region. And to capture a local behaviour it is possible to specify a so called sphere of influence which makes it possible to set the element size (mesh size) within the volume of a sphere. The sphere of influence can be used to enclose both faces and bodies.

VI. POWER SUPPLY

The basic step in the designing of any system is to design the power supply required for that system. The steps involved in the designing of the power supply are as follows,

1) Determine the total current that the system sinks from the supply.
2) Determine the voltage rating required for the different components.

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The bridge rectifier and capacitor i/p filter produce an unregulated DC voltage which is applied at the I/P of 7805. The minimum dropout voltage is 2v for IC 7805, the voltage applied at the input terminal should be at least 7 volts.

a) C1 (1000 µf / 65v) is the filter capacitor.

b) C2, C4 (0.1 µf ceramic), C3 (220uF/25V electrolyte capacitor) is to be connected across the regulator to improve the transient response of the regulator.

Assuming the drop out voltage to be 2 volts, the minimum DV voltage across the capacitor C1 should be equal to 7volts (at least).

A. Power Supply Component Design

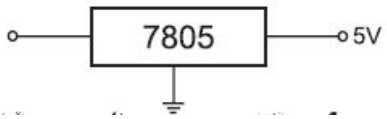

Fig. 15 Power supply component design

B. Transformer Design

We require +5V o/p. The drop-out voltage of regulator is 2V (As per datasheet).

Vdc = 5+2 = 7V

So at the regulator input minimum 7V should be applied.

According to formula,

Vdc = 2Vm / pi.

Assuming there is no Ripple Capacitor,

Hence From,

Vm = Vdc. pi / 2 = 7 x 3.14 / 2 = 10.99V

During one cycle, two diode are conducting, hence

- Drop of voltage of one diode = 0.7V
- Drop of voltage of two diode = 1.4V

∴ Vim = Vm + 1.4V = 10.99 + 1.4 = 12.39V

∴ Vrms = Vim / Sqrt (2) = 12.39 / Sqrt (2) = 8.76V

So as, Vim = 12.39V, Vrms = 8.76V

∴ We select transformer of 9V.

Similarly,

Im = Idc x pi / 2 = 400m x 3.14 / 2 = 628mA

∴ We select transformer with current rating of 500mA.

Considering voltage and current transformer.

We take Transformer - 0-9V / 500mA Step down transformer.

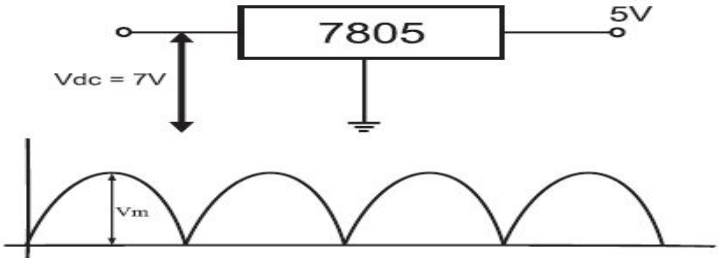

Fig. 16 Transformer design

C. Rectifier Design

PIV of diode = Vm = 12.39 V

Im = 628 mAmp

∴ We select bridge IC of 1 Ampere rating.

D. Filter capacitor Design

R = Vdc / Idc = 7 / 400m = 17.5 Ohms
Vr = 2 (Vim - Vdc) = 2(12.39 - 7) = 10.78V
C = Vdc / (F x R x Vr) = 7 / (100x17.5x10.78) = 371.05 µf
So for safe working we select capacitor 0f 1000uF
C = 1000uF / 35V
C1 - 1000uF/35V - Electrolytic Capacitor
C2, C4 -0.1uF Ceramic Capacitor
C3 -220uF/25V Electrolytic Capacitor

E. Circuit Diagram

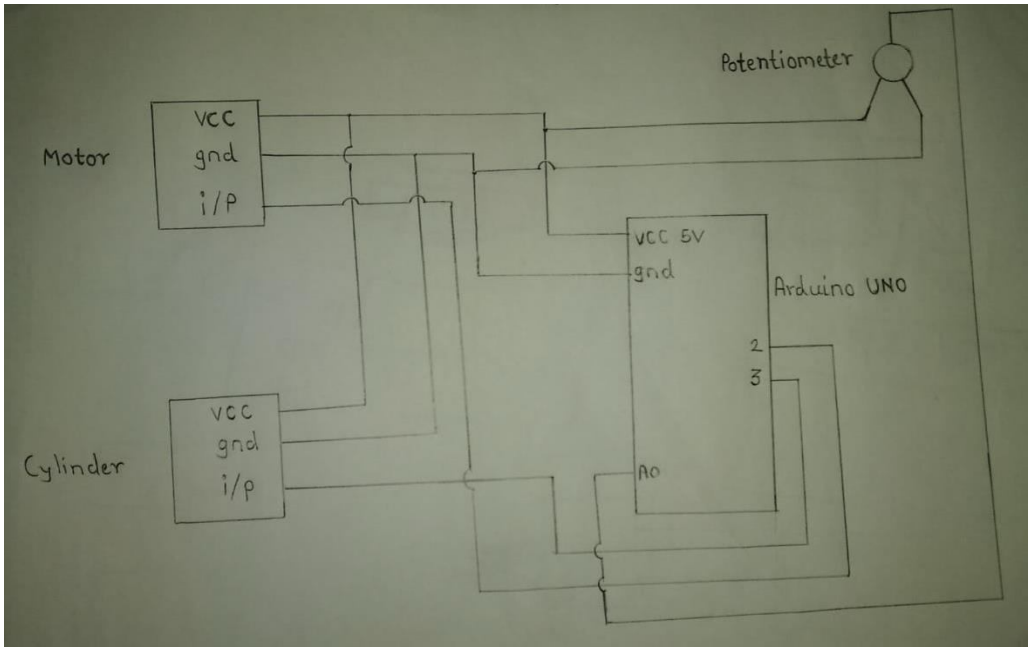

Fig. 17 Circuit Diagram

VII. FUTURE SCOPE

If we adjust the arrangement of piston at centre of frame & by adding a punching dies to piston end & adding additional a base table we can use this machine as “Pneumatic Punching machine” also for punching work. By using automation & electronics system we can improve the performance of Pneumatic shearing machine particularly designed for Cutting Dies blades, cork, leather, plastic and PVC materials etc. Most Handsome and compact patronized Model requires Minimum Space. Minimum "Make-Ready" Time and provides sufficient hourly production. By using proper balancing of pneumatic systems & reciprocating parts we can use this Pneumatic shearing machine for high speed & high production rate applications. By using proper pneumatic balancing weight of parts we can use this pneumatic shearing machine for cut the hard material & for more thick sheets or blades. Improve performance by adopting imported guide rails stopper, advanced controlling system and our special designed software. Automatic tracing system, by using counter will be used for counting the cutting strokes.

VIII. ADVANTAGES

A. Machine work on the low power consumption as compare to the old shearing machine.
B. It provides multiple cutting sizes of the metallic blades & aluminium sheets.
C. Complex shapes can be Shearing as per requirement easily.
D. Very thin sections up to 0.5mm to 1mm can cut easily.
E. Only simple support structures are required Design & fabrication is easy.
F. Wide variety of cork, aluminium sheet & plastic sheets can be cut.
G. Highly accurate profiles and good cutting finishing can be easily obtained and economical in mass production.

IX. CONCLUSION

It is observed that the pneumatic cutting is very cheap as compared to hydraulic cutting machine. The range of the cutting thickness can be increased by using high pressure compressor and more hardedned blades. This machine is advantageous to small sheet metal cutting industries as they cannot afford the expensive hydraulic cutting machine. Further with the employment of automation, it provides provision to enter the number of sheets to be cut and required length of the sheet. Hence human effort is reduced with increase in accuracy in operation.

X. ACKNOWLEDGMENT

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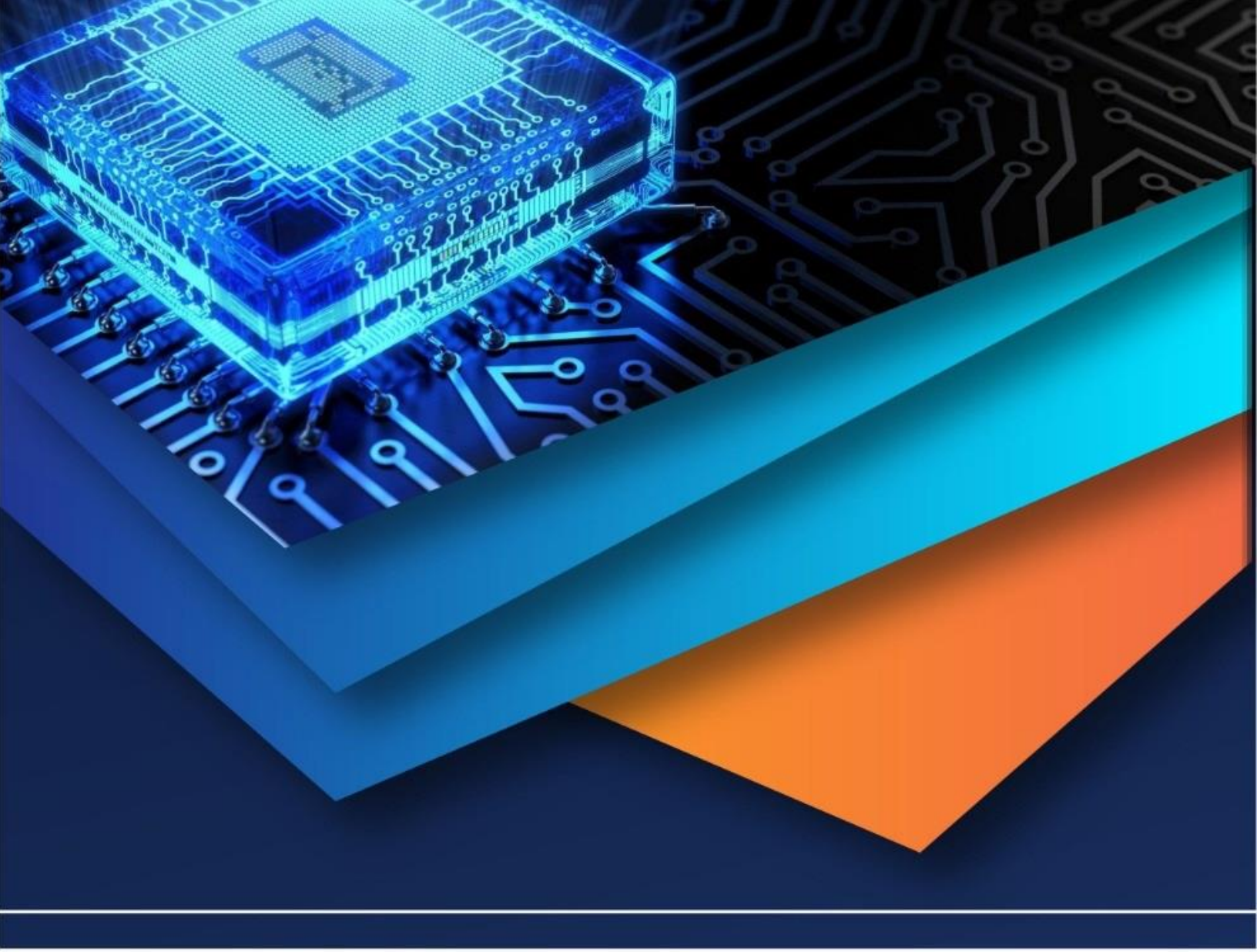
REFERENCES

[1] Aniruddha Kulkarni, Mangesh Pawar, “Sheet Metal Bending Machine”, International Journal of Engineering Re-search and Technology, Vol. 2, March 2015.
[2] Adithya Polapragada A.S, K.Srivarsha, “Pneumatic Auto Feed Punching, Cutting and Riveting machine”, International Journal of Engineering Research and Technology, Vol.1, September 2012.
[3] Dinesh Lamse, Akash Navghane, Rahul Chavhan, Ajay Ma-hawadiwar, “Design and Fabrication of Pneumatic Sheet Metal Cutting and Sheet Metal Bending Machine”, International Research Journal of Engineering and Technology, Vol. 4, March 2017.
[4] Paul.Degarmo .E, “Shearing in metal cutting”, Materials and Processes in Manufacturing, Eight edition, 2003, p. 518-528.
[5] Karthikumar K, K.V.S.S. Saikiran, Jakkoju Satish, “Pneumatic Sheet Metal Cutting Machine”, International Journal and Magazine of Engineering and Technology, Management, Research”, Vol. 3, March 2016.
[6] Madhu Kumar V, Arun Kumar N, Harsha B S, Naveen Kumar K N, “Design and Fabrication of Pneumatic Sheet Metal Cutting and Bending Machine”, International Journal
[7] P.M.Pradhan, “Experimental Investigation and Fabrication of Pneumatic Cutting tool”, International Journal of Innovative Research in Science, Engineering and Technology, Vol. 2, Issue 6, June 2013.



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