INTERNATIONAL JOURNAL OF LATEST TECHNOLOGY IN ENGINEERING, MANAGEMENT & APPLIED SCIENCE (IJLTEMAS)

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIV, Issue VII, July 2025

Fabrication of Geneva Wheel Based Auto Roll Punching Machine with IR Sensing

[1] V. Madhu Sudhan Reddy, [2] M. Naveen

[1] Assistant Professor, Dept of ME, JNTUACEP

[2] GVS Deepak

DOI: https://doi.org/10.51583/IJLTEMAS.2025.1407000103

Abstract: In conventional punching machines, the time required for job setting, marking, and punching operations is relatively high, leading to increased labor cost and reduced efficiency. To overcome these limitations, a Geneva mechanism-based automatic punching machine is proposed, which significantly reduces setup time, labor involvement, and maintenance requirements. This project focuses on the design and fabrication of an automated roll punching machine using the Geneva mechanism, specifically tailored for continuous punching on paper or fabric rolls.

The aim is to introduce low-cost automation in industrial applications, particularly in processes requiring repetitive punching tasks. The major components utilized in this system include a DC motor, cam arrangement, chain drive, Geneva wheel mechanism, and punching tool. The setup includes two rollers to move the paper or fabric sheet during operation. A DC motor drives the cam, which features a pin that periodically engages the Geneva wheel. The Geneva wheel, in turn, is connected to a chain drive system that moves the rollers, feeding the material for the punching operation.

An IR sensor is incorporated into the system to detect the presence of paper or fabric before each punch cycle. This addition prevents dry runs, ensuring that the punching tool only operates when material is properly in place, thus increasing operational reliability, reducing wear and tear, and avoiding damage to the punch. This prototype is suitable for mass production scenarios and represents a step toward intelligent automation in material handling and processing systems.

I. Introduction:

Automation and mechanical innovation play a critical role in enhancing productivity and precision in modern industrial processes. In the field of sheet metal operations, especially punching, automating the material feeding and punching process can significantly improve efficiency while reducing manual effort. The Geneva wheel mechanism, known for its ability to convert continuous rotary motion into intermittent rotary motion, finds effective application in indexing and timing-based systems.

TheGenevaWheelBasedAuto-RollPunchingMachinewithIRSensingisasemi-automatedsystem thatutilizestheGenevamechanismtopreciselycontrolthemotionoftheworkpieceandsynchronize it with the punching action. The inclusion of IR sensors ensures detection and positioning accuracy of the roll material, thus eliminating errors due to misalignment and enhancing the quality and repeatability of punched parts.

This project focuses on the design and fabrication of a punching setup using mechanical, pneumatic, and sensing principles to achieve a synchronized, cost-effective, and reliable punching system suitable for small-scale production lines or educational demonstrations.

Geneva Mechanism

The Geneva drive or Maltese cross is a gear mechanism that translates a continuous rotation into an intermittent rotary motion. The rotating drive wheel has a pin that reaches into a slot of the driven wheel advancing it by one step. The drive wheel also has a raised circular blocking disc that locks the driven wheel in position between steps.

The name derives from the device's earliest application in mechanical watches; Geneva in Switzerland being an important centre of watchmaking.

TheGenevadriveisalsocommonlycalledaMaltesecrossmechanismduetothevisualresemblance when the driven wheel has four spokes. Since they can be made small and are able to withstand substantial mechanical stress, these mechanisms are frequently used inwatches. Precision in indexing motion. This mechanism is chosen for its Simplicity in design, Ability to handle synchronized timing tasks, Low maintenance and mechanical reliability.

Types of Genevas

External Geneva Mechanism

TheexternalGenevamechanismisthemostcommonlyusedtype.Inthissetup,thedrivingwheelis positioned outside the Geneva wheel, and it has a pin that engages with radial slots on the Geneva wheel. As the driving wheel rotates continuously, the pin enters one of the slots and rotates the Genevawheelbyaspecificangle(like90°for4slots).Aftercompletingthestep,theGenevawheel remains stationary until thepin comesaroundagain. During thedwell phase, araisedportion on the driving wheel locks the Geneva wheel in place. This type is simple in construction and suitable for machinesoperatingatlowtomediumspeeds.Itiscommonlyfoundinmechanicalwatches,punching machines, and film projectors.

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIV, Issue VII, July 2025

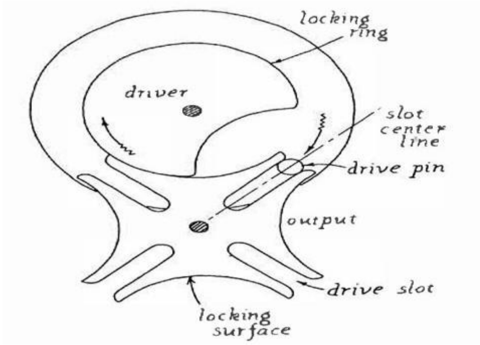


Fig1.14-SlotExternal Geneva

DetailedExamplesofSheetMetalOperationsUsingtheGenevaMechanism

Punching

- **Purpose:** Tocreateholesorshapesthroughthesheetmetal.
- **Process:** Atoneindexingposition,apunchingtoolpreciselypuncheshol esatmarked locations.
- **Application:** Creatingventilationholesin panels,mountingholesin brackets.

Piercing

- **Purpose:** Similartopunchingbutgenerallyforsmaller,preciseholesorslotswithout removing the blank.
- **Process:** Apiercingtoolcreatesslits,slots,orsmallopenings.
- **Application:** Ventilationslotsinenclosures,alignmentholes.

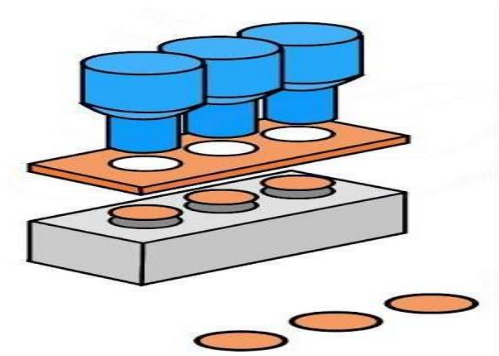


Fig1.4: Punching & Piercing

Blanking

- **Purpose:** Tocutoutaflatshape(blank) froma sheet.
- **Process:** ThesheetisfedtoablankingdieatastationwheretheGenevawheelhalts momentarily; the die cuts the complete shape out of the sheet.
- **Application:** Manufacturingofwashers,covers, baseplates.

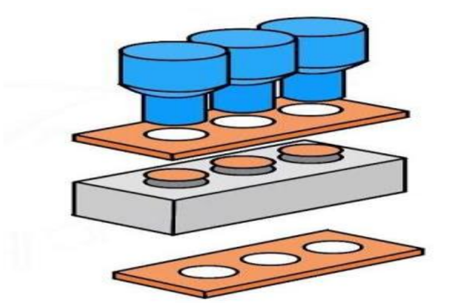


Fig 1.5: Blanking

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIV, Issue VII, July 2025

Notching

- **Purpose:**Toremoveasmall sectionfrom thesheet's edgeorcorners.
- **Process:**Specialnotchingtoolscutout cornersorslotsduringeachGenevastop.
- **Application:**Preparingsheetedgesforbendingor assembly.

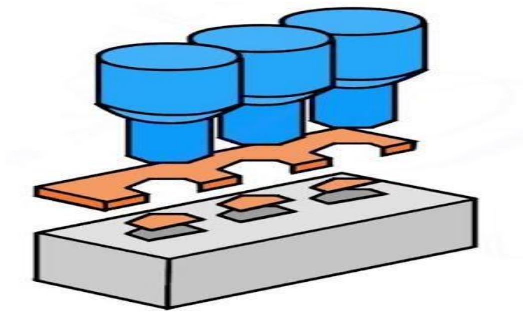


Fig1.6: Notching

Embossing

- **Purpose:** Tocreateraisedorrecessedfeaturesonthesheetsurface.
- **Process:** Attheembossingstation,diespressintothesheettoformthedesiredsurfacetexture or logo.
- **Application:** Decorativepanels,nameplates,texturedsurfaces forgrip.

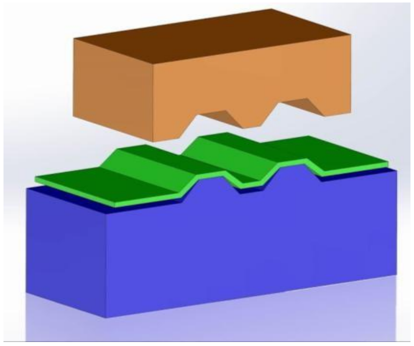


Fig 1.7: Embossing

Lancing

- **Purpose:** To cut and simultaneously form a tab or tongue from the sheet without removing material.
- **Process:** A lancing die slices and lifts a portion of the sheet to form louvers or ventilationopenings.
- **Application:**Electricalcabinets,HVACpanels.

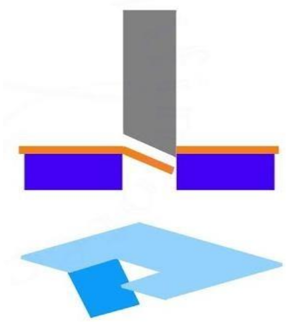


Fig 1.8: Lancing

II. Literature Survey Summary

Innovation in the field of automatic punching machines demands a deep study of existing mechanisms, materials, and technologies. This helps in understanding different motion conversion techniques, precision control methods, automation enhancements, and safety mechanisms. The following are the list of relevant published, patented, and unpublished research around the world.

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIV, Issue VII, July 2025

The Geneva mechanism is widely utilized in applications requiring intermittent motion, making it an ideal choice for automatic punching machines. The mechanism transforms continuous rotary motion into intermittent rotary motion, allowing precise control over the indexing of material in automated systems.

R. S. Khurmi and J. K. Gupta (2005) in their work Theory of Machines discuss the basic working principles and design considerations of the Geneva mechanism. The intermittent natureofmotion provided by this mechanism is especially beneficial in automation processes like punching, indexing tables, and film projectors.

V.S. Kumbharetal. (2016) in theirpaperDesign and Fabrication ofGenevaOperated Auto Punching Machine, emphasize the efficiency improvements in production lines due to the Geneva mechanism. They noted that the precise indexing reduces material wastage and increases productivity, making it suitable for repetitive punching operations.

R. Syam Sudhakar Rao et al. [1] presented a design for an auto-roll punching machine utilizing a Geneva mechanism. Their system integrates a DC motor, cam arrangement, chain drive, and punching tool. The Geneva wheel facilitates intermittent motion, enabling precise sheet feeding and punching operations. This design aims to reduce labor costs, maintenance, and operational time, making it suitable for mass production in sheet metal industries.

Ankit Raj and Bhaskar Singh [2] explored a smart punching and labelling machine employing a Geneva drive coupled with proximity sensors. Their machine automates positioning, punching, and labelling, enhancing throughput and minimizinghuman error.The study underscores the efficacy of integrating simple sensors to augment mechanical systems'intelligence.

Priya Sharma and Manish Kumar [3] investigated the application of Geneva wheel mechanisms in semi-automatic machines. Their research emphasizes how Geneva drives convert continuous rotary motion into intermittent motion with precise indexing, discussing various configurations and their impact on dwell time and cycle optimization.

SrinivasaRaoP.etal.[4]developedanautomaticpaperpunchingsystemintegratedwith IR sensors. The IR sensor detects material presence, triggering the punching operation automatically. Thisintegrationeliminatesmanualfeederrorsandimprovesprocessreliability, demonstrating cost-effective automation using basic IR technology.

Prof. A. S. Rathi et al. [5] reviewed mechanical-based automation systems for small-scale industries, focusing on low-cost Geneva mechanism applications in assembly lines and semi- automated production setups. Their findings highlight the Geneva mechanism's versatility in operations requiring precise, repeated indexing, such as drilling, punching, and labeling.

Conclusions from Literature Survey:

- Geneva Mechanism Efficiency: The Geneva wheel effectively converts continuous rotary motion into precise intermittent motion, optimizing indexing operations in punching machines.
- Automation Integration: Incorporating IR sensors enhances automation by enabling non-contactmaterialdetection,initiatingpunchingcyclesautomatically,andimproving process reliability.
- Cost-Effective Solutions: The amalgamation of mechanical systems like the Geneva mechanism with simple electronic components such as IR sensors offers a cost- effective solution for small and medium-sized enterprises.
- Enhanced Productivity: Automation reduces manual intervention, minimizes operator fatigue, and increases production rates, making it suitable for mass production scenarios.
- DesignConsiderations:ProperconfigurationoftheGenevawheelandintegrationwith other components like cam drives and sensors are crucial for achieving desired performance and reliability.

Problem Definition

To overcome manual errors, fatigue, time delays, and inconsistent punching in traditional sheet punching methods by designing an automatic Geneva wheel-based punching machineintegratedwithIRsensingforaccurate,sensor-drivenoperationandpreciseindexing.

Objective

- To designand fabricatean efficient automatic punchingmachine usingthe Geneva mechanism for intermittent motion.
- ToimplementIRsensingtechnologyforaccuratematerialdetectionandautomatic activation of the punching unit.
- Toachieveprecisecontroloverpunchingintervalsandindexing,ensuringuniform spacing and enhanced productivity.
- To reduce labor involvement, improve operator safety, and increase repeatability insmall-scale manufacturing units.

Scope of the Project

- AutomatesheetfeedingandpunchingprocessusingGenevawheel-basedindexing system.

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIV, Issue VII, July 2025

- IntegrationofIRsensortodetectmaterialpresenceandactivatepunchingaction without manual intervention.
- Suitable forlightweight sheet punching in small workshops, packaging, or craft-based industries.
- Reducehumanerrorandcycletimewhileincreasingproductionqualityand consistency.
- Serveasacost-effectivealternativetoCNCorhydraulicpunchingsystemsformedium- precision tasks.

III. Methodology

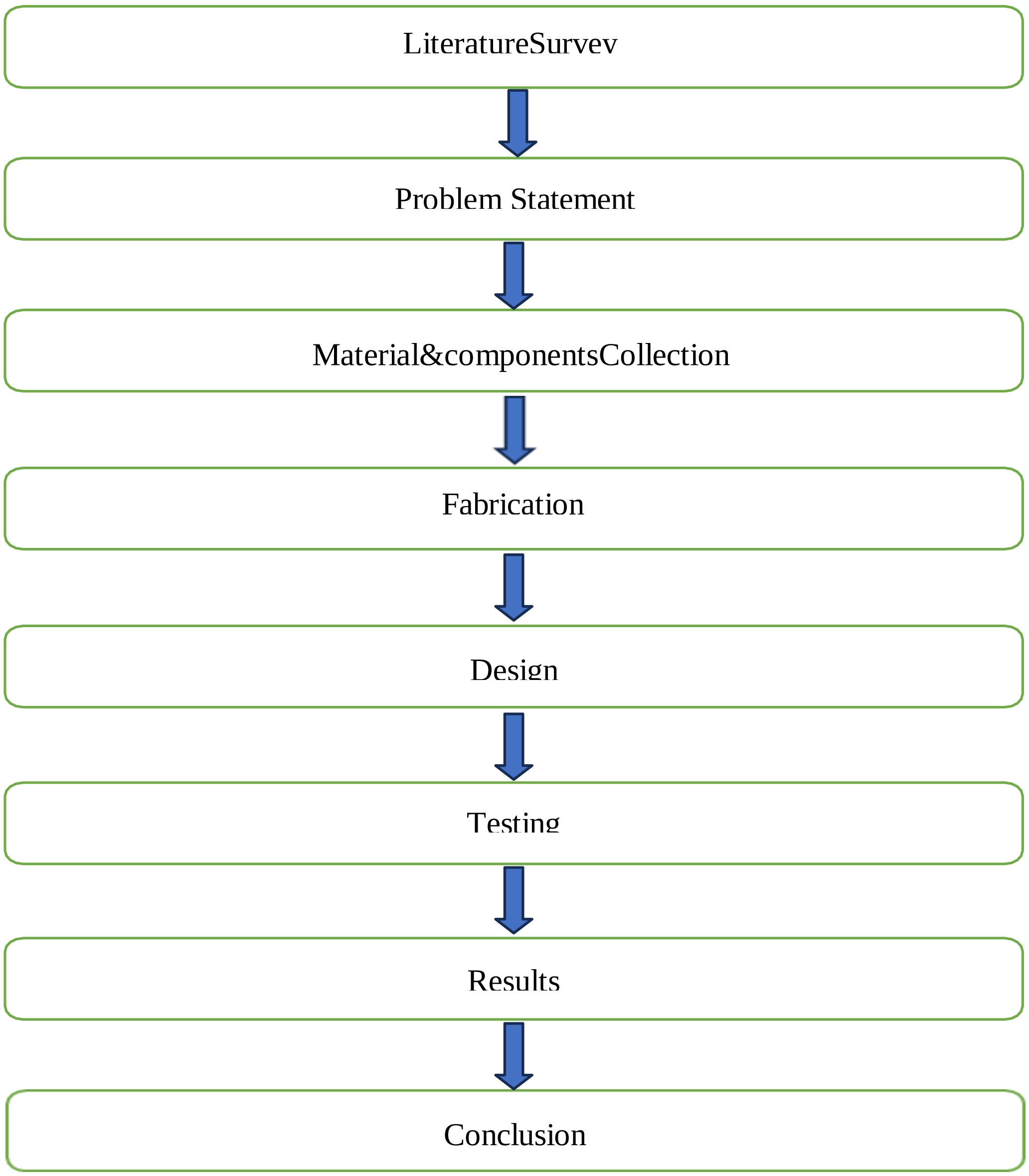


Table5.2:SpecificationsofRechargeablebattery

Specification	Details
Brand	SANCA
Model	RB1275BS
BatteryType	SealedLead-Acid(SLA)Rechargeable
Nominal Voltage	12V
Capacity	7.5 Ah
ChargingVoltage(Cycle Use)	14.40V – 15.00V

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIV, Issue VII, July 2025

ChargingVoltage(Standby Use)	13.50V – 13.80V
MaximumChargingCurrent	2.35A

Fig5.4: Rechargeablelead-Acid Battery

Table5.3: Specifications of Chain & Sprocket

Specification	Details
Material(Chain)	Carbon Steel
Material(Sprocket)	HardenedSteel
LargeSprocketDiameter	180mm
SmallSprocketDiameter	80mm
No.ofTeethon Large Sprocket	44
No.ofTeethon Small Sprocket	24
No. ofLinks in Chain	30

Rollers

Introduction to Rollers:

Rollers are cylindrical components that facilitate smooth linear or rotational motion between contacting surfaces, typically with minimal friction. In an Autoroll punching machine, rollers play a critical role in feeding the sheet material or substrate into the punching zone in synchronization with the Geneva indexing mechanism.

FunctionofRollersin AutorollPunchingSystem:

In a Geneva-based punching setup, rollers are responsible for the continuous or intermittent movementofthematerialbeingprocessed.TheGenevamechanismimpartsanindexedmotion, and the rollers must grip and guide the material precisely during the dwell and motion phases of the Geneva wheel.

Keyfunctions include:

- **MaterialFeeding:**Rollersfeedthesheetormaterialintothepunchingzoneata controlled rate.
- **Synchronization:**TheyworkincoordinationwiththeGenevaindexingtoensure accurate timing between feed and punch.
- **Friction Control:** Proper roller material ensures adequate grip without damaging the substrate.

TypesofRollersUsed:

- **Drive Rollers:** Connected to a motor or Geneva-driven mechanism to actively pull or push the material.
- **IdlerRollers:**Passiverollersthatprovidesupportandmaintaintensiononthematerial.

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIV, Issue VII, July 2025

Fig. 5.7: Rollers

Table5.4: Specifications of Rollers

Specifications	Details
LengthofUpper Roller	215mm
LengthofLower Roller	215mm
DiameterofUpperRoller	38mm
DiameterofLowerRoller	150mm
BearingDiameterinUpper Roller	31mm
BearingPinLength	250mm
MaterialoftheRoller	Aluminum

Paperfeeder

The paper feeder roller used in the Geneva wheel-based auto-roll punching machine with IR sensingisacompletelystationarycomponent.Itisdesignedtosupportandguidethepaperroll movement without itself rotating. When the machine is operational, the paper roll moves forwardundertheinfluenceofaseparatepowereddriveroller,whilethefeederrollerremains fixedinplace.Themovementofthepaperacrossthestationaryrollerissmoothandcontrolled,

ensuringastablefeedintothepunchingsectionwithoutdirectmechanicalinteractionfromthe feeder itself.

Animportantfeatureofthepaperfeederrolleristheinclusionoftaperedconicalplasticguides at both edges. These conical guides are fixed firmly and play acritical role in maintaining the paper's central alignment. They prevent the paper from drifting sideways during its forward movementandprotectagainstpaperedgewrinklingorjamming.Byphysicallylimitinglateral motion,theconicalguidesensurethatthepaperremainsproperlyalignedthroughouttheentire operation, maintaining punching accuracy and consistency.

Fig.5.8: Paperfeeder

Fig.5.9: Sliding Bearing & Plastic Knob

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIV, Issue VII, July 2025

Table5.5: Specifications of Sliding Bearing & Plastic Knob

Specification	Details
Bearing Diameter	30mm
Knob Length	160mm
KnobHeadDiameter	30mm
Knob Diameter	15mm

Punching Machine

A punching machine is a mechanical device used to create holes or shapes in sheet metal or other materials by applying a large force with a punch tool onto a die. The basic working principle involves placing the material over the die and then forcing the punch through the material into the die opening, cutting out the desired shape.

Fig.5.10: Paper Punching Machine

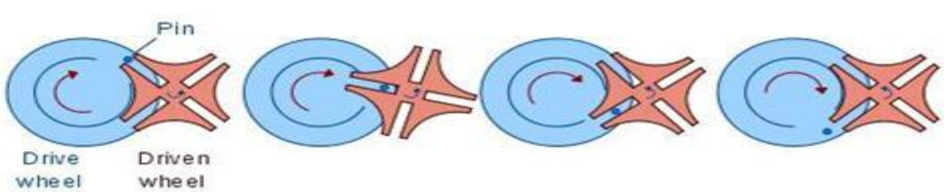
Geneva Wheel

The**Genevadrive** or **Maltesecross** is a gearmechanism that translates a continuous rotation intoanintermittentrotarymotion.Therotatingdrivewheelhasapinthatreachesintoaslotof thedriven wheel advancing it by onestep.Thedrivewheel also has araised circularblocking disc that locks the driven wheel in position between steps.

The **four-slot Geneva** wheel in the punching machine is made of nylon and features four evenly spaced radial slots. Driven by a crank with a pin, powered by a 12V DC motor with a speed reduction gearbox, it rotates 90 degrees per slot engagement, pausing briefly between rotations to ensure precise, intermittent motion for synchronized paper feeding.

Uses of making the Geneva wheel with nylon:

- **Lightweight**:Nylon’slowdensityreducesthewheel’s weight,minimizinginertiaand energy consumption during operation.
- **Durability**: Nylon’s high strength andwear resistance ensure the wheelwithstandsrepeated slot engagements without significant wear.
- **Low Friction**: Nylon’s self-lubricating properties reduce friction with the crank pin, enhancing smooth operation and reducing maintenance.
- **Cost-Effective**:Nyloniseconomicalcomparedtometals,loweringmanufacturing costs for the wheel.
- **CorrosionResistance**:Nylonresistscorrosion,makingitsuitableforvarious fabrication environments without degrading.
- **Noise Reduction**: Nylon’s damping properties reduce operational noise compared to metal, improving workplace conditions.



ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIV, Issue VII, July 2025

Table5.6: Specifications of 4-Slot Geneva Wheel

Specifications	Details
No. of Slots	4
DepthofEachSlot	100mm
Widthof theSlot	10mm
ArcRadiusofEachSlot	120mm
MaterialUsed	NYLON
SquareSide ofNylon Billet	260mm X 260mm
Thicknessof theNylonBillet	10mm

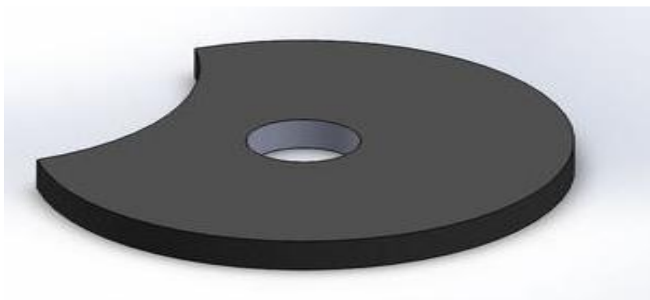


Fig.5.12: Crank Wheel

Table5.7: Specifications of Crank Wheel

Specifications	Details
DiameteroftheCrank Wheel	240mm
MaterialUsed	NYLON

I.R Sensor

Infrared (I.R) sensors are electronic devices that detect infrared radiation (heat) from objects. They are commonly used for motion detection, proximity sensing, and temperature measurement. IR sensors work by either emitting and detecting infrared light (active) or just detectingambientinfraredradiation(passive).They'rewidelyusedinremotecontrols,security systems, obstacle-avoiding robots, and thermal imaging.

IR sensors are super handy for detecting objects, motion, or line tracking. Here are a few common uses:

- **Obstacle avoidance**: In robotics, IR sensors detect nearby objects so the robot can avoid collisions.
- **Line-followingrobots**:Sensorsdetectcontrast(likeablacklineonawhitesurface)to help the robot follow a path.
- **Automateddoors**: IRsensors detectwhensomeoneis nearbytotrigger the door.
- **Securitysystems**:Usedinmotiondetectorstosensemovementandtrigger alarms.
- **Speeddetection**:InDIYspeedmeasurementsystems,theytrackwhenanobjectpasses two points.

Fig. 5.14: I.R Sensor

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIV, Issue VII, July 2025

ARDUINOUNOATmega328P

Features

- HighPerformance,LowPowerAVR®8-BitMicrocontroller
- AdvancedRISCArchitecture
  1. 131PowerfulInstructions–MostSingleClockCycleExecution
  2. 32x 8General PurposeWorkingRegisters
  3. FullyStaticOperation
  4. Upto 20 MIPSThroughput at 20 MHz
  5. On-chip2-cycle Multiplier
- HighEnduranceNon-volatileMemory Segments
  a. 4/8/16/32KBytesofIn-SystemSelf-ProgrammableFlashprogrammemory
  b. (ATmega48PA/88PA/168PA/328P)
  c. 256/512/512/1KBytes EEPROM (ATmega48PA/88PA/168PA/328P)

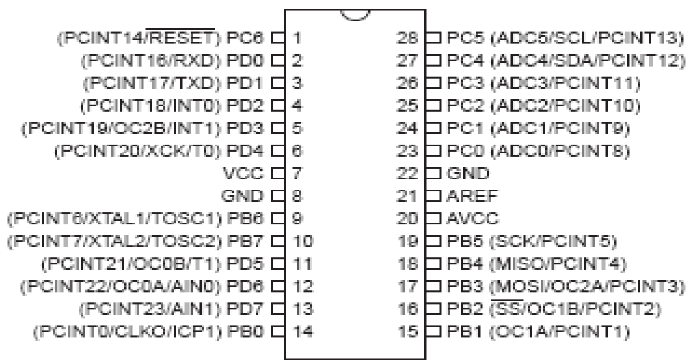


Fig.5.15:PDIP

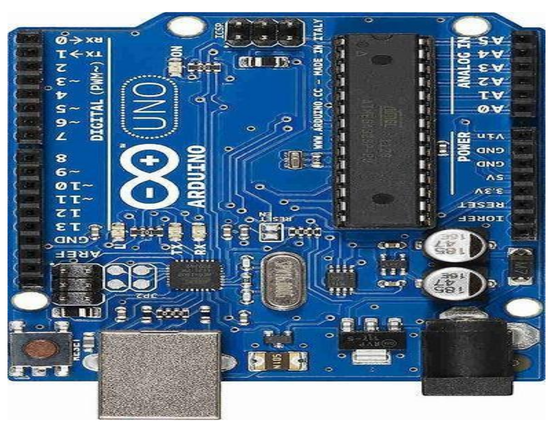


Fig.5.16: ARDUINO UNO ATmega328P

Relay (Single-Channel5v)

Relays are electrically operated switches used in many electronic and electrical projects to control high-voltage or high-current devices with a low-power signal. They work using an electromagnet that, when energized, pulls a switch to open or close a circuit. Relays are commonly used to:

- Turnon/offlights, motors, or appliances
- Isolatecontrolcircuitsfromhigh-power loads
- Interfacemicrocontrollers(likeArduino)with ACorhigh-currentDC device

INTERNATIONAL JOURNAL OF LATEST TECHNOLOGY IN ENGINEERING, MANAGEMENT & APPLIED SCIENCE (IJLTEMAS)

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIV, Issue VII, July 2025

Regulated Power Supply (R.P.S)

A Regulated Power Supply (RPS) module is designed to convert **230V** AC mains power into a stable **5V** DC output, commonly used in electronic circuits.

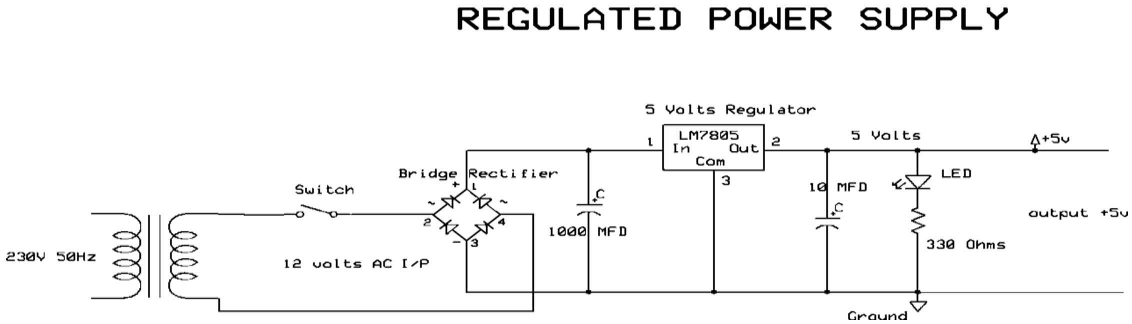


Fig5.18: Circuit Diagram of Regulated Power Supply with Led Connection

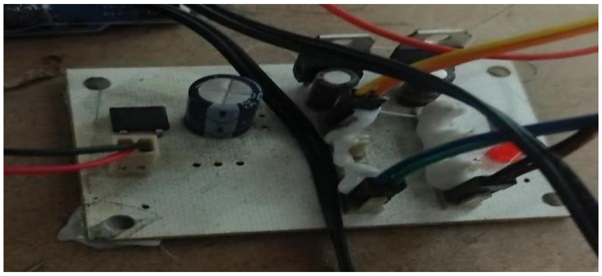


Fig5.19:5 vregulatedpowersupplyusing7805withtransformerand Bridge Rectifier

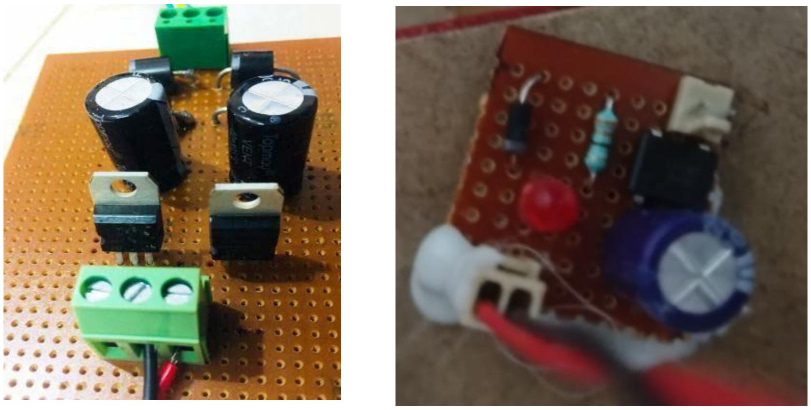


Fig5.20:12V AC To 12VDCCONVERSION CIRCUIT BUILT ON PERFBOARD

Fig.6.1MildSteelSupportFrame

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIV, Issue VII, July 2025

Fig. 6.2 Rollers

Design and Fabrication

The 4-slot nylon Geneva wheel with four equally spaced slots and Crank Wheel are designed in CATIA to achieve intermittent rotation, driven by a crank wheel with a pin engaging the slots.Thecrankwheelwasdesignedtomatchthe Genevawheel’sgeometry,ensuringsmooth engagement. Both components were modelled with precise tolerances to minimize backlash andensurereliablemotion.Thechainandsprocketsystemwasselectedtotransmitpowerfrom the crank wheel to the rollers, with sprocket sizes chosen to achieve the desired gear ratio.

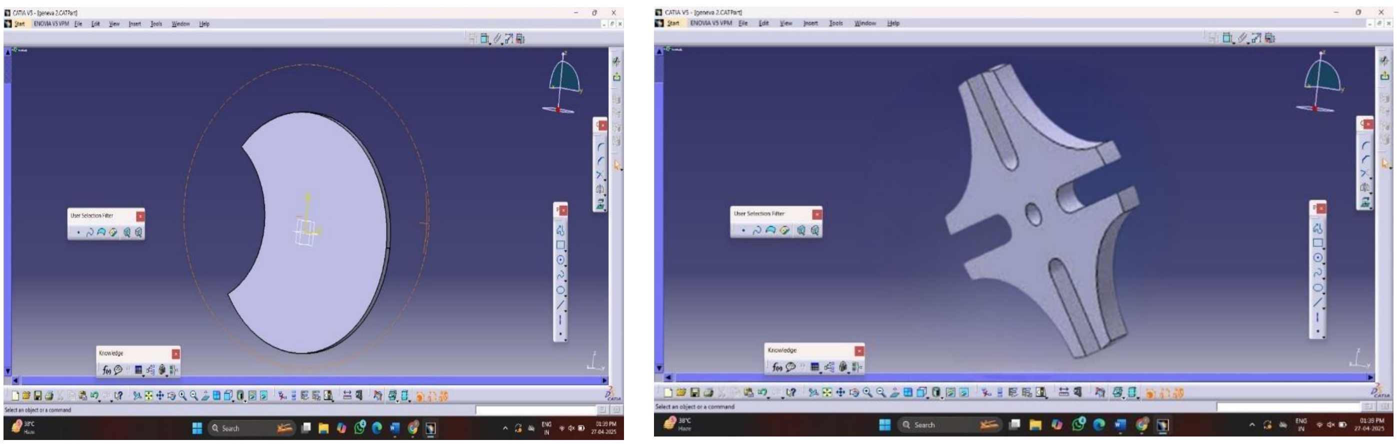


Fig.6.4CATIAdesignsofCrank Wheel & Geneva Wheel

CNCMillingOperationsforPrecisionFabricationofCrankWheelandGenevaWheel"

CNCmillingprocesscoding-Geneva wheel

[BILLETX260Y260Z10]; G21 G17 G90 G94;

G00 Z5.0; G00X0Y0; M06 T1; M03S3000;

G00 X120 Y0; G01Z-10.0F200;

G03X0Y120R120F300; G00 Z5.0;

G00 X0 Y0; G00X0Y120;

G01 Z-10.0 F200;

G03X-120Y0R120F300; G00 Z5.0;

G00 X0 Y0; G00X-120Y0;

G01 Z-10.0 F200;

G03X0Y-120R120F300; G00 Z5.0;

G00 X0 Y0; G00X0Y-120;

G01 Z-10.0 F200;

G03X120Y0R120F300; G00 Z5.0;

G00X0Y0; M05;

M30;

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIV, Issue VII, July 2025

CNCmillingprocesscoding-Crankwheel

```
[BILLET X260 Y260 Z10];
G17;
G90;
T1 M06;
M03S8000; M08;
G00 Z5.0; G00X0Y120;
G01 Z-5.0 F200;
G02X0Y-120I0J0F500; G00 Z5.0;
G00 X90 Y0; G01Z-5.0F200;
G02X0Y-90I-90J0F500; G00 Z5.0;
G00 X-90 Y0; G01Z-5.0F200;
G02X0Y90I90J0F500; G00 Z5.0;
G00 X0 Y120; G01Z-10.0F200;
G02X0Y-120I0J0F500; G00 Z5.0;
G00 X90 Y0;G01Z-10.0F200;
G02X0Y-90I-90J0F500; G00 Z5.0;
G00 X-90 Y0; G01Z-10.0F200;
G02X0Y90I90J0F500; G21;
G00 Z50.0;
M09;
M05;
M30;
```

Fig.6.6Electrical&ElectronicsCircuitsIntegration

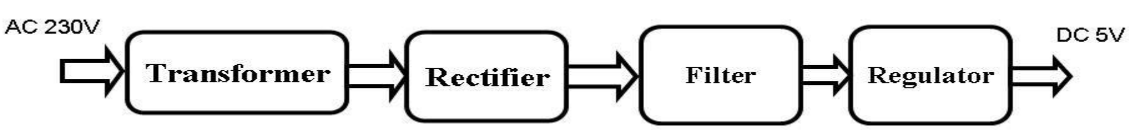


Fig.6.7RegulatedPowerSupplyLineDiagram

Fig. 6.12 Fixing of I.R Sensor

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIV, Issue VII, July 2025

I.R sensor Module Programming

```
void setup(){ //putyoursetupcodehere,torunonce: pinMode(2, INPUT); pinMode(3,OUTPUT); }voidloop(){
if(digitalRead(2)==1){ digitalWrite(3, LOW);}else {digitalWrite(3,HIGH);}delay(800);}
```

Code Analysis

- pinMode(2,INPUT);setspin2(connectedtoIRsensor)asinput.
- pinMode(3, OUTPUT); sets pin 3 (likely connected to an alert like an LED or buzzer) as output.
- In loop(), if the IR sensor detects an obstacle (digitalRead(2) == 1), it turns OFF the output (digitalWrite(3, LOW)), otherwise it turns it ON (digitalWrite(3, HIGH)).
- delay(800);pausestheloopfor800msbetween readings.

Overallcalculations:

GivenData:

- Drivingwheel speedNd= 13RPM
- No.of slotsinGeneva=4
- Holediameterd=5mm
- Sheetthicknesst=0.15mm
- Punchesperminute=13(matchestheGenevarotation)
- Shearstrengthofpaper = 100kPa=0.1N/mm² (Assume)

PunchingForceCalculation

PunchingForceformula:$F=\pi \times d \times t \times ShearStrength$ Substituting: $F = 3.14 \times 5 \times 0.15 \times 0.1 = 0.2355NF$

Thus,required punchingforceisapproximately: $F \approx 0.47N$

Torque Required

crankradius(r)=120mm=0.12m Torque (T): $T= F \times r = 0.0564$ N-m

Power Requirement

Power(P)= $2\pi NdT / 60$

$P = 2 \times 3.14 \times 13 \times 5 \times 0.0564 / 60 \approx 0.38$ W

1. GENEVAWHEELOUTPUT $Ng= Nd / 4 = 13 / 4 = 3.25$ RPM

SHEETFEEDPERPUNCH:15cm

Parameter	Value
PunchHoleDiameter	5 mm
Sheet Thickness	0.15 mm
ShearStrengthofPaper	200kPa (0.2 N/mm²)
Punching Force	0.47 N
Torque Required	0.0564N-m
DrivingWheelSpeed	13 RPM
GenevaWheelSpeed	3.25 RPM
Punchesper Minute	13
FeedperPunch	150 mm
PowerRequired	0.032 W

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIV, Issue VII, July 2025

IV. Conclusion

The project titled **"Fabrication of Auto Roll Punching Machine Using Geneva**

MechanismwithIRSensing"hasbeensuccessfullydesigned,fabricated,andtested. The machine combines the precise intermittent motion of the Geneva mechanism with automated material sensing through an infrared (IR) sensor system. The Geneva mechanism ensures accurate and stepwise rotation of the punching roller, leading to consistent and repeatable punching at a controlled speed.

Importantly, the integration of the **IR sensor** plays a crucial role in **preventing dry runs**—meaningthepunchingactiononlyoccurswhenthematerial(sheetorpaper)ispresent. Thisfeaturenotonlyavoidsunnecessarywearandtearofthepunchingtoolbutalsoimproves operational efficiency and extends the machine's service life.

Theprojectdemonstrates:

- **Reliablepunchingoperation**withprecisefeedcontrol.
- **Automation**withouttheneedfor constanthumansupervision.
- **Preventionoftooldamage**and**energy savings** byavoidingdrypunching cycles.
- **Low power consumption**, making the machine suitable for small- and medium-scale production units.
- Theprojectprovesthatintegratingsimplemechanicalsystemswithbasicautomation can create **a reliable, cost-effective, and efficient production** solution for lightweight materials **like paper** and **thin sheets**.

References

1. KundanKumar,"DESIGNANDFABRICATIONOFAUTOROLLPUNCHING
2. MACHINE",InternationalJournalofInnovativeResearchinScience,Engineeringand Technology, Vol. 5, Special Issue 8, May 2016, 96-104.
3. Kundan Kumar, "Fabrication of Auto Roll Punching Machine," International Journal of Engineering Research and Technology (IJERT), Vol. 6, Issue 4, 2017.
4. P. M. Pradhan, "Experimental Investigation and Fabrication of Pneumatic Punch," InternationalJournalofInnovativeResearchinScience,EngineeringandTechnology (IJIRSET), Vol. 2, Issue 6, June 2013.
5. AdityaPolapragada,SriVarsha, "PneumaticAutoFeedPunching andRiveting
6. Machine,"InternationalJournalofEngineeringResearchandTechnology(IJERT), Vol. 1, Issue 7, September 2012, ISSN: 2278-0181.
7. S.V.C. E.T. Chittoor, "Design of Geneva Wheel BasedAuto-Roll Punching Machine,"InternationalResearchJournalofEngineeringandTechnology(IRJET), Vol. 4, Issue 3, March 2017.
8. P. Kali Sindhur, "Design and Fabrication of Geneva Conveyor for Material InspectionandNoiseReduction,"InternationalJournalofScientificResearchand Development (IJSRD), Vol. 4, Issue 10, 2016.
9. RachitPatel,"Analysis and Synthes is of Geneva Wheel for Automation of Conventional Paper Cutting Machine,"InternationalJournalforResearchinApplied Science and Engineering Technology (IJRASET), Vol. 5, Issue 4, April 2017
10. Ajmera,Pooja."AReviewPaperonInfraredSensor."InternationalJournalof Engineering Research & Technology (IJERT), vol. 5, no. 23, 2018.