Design and Development of Multipurpose Mechanical Machine

Mr. Jadhav Mahesh Balavant [1], Mr. Pardeshi Ganesh Jayram [1], 3. Ayare Atish Rajaram[1],
Mr. Shelar Shraddha Maruti[1], Mahesh Laxman Rathod[2]
Mechanical Engineering, Yashoda Technical Campus, Satara-415011, Maharashtra, India
Email: maheshrathod579@gmail.com

ABSTRACT

This project introduces the concept of a multi-purpose machine that can perform multiple operations at the same time with the same speed. This machine is mainly used in manufacturing industries and is designed to be economically and efficiently used. It is an automatic machine that is powered by a motor and runs with current. It uses the same shaft as a motor and is powered by pulleys. This machine is designed to be portable and can be used to cut in different places and on different materials. It is also suitable for remote locations and workshops. This machine requires very little human effort and is cost-effective.

Keyword: Multipurpose, Mechanical, Machine, Design, Development

INTRODUCTION

A multi-purpose Mechanical Machine (MMM) is a machine design specially designed for small industries where workers work with very little technology. A MMM is a machine that performs its function quickly and efficiently without using other machines to perform other functions on the working piece. A MMM has three arms that perform three different operations. As a research area, multi-purpose machines are motivated by questions that arise from industrial manufacturing, production planning, and computer control. For example, imagine a large garage that houses a specialty store. This industry is mainly focused on producing useful products and services with low manufacturing costs, equipment costs, and inventory costs. Today's world is driven by technology that makes everything work faster and more efficiently, but these advances also require large investments and costs.

Industries strive to achieve a high level of efficiency by maintaining the quality and quality of the product at a low current cost. In industry, the installation of machinery is a major part of the investment. In this project, we propose to work on a machine designed to cut, drill, and grind. Some economists say that the manufacturing industry is the one that produces the output. The economy is abundant, and the assistance area will usually be a buyer of wealth. New technologies have brought new opportunities for advanced manufacturing on the manufacturing line in the US. The assembling business provides significant material

aid for public foundations and public safeguard. Before we begin, we have been subject to many research papers that say that the installation of machinery in the manufacturing industry is a delicate business due to many factors that go into it, such as electricity consumption per machine, maintenance costs per machine, number of units produced per machine, machine capacity, time spent, and ability to perform operations like drilling, cutting, and grinding

PROBLEM STATEMENT

In many workshops, we need to perform operations, such as cutting, grinding and drilling. These operations performed on individual machine. Due to this, we need many machines for performing operations. Hence, we will be designed and fabricated of multipurpose mechanical machine. By using this machine, we perform cutting, grinding, and drilling at time. Individual operation foreach machine requires more cost and equipment. By using the multipurpose machine, we reduce cost and time.

LITERATURE REVIEW

I. Raja et.al (2018): -

Machine designed for multi operations like cutting, shaping, and cutting using hacksaw. Whit worth quick return mechanism is used for hacksaw cutting and also electric motor isused to power the operations due to which required speed and automatic control obtained.

II. R. Vijayakumar (2017): -

Found that how to increase the productivity by fabricating a Motorized Multipurpose machine that could perform four machining operation (Drilling, Sawing (Using Hacksaw),Grinding & Sheet Metal Cutting) at a time. The Bevel gear mechanism, Rack & pinion mechanism and CAM mechanisms were used in our project to make the multi-operations possible with a single input.

III. Singh Ankit Kumar Awadhesh (2017): -

Implemented multipurpose mechanical machine. They have presented the development ofmultipurpose machine in various modes by which it can be actively adopted. Different types of attachment and tools which can be implemented on multipurpose machine have been discussed.

IV. R. Robert Henty et.al, (2016): -

Scotch yoke mechanism is used in this machine to perform the sawing operation at four places. Scotch yoke mechanism converts rotational motion into linear motion. Pistons likereciprocating parts are directly coupled

to sliding yoke with a slot that engages a pin on therotating part. In I.C. engines linear motion converted in rotational motion by means of crankshaft, piston and rod that connects them. The scotch yoke mechanism is considered as more efficient to produce rotational motion.

V. Dr. Saif Imam et.al, (2016): -

Proposed an innovative synchronous machine which will have ability to perform multiple mechanical operations of several machines instead of having one machine for one work. Utilizing this machine, they are able to achieve the goal of low investment machine for not only use but also for various colleges for practice. In future these machine complex variations can help to fulfill the requirement.

VI. Pradip R. Bodade (2016): -

Proposed a machine able to perform operations such as drilling, grinding, cutting and manufacturing of "MULTIFUNCTION MACHINES". The industries are basically destined for the production of goods and services useful at low production costs, machinecosts and low inventory costs. The model allows us to perform the operation in different work centres simultaneously, as it receives units from a single power source. The goal of this model is the conservation of electricity (energy supply), the reduction of costs associated with the use of energy, the increase in productivity and the reduction of space. This machine can be used in industries and in domestic operations.

VII. Rakesh Ambade etal (2015): -

Designed and fabricated a human powered multipurpose machine. The main objective is to provide a multipurpose machine which can work when there is no electricity. It has to be understood that in rural areas where there is problem of electricity shortage or no electricity, it is a very stressful and laborious job to perform machining operations. It satisfies the need of rural people by giving them an alternative way of performing machining operations like drilling and grinding. The product designed has zero operating cost & cost effective.

VIII. Sharad Srivastava (2014): -

Have fabricated a machine using a scotch yoke mechanism, belt drive and gears. In an industry a considerable portion of the investment is being made for machinery installation.They have proposed a machine which can perform operations like drilling, cutting,grindingat different working centres simultaneously which implies that industrialists do not have topay for machine performing above tasks individually for operating operation simultaneously.

IX. Heinrich Arnold (2009): -

Rather long reinvestment cycles of about 15 years have created the notion that innovationin the machine tool

industry [happens incrementally. But looking at its recent history, the integration of digital controls technology and computers into machine tools have hit the industry in three waves of technology shocks. Most companies underestimated the impact of this new technology. This article gives an overview of the history of the machine tool industry since numerical controls were invented and introduced and analyses the disruptive character of this new technology on the market. About 100 interviews were conducted withdecision-makers and industry experts who witnessed the development of the industry overthe last forty years. The study establishes a connection between radical technological change, industry structure, and competitive environment. It reveals a numberof important occurrences and interrelations that have so far gone unnoticed

X. . **Dr. Toshimichi Moriwaki (2007): -** Recent trends in the machine tool technologies are surveyed from the viewpoints of high speed and high-performance machine tools, combined multifunctional machine tools, ultra-precision machine tools and advanced andintelligent control technologies.

XI. M. Prathyusha (2006): -

Developed a multiple operating machine. It has focused on the principle of scotch yoke mechanism, type of tooling and machining parameters and process performance measure,which include cutting speed, depth of cut, material removal rate with different type of equipment which can run simultaneously and fabricate the work piece in multipurpose machine has been presented.

OBJECTIVES

- To perform many operations at a time.
- To conduct all operations in a single motor.
- To decrease manufacturing and maintenance cost.
- To reduce space occupation.

METHODOLOGY

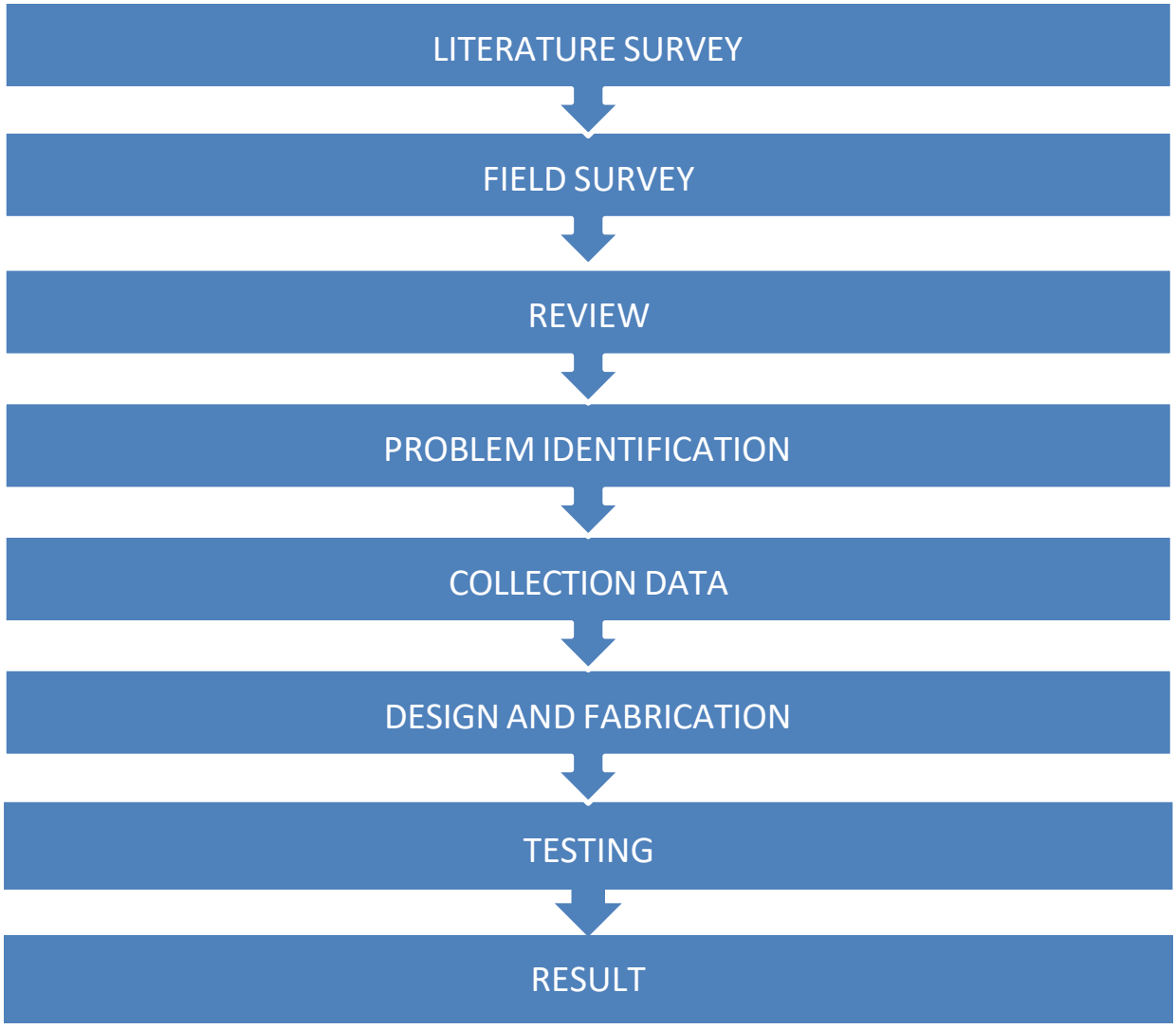

Fig.1: - Block Diagram of Methodology

DESIGN AND MECHANISM

Design of frame

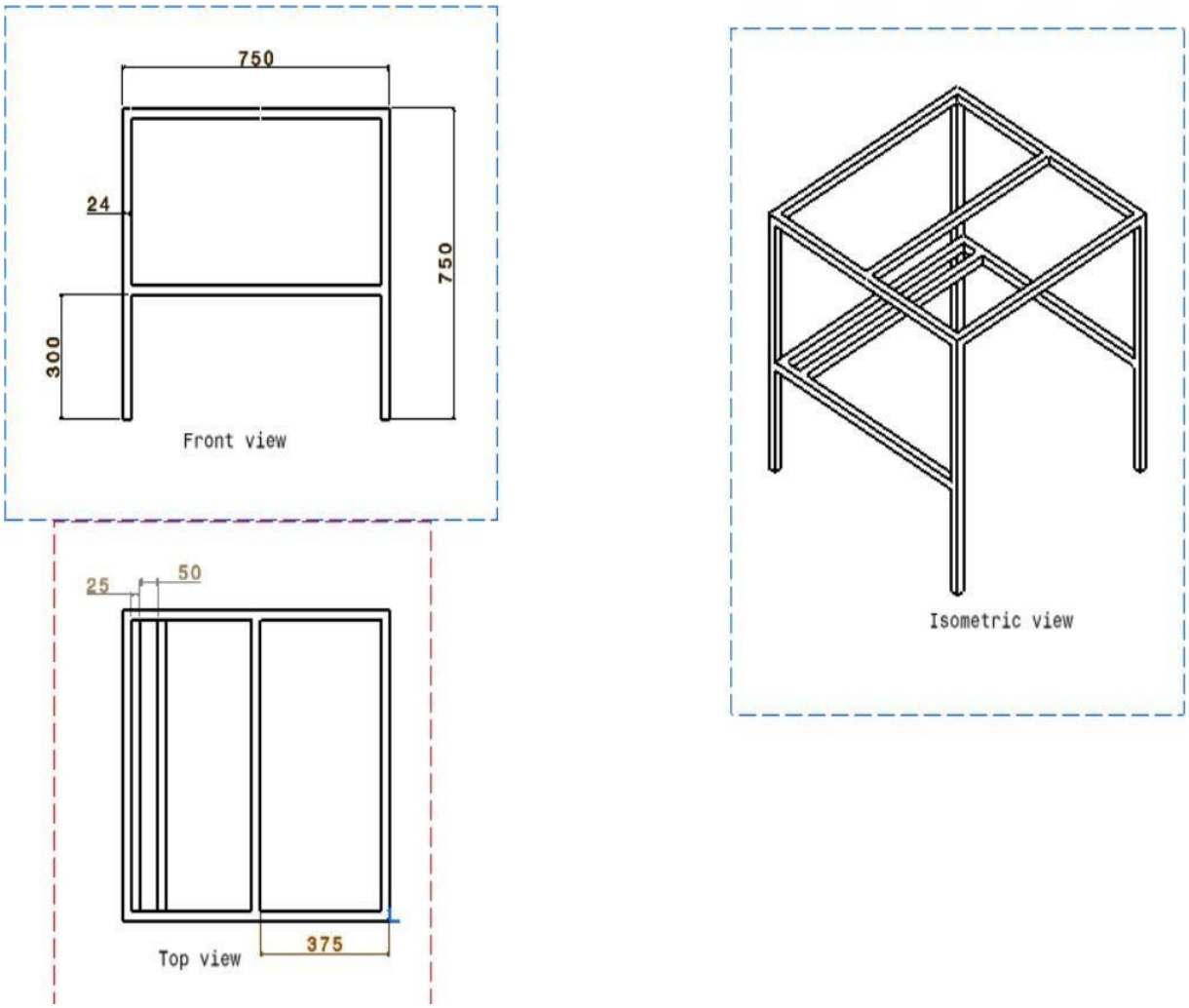

Fig.2: - 2D Design of Frame

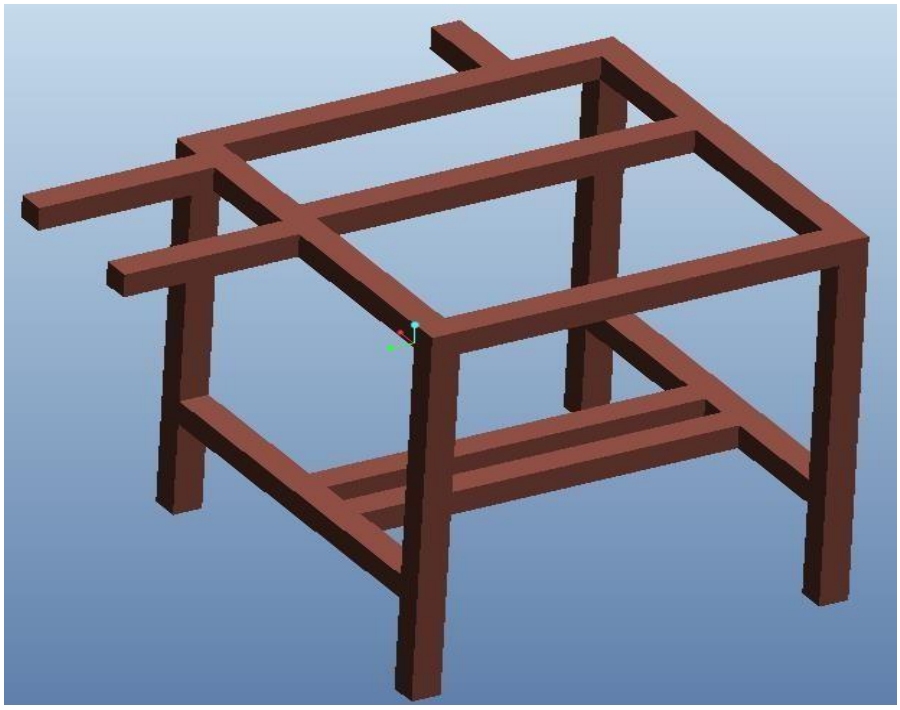

Fig.3: - 3D Design of Frame

The frame is usually the structural system that supports the other components of the physical building and/or the steel frame that limits the span of the building. The frame is the basic part of the machine, it supports the assembly of the machine and absorbs any shocks and vibrations during operation. In this machine frame is made of a mild steel bar and an L channel. The length, width and height of the frame are 750mm × 750mm × 750mmrespectively.

Specification of Frame: -

- L X B X H = 750mm X 750mm X 750mm
- Type of Material: - Mild Steel

Bill of Material (B.O.M.)

Sr. No	Part Name	Qty.	Cost in Rs.
1	AC Motor	1	2500
2	Pulley	4	1600
3	V-Belt	2	300
4	Square Pipe	2	1800.
5	Pedestal Bearing	4	1200
6	Nut and Bolt	10	150
7	Shaft	2	600
8	Drill	1	100
9	Hacksaw	1	80
10	Grinding Wheel	1	40
Total			8370/-

Table: -1 Bill of Material (B.O.M.)

ASSEMBLY AND WORKING

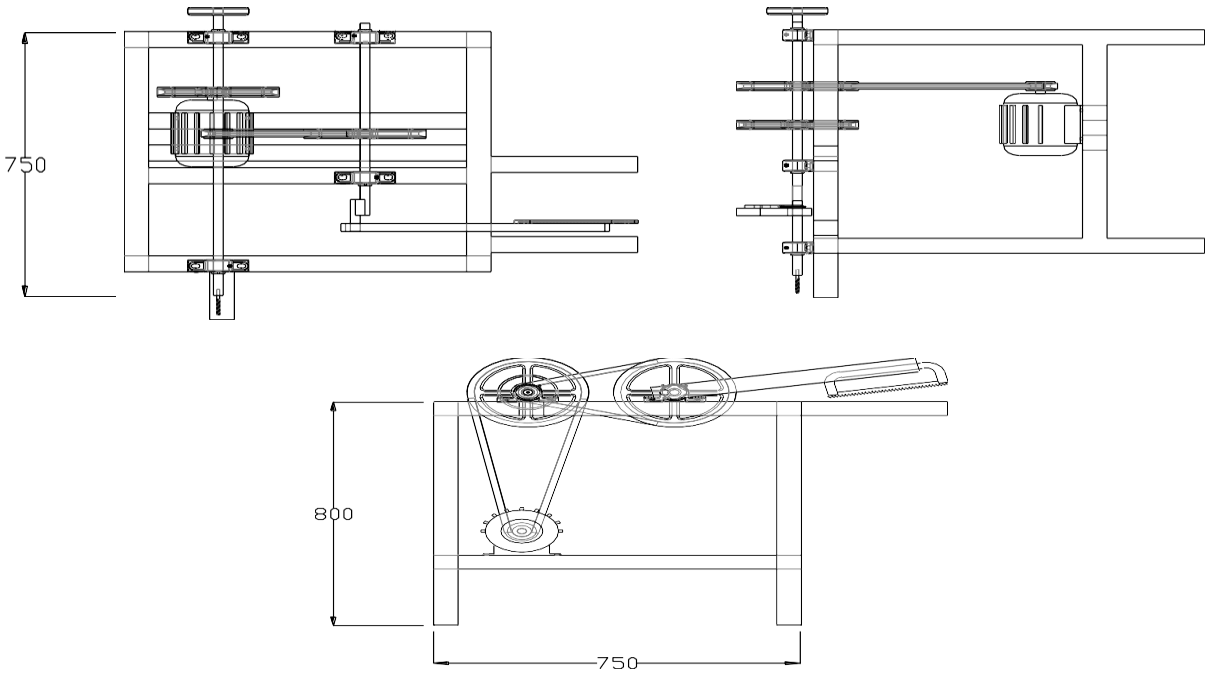

Fig.4: - 2D Drawing of Multipurpose Machine

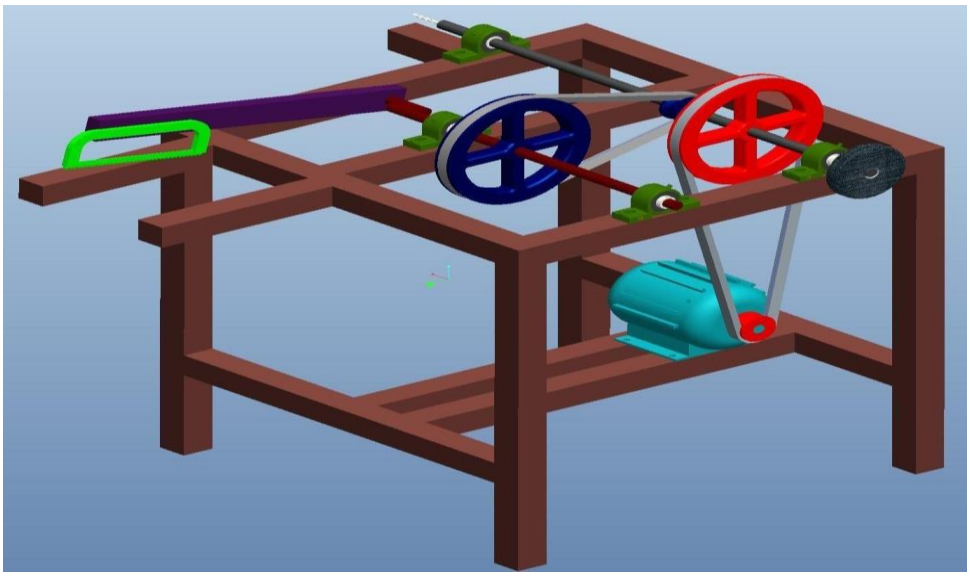

Fig. 5: - Isometric Front View of Multipurpose Machine

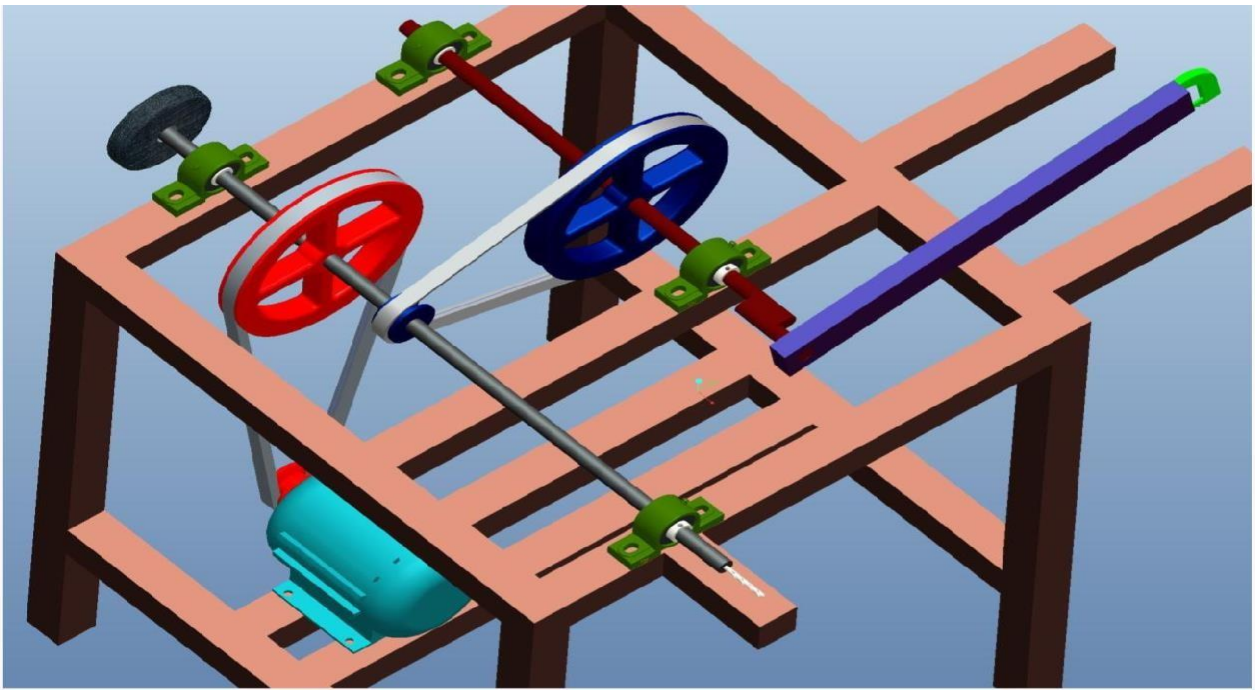

Fig.6: - Isometric Top View of Multipurpose Machine

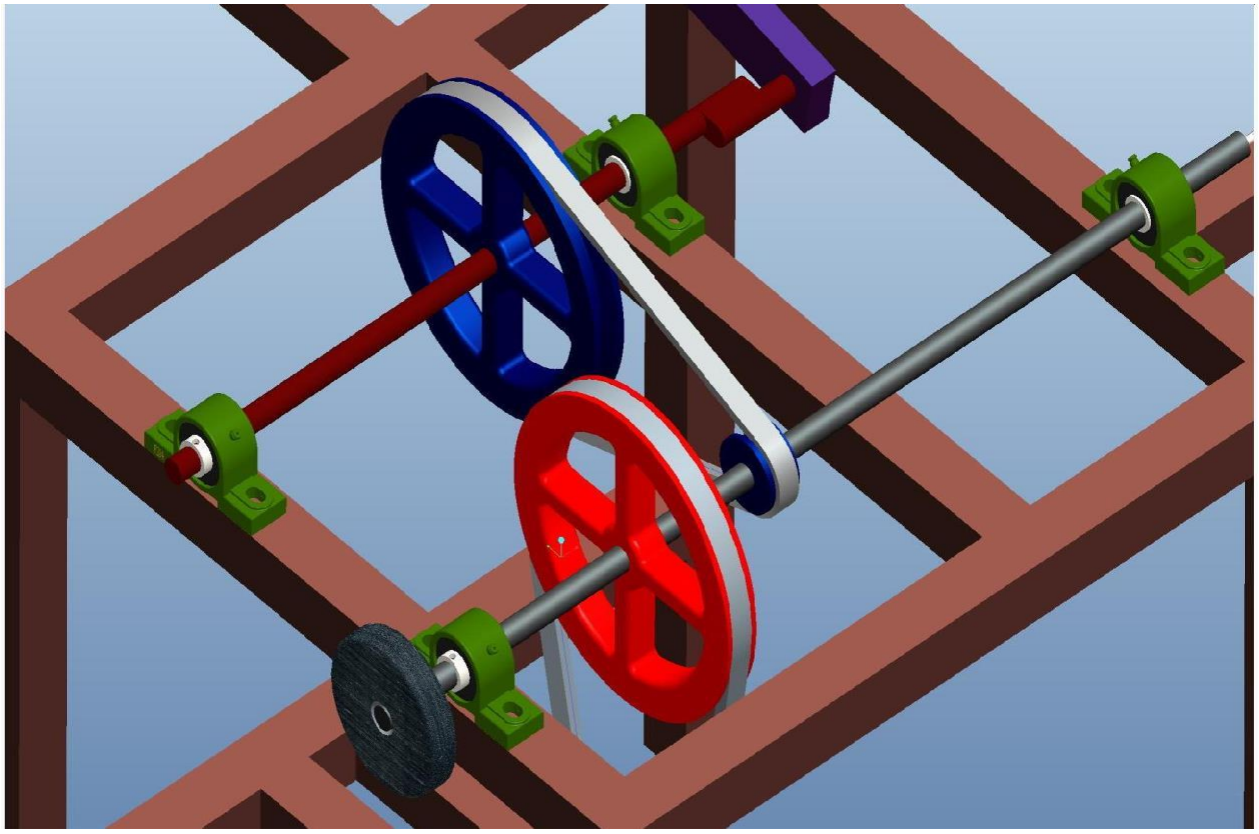

Fig.7: - Belt Drive Connection System of Multipurpose Machine

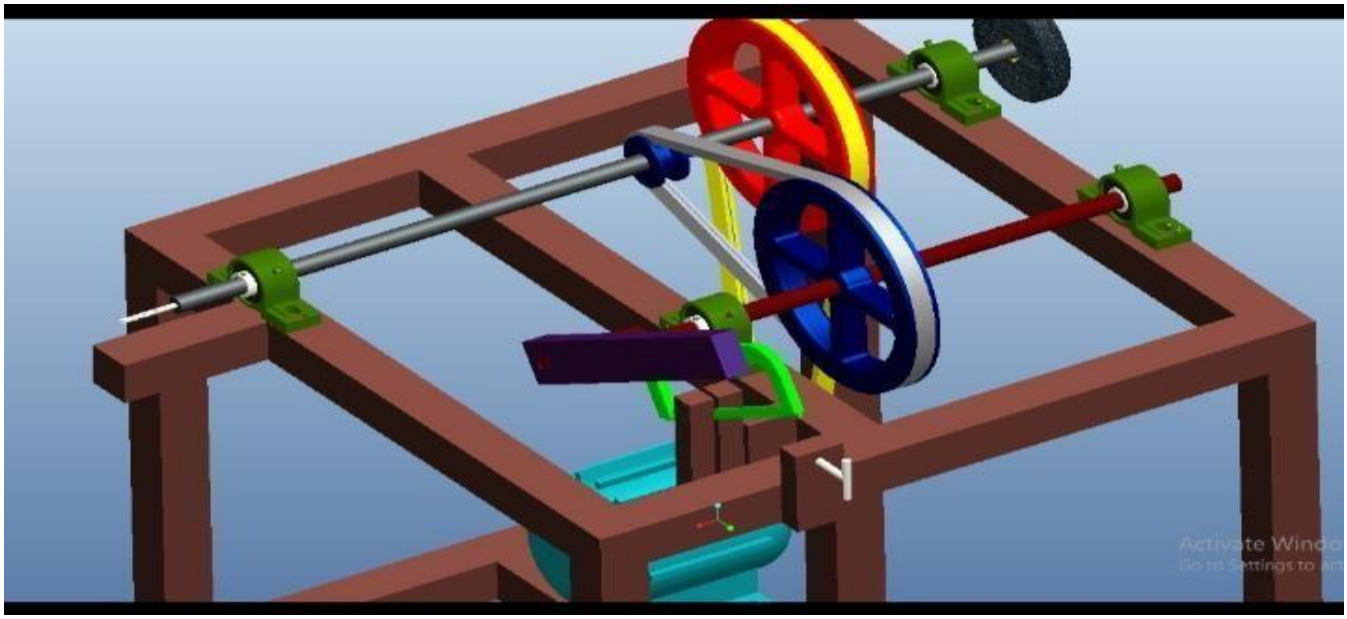

Fig.8: - Isometric Top View of Multipurpose Machine

TESTING

In multi-operation mechanical machine, we have tested following materials

Type of Operations	Mild Steel	PlywoodWood	Polyviny Pipe(pvc)
Grinding (Rough)	3mm/min	8mm/min	5mm/min
Cutting	5mm/min	14mm/min	25mm/min
Drilling	4mm/min	50mm/min	90mm/min

Table: -2 Tested Material Details

Conditions:

- **Grinding** (Rough): -

- Grinding done on steel plate 3 mm
- Wood block of 25X25 mm
- Pvc tube of dia.25 mm and 3 mm wall thickness

- **Cutting**

- Mild Steel round bar 10 mm
- Wood block of 25X25 mm
- Pvc tube of dia.25 mm and 3 mm wall thickness

- **Drilling**

- Steel plate 100X100x5 mm
- Pvc tube of dia.25 mm and 3 mm wall thickness
- Wood 50X50 block

RESULTS AND DISCUSSION

Hence, it is concluded that from this project, one can manufacture or bought this type of machineto perform drilling, grinding, and cutting operations at the same time. This reduces space occupation, time occupation and needs less investment. This machine will be grateful advisable tolocal carpenters and small industrialist.

We have done grinding, cutting and drilling operations on different materials like. Wood, pvc, steel. Wood

taken is solid section while others are hollow tubes.

The results observed are as follows:

Type of Operations	Mild Steel	PlywoodWood	Polyvinyl chloridePipe (pvc)
Grinding (Rough)	3mm/min	8mm/min	5mm/min
Cutting	5mm/min	14mm/min	25mm/min
Drilling	4mm/min	50mm/min	90mm/min

Table: -3 Tested Material Details

Grinding (Rough): -

- Grinding done on steel plate 3 mm
- Wood block of 25X25 mm
- Pvc tube of dia.25 mm and 3 mm wall thickness

▪ **Cutting**

- Mild Steel round bar 10 mm
- Wood block of 25X25 mm
- Pvc tube of dia.25 mm and 3 mm wall thickness

▪ **Drilling**

- Steel plate 100X100x5 mm
- Pvc tube of dia.25 mm and 3 mm wall thickness
- Wood 50X50 block

CONCLUSIONS

We see that all the industries, which are production based want low production cost and high workrate which is only possible through the utilization of multi-function operating machine which willuse less power as well as less time and less labour. Since this machine provides working at the different center so it reduces the time consumption up to a considerable limit. In an industry a considerable portion of investment is being made for machinery installation which is very costly. We have proposed a machine capable of performing operations such as drilling, cutting and grinding simultaneously in different centers which shows that the industrialist does not have to payfor a single machine. Execute jobs on it individually to run concurrent operations**.** The machine is especially useful for small industries. Workers movements can be minimized. Number of operations that can be performed on a single machine. Power consumption is reduced. The requiredfloor space is reduced.

REFERENCES

- R. Robert Henty, R. Ranjith Kumar, R. Raju, M. Sheik Mohamed Shabir, V. Tamilvanan "Multi-Purpose Scotchyoke Mechanism" International Journal of Innovative Research in Science,Engineering and Technology (Vol. 5, Special Issue 8, ISSN: 2319-8753) (May 2018).
- R. Vijayakumar, A. Gokul Krishnan, D. Sathish, A T. Ganesh Kumar "Motorized Multipurpose Machine" International Conference on Latest Innovations in Applied Science,Engineering and Technology (ICLIASET 2017), March 2017.
- Singh Ankit Kumar Awadhesh "Implementation of multipurpose mechanical machine",IJARSE May 2017.
- Dr. Saif Imam "Design, Construction and Application of Synchronous Operation Machine Tool" International Journal of Innovative Research in Science, Engineering and Technology (Vol. 5, Issue 7, ISSN: 2319-8753) (July 2016).
- Pradip R. Bodade, Chetan R. Khade, Shubham C. Hiwanj, Suyash A. Shete, Vikrant R. Kaveri,Neel Chaudhari "A REVIEW ON MULTI FUNCTION OPERATING MACHINE" international journal for engineering applications and technology ISSN: 2321-8134, May 2016.
- Rakesh Ambade "Design & fabrication of human powered multi-purpose machine", IJATES April 2015.
- Sharad Srivastava "Multi-function operating machine: A conceptual model", IOSR-JMCE May-June 2014.
- Arnold, Heinrich" The recent history of the machine tool industry and the effects of technological change", University of Munich, Institute for Innovation Research and Technology Management, November 2009.

- Dr. Toshimichi Moriwaki "Trends in Recent Machine Tool Technologies" Professor Department of Mechanical Engineering Kobe University, TN Technical Review No.74(2007).
- M. Prathyusha "Multiple operating machines (drilling, sawing, shaping)", IJMETMR May 2006.
- T. Moriwaki "Multi-functional machine tool", Department of Industrial and Systems Engineering, Satsuma University, Neyagawa, Japan CIRP Annals - Manufacturing Technology DOI: 10.1016/j.cirp.2008.09.004.
- Frankfurt am Main "Multi-purpose machines ensure enhanced ", 1 January 11.
- Selecting and planning the process of Manufacture Dr. Pulak, Mr. Pandey http://paniit.iitd.ac.in/~pmpandey.
- VB. Bhandari, "Design of Machine Elements", TMH Publishers, NewDelhi, 2nd Edition,2013.
- V.B. Bhandari, Design of Machine Elements, Tata McGraw-Hill Publication CompanyLimited, New Delhi.
- R.S. Khurmi, Design of Machine Elements, S. Chand & Company Ltd. New Delhi.
- V.D. Kodgire, Material Science and Metallurgy, Everest Publishing House
- Dharwa Chaitanya Kirthikumar, "A Research on Multi-Purpose Machine", InternationalJournal for Technological Research in Engineering (Vol.1, Issue.1, ISSN: 2347-4718) (2013).
- Labor, Wellington New Zealand 1st Edition 1986
- Ergonomic guide lines for manual material handling Published 2007 by the CaliforniaDepartment of Industrial Relations.
- Design of army ant co-operative lifting robot By John S. Bay march 1998.
- Machine Selection Rules in a Dynamic Job Shop; Names: V. Subramanian, G. K. Lee, T.Ramesh, G. S. Hong and Y. S. Wong. Department of Mechanical and Production Engineering,National University of Singapore, Singapore International Journal Manufacture Technology (2000) 16:902– 908 2000 Springer-Verlag London Limited.
- multi-functional machine tool; Name: T. Mariachi Department of Industrial and Systemsengineering, Setsunan University, Neyagawa, Japan CIRP Annals Manufacturing Technology2008 CIRP.
- Homokinetic Shaft- Coupling Mechanism Via Double Schoen flies motion Generators. Names: Chung-Chin and Lee Jacques M. Hervey ASME 2014 International Design Engineering Technical Conferences August 17- 20, 2014, Buffalo, New York, USA
- Vibration influence on a drilling machine Names: Lushnikov R.E., Shvagrukova E.V.2014 International Conference on Mechanical Engineering, Automation and Control Systems (MEACS), Tomsk, Russia 2014 IEEE.