PIIT JOURNAL OF MECHANICAL ENGINEERING

PILLAI COLLEGE OF ENGINEERING
ISSN 2277-5951

AESA

MESA

VOL-10 | ISSUE 2 | DEC-16

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3-Degree 3-Axis Universal Router For Material Removal

***Abstract*—** A 3-Degree 3-Axis material removal router was designed with the help of a designing software (CAD), Solidworks. A user is equipped with a remote to control from safer distance and produce simple geometry parts. The machine weight is approximately 25 lbs and the work space of 7" x 9" x 9". Router is a machine which is used to remove the material with the help of grooving action. The design of the router is such that it is light weight and portable. The minimum accuracy of the router is around 2mm. The machine will be powered with a high RPM motor. The feed rate of motor is controlled with the help of a potentiometer. The fabrication materials used are wood, bakelite sheet, steel, acrylic panel. The billet materials used are wood, soft materials like teflon, acrylic panel for engraving and nylon. The total initial cost of fabricating the router is approximately Rs.9850. The base plate can be incorporated with clamps which are used for fixing the billets on the base plate. The router is provided with measuring scales which help to measure the depth of cut. The 3-Degree motion of router is ensured with a unique design of the guide mechanism which has the fork assembly to restrict the motion. The traditional drilling tools are used as tools. This project has made progress towards both the development of an operator safety and cost effective design of the router.

Key words: Router, Remote, Simple geometry, grooving action, Motor.

I. LITERATURE REVIEW

A Swedish Engineer, Mr. John T and Homo Facien's association developed the 3-axis material removal machine in year 2005-2006. Parsons worked to attach servomotors to the x and y axis of a manual operated machine tool to control them with a computer and sensors. The reason for devising such a system was to machine complex shapes like arcs that can be made into aerofoils for airplanes. This was not a trivial task to attempt with a manual milling machine. The idea behind this creation was to fulfil the desire for a desktop sized CNC machine. While it would have been nice to purchase an off the shelf unit the issue of price as well as size proved prohibitive. With this in mind they designed and built a 3-axis material removal machine[1].

Several another authors have studied the development of such machines on a smaller, low-cost scale material removal machine. Yung C. Shin, Studied the Characterization of 3-axis router machining centres. M.Kumar, worked on low cost automation for 3- axis machining center. I. Pahole and L. Rataj, did research on the "Construction and evaluation of low-cost table milling machine". V.K. Pabolu and K.N.H. Srinivas,(2010) made a design of Low Cost milling machine. T. Andrei and I. Nae, did the workout on "Practical applications performed by a stepper motor in a 3-axis router". P.A. Sherring da Rocha Jr., R.D.S. Souza, and M.Emilia de Lima Tostes, "Prototype 3-axis router machine design"[2].

Moshat et. al. (2010) studied optimization of CNC milling process parameters using PCA- based Taguchi method that had served the purpose of optimization but not simultaneous optimization of surface roughness and the material removal rate in the study[4]. Aggarwal and Singh (2005) reviewed various linear and non -linear optimization techniques in detail and the relative advantages are also discussed and inferred for the non-linear optimization methods, the most suited for the optimization of machining processes[5]. M. Boujelbane studied 5-axis machine with Computer Aided Design (CAD) software systems that give us the potential to model very complex shapes. The growing complexity of products has been pushing the development of new manufacturing technologies. Complex or organic geometries introduce different and more complex manufacturing problems. Dies and mould are usually machined using 5-axis ball end milling. Due to the increasing demand for higher accuracy, lower machining time, and higher surface integrity, several researchers have investigated the effect of cutter orientation on surface roughness and tool life. Based on a comparative study of milling at different inclination angles, they concluded that downward/reverse milling with a tool inclination in the range of 10-20 degrees represents the optimum machining strategy.

Y.-B. Bang, developed Micro cutting by precision machine tools is an effective method for producing 3D micro parts[6]. Therefore, research related to micro cutting is being performed. In this researcher constructed a precision 5-axis milling machine of compact size (about 300 mm in height) and at a low cost (about 1/10 of the cost of precision milling machines on the market), which is available for machining micro parts. This machine is composed of three precision linear stages (X, Y and Z-axis) and two precision rotary stages (A and C-axis).

Werner Babel, the invention concerns a milling head for machine tool, which has housing and in it a working spindle mounted so it can move axially, and the work head, which can move horizontal on the face, is mounted so it can pivot on a horizontal axis of rotation[3].

Leslie P. Stickney, invention of a milling machine is provided with a substantially vertical support on which a machine head is mounted. The machine head includes a mounting portion which is attached to the vertical support for rotational movement about a substantially vertical axis. The machine head is provide with tool spindle in which a milling tool may be mounted for milling a workpiece supported on bed of the machine. N.Mishim has developed various types of conceptual design of supports of machine tool for multiaxis machine tools. In this research the author tried to develop a new design tool to support decision making at the conceptual design stage of machine tools. The proposed design evaluation method based on robust design methodology was effective in determining suitable structure of machine tools[4].

II. METHODOLOGY

A. *Implementation of X-Axis:*

The base of router is designed such that it incorporates the movement of x-axis which helps it to provide the linear motion with the help of motor. The X-axis is designed in the form of a plate which includes circular pattern of rivet nuts that are used to fix the billet on the base plate. The plate has a circular rotating table which allows the rotating of the billet. The design of guide is motivated from the design of traditional CNC desktop router.

B. *Implementation of Y-Axis:*

It is supported with the help of one linear rods and one lead screw. The travel distance of Y-axis is 270 mm. The Y-axis supports Z-axis assembly. The linear rod and lead screw are fixed to the vertical supports. The linear rods simply follow the motion of lead screw. A 300 rpm motor ensures that the lead screw gets more torque which is necessary for moving the heavy Z-axis assembly. the design of Y-axis is such that it incorporates 1 degree(i.e. pitch) of motion in it.

C. *Implementation of Z-Axis:*

A guide supports the Z-axis motion in vertical direction with a travel of 150 mm. The Z-axis also incorporates 1-degree motion of the router (i.e. roll). there is a bolt about which the whole Z-axis assembly is allowed to swivel. this in turn allows roll. using simple guides the main motor can be maneuvered linearly in Z- axis direction.

D. *Operation of 3-degree mechanism:*

Currently, the 3- degree motion of the router is designed in such a way that it is controlled manually by the operator. Pitch is controlled with the help of guide mechanism which is allowed to swivel about y axis. Yaw is controlled with a rotating base which is connected to the x axis. this rotating base is controlled with the help of stepper motor which allows precise motion to the rotations. this rotating base also acts as the base plate for mounting the billet. Roll is controlled with a mechanism which is incorporated in z axis which allows it to swivel about x axis. this motion is controlled manually and uses allen bolt and locknut to lock in a particular angle.

E. *Steps:*

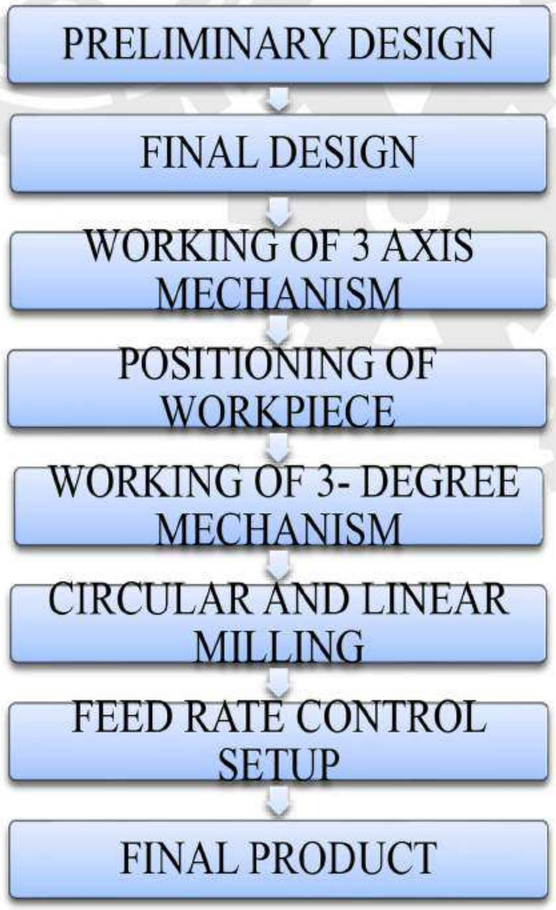

Fig.1 Steps in methodology

Fig.4 DC Motor

f. *Cad Model & Fabricated Router:*

The project work has been started with literature review as below. After referring several papers we got many ideas. From these ideas we started developing a typical Material removal machine as follows figure 2 & figure 3.

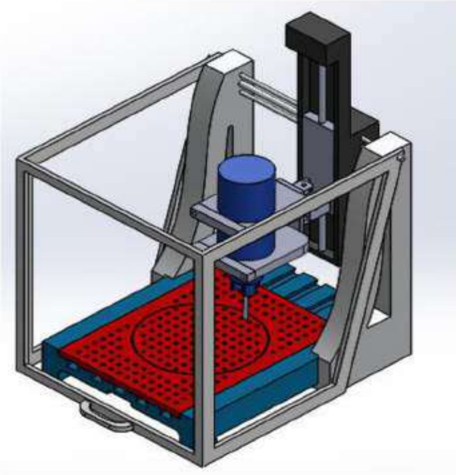

Fig.2 CAD Model

Fig.3 Fabricated Router

g. ***Integral Parts of the Router:***

1) ***Direct current motor:***

It Works on the principal, when a current carrying conductor is placed in a magnetic field. it experiences a torque and has a tendency to move. This is known as motoring action. If the direction of current in the wire is reversed, the direction of rotation also reverses. When magnetic field and electric field interact they produce a mechanical force, and based on that the working principle of DC motor is established.

2) ***Lead Screw:***

Right hand threads are configured so that clockwise rotation tightens the threaded rod to a fastener. Left hand threads are less common, but well-suited for applications in which motor vibration would cause right handed threads to loosen. When thread direction is not specified, the default direction is usually to the right. Left handed threads are usually listed explicitly.

Fig.5 Lead Screw

3) Coupling Nuts:

Coupling nuts are internally threaded fasteners that join threaded rods, pipes, and other threaded parts, sometimes parts of differing sizes. These nuts are cleverly used in the router to achieve liner motion of the supporting axis.

Fig.6 Coupling Nut

4) Linear rods:

Linear rods are rigid, strong stainless Steel shafts which are used to carry the load without affecting the motion and supports linear movement. Linear rods with linear bearing assembly are used to carry the loads and supports the structures in linear motions. The total load of the structure is taken away by the linear rod bearing assembly and therefore the load on ball screw is reduced and causes precise smooth linear motion.

Fig.7 Linear Rod

5) Potentiometer:

A potentiometer is an instrument designed to measure an unknown voltage by comparing it with a known voltage. The known voltage may be supplied by a standard cell or any other known voltage from a respective reference power source or power supply.

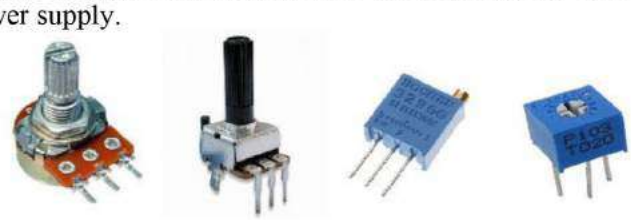

Fig.8 Potentiometer

Motor coupler is a cylindrical hollow part which couples the motor with the driving shaft. This coupler is manufactured in

6) Motor coupler:

steel. A screw is used to fasten the coupler with the motor shaft and lead screw.

Fig.9 Motor Coupler

7) Fork:

Fork is a small Y shaped part which enables pitch motion in the router. The fork is pivoted at one point on the y axis support with the help of allen key. The fork supports a stainless steel guide which has a provision to control the pitch angle of the router.

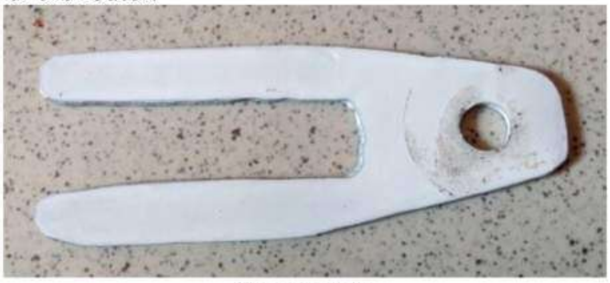

Fig.10 Fork

8) Drill Chuck:

A chuck is a specialized type of clamp. It is used to hold an object with radial symmetry, especially a cylinder. In drills and mills it holds the rotating tool whereas in lathes it holds the rotating workpiece. Drill chuck is a part which holds the machining tool within its jaws. It can be tightened with the help of key.

Fig.11 Drill Chuck

III. CONCLUSIONS

The inspiration behind the design of this router was derived from a CNC Desktop router. The design of the router was successfully completed along with the material selection for the frame. Improving the functionality was achieved by adding a rotating table within the X-axis base. Further a 3-degree system improved the degree of freedom for machining. Hence the objective of developing a system with low cost better functionality and ease in operation was achieved.

There is a tremendous improvement in the way this new machine operates over the old conventional lathe. There is a huge difference in the way the old and the new machine works and even looks. The new machine even looks much more organized and compact. The new machine is much more accurate and fast as compared to the old one which is evident while Job Trials and Commissioning.

This machine plays an important role in performing milling machine operations. Knowing which cutter to select and use for a specific operation, will at times, determine the overall quality of the final product. The knowledge gained in this task on cutters will assist in determining the type of cutter(s) to employ for a specific operation, to include the nomenclature, selection, use and care of cutters when tasked to perform machine operations.

The objective of this machine is to remove material from a work piece to obtain a specific shape and improve surface finish .This is done with a tool that applies a force on the material. Then either the tool or the work piece will move and material will be removed .Before either operation is done, several parameters need to be determined. Tool geometry and material have a significant effect on the cutting operation. It is important to use a material that is harder than the work piece material. Tool life is affected by several parameters. These are depth of cut, feed rate, and cutting rate. Just by doubling one of these parameters, tool life will decrease. This is especially true for feed rate and cutting rate.

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Design and Fabrication of suspension incorporated in bicycle wheel

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Abstract— **The bicycle's invention has had an enormous effect on society, both in terms of transport and way of living. Several components that eventually played a key role in the development of the automobile were initially invented for use in bicycle, including ball bearings, pneumatic tires, chain-driven sprockets, and tension-spoked_wheels. This study presents a suspension system which is placed inside a bicycle wheel.In traditional suspension systems the isolation is provided by spacious and complicated mechanisms, and mainly in the vertical direction.In case of SIIBW system vertical as well as horizontal isolation is provided. All the experiments are conducted at lower speeds and limited loads.**

Keywords- Suspension incorporated in Bicycle wheel (SIIBW)

1 . Introduction

One of the major subsystems in a modern passenger car is the suspension system. The suspension system of a road vehicle refers to the assembly between the chassis and wheels. It transfers forces and moments from contact patch to the chassis . Vehicle suspension systems are designed to provide ride comfort. The major challenge in the In wheel suspension is space limitation . The suspension system should fit inside the vehicles wheel without altering its outer dimensions. This design requires selection of proper materials for flexible suspension components and optimization of the shape of the components for most energy absorbance efficiency. Also the design should be simple and easy to manufacture.

Although the current suspension systems effectively isolate the sprung mass from road excitations in vertical direction, but the sprung mass' horizontal connection to the ground is almost rigid. The slight horizontal isolation is achieved by suspension mounts and tire (Reimpell, et al., 2001). Furthermore, traditional suspension systems usually consist of spacious three dimensional mechanisms with heavy components. The higher suspension system mass (part of the un-sprung mass) not only decrease the isolation effectiveness (Dixon, 1996), but also results in lower fuel efficiency. A study of European vehicles weighing less than 1000kg shows that a 10% increase in vehicles' mass, increases the fuel consumption by 7-8%

In order to overcome the limitations of conventional suspension systems, a new concept of the SIIBW is proposed. The SIIBW concept not only improves the horizontal isolation but also eliminates the spacious suspension mechanisms by embedding the suspension system inside the vehicle's wheel. The development of SIIBW is based on the idea of fitting the spring and damping elements inside a vehicle's wheel.

The traditional suspension systems usually consist of spacious 3D mechanisms with heavy components . The higher suspension mass not only decrease the isolation effectiveness but also results in lower fuel efficiency . In order to overcome the limitations of conventional suspension systems , the concept of Suspension incorporated in Wheel system was proposed . The reason behind is, it eliminates the spacious suspension mechanisms by embedding a specially designed suspension system inside the vehicles wheel. The development of Suspension in wheels system is based on the idea of fitting the spring and damping elements inside a bicycle wheel .

2 . Literature Review

For any road vehicle, a common method to isolate passengers from undesirable excitation caused by road roughness or onboard sources is the use of a suspension system (Gillespie, 1992). Suspension systems have been utilized on different types of vehicles, such as motorcycles, passenger cars, trucks and bikes. Suspension is basically an assembly of spring and damper components used to reduce the transferred excitations to a vehicle's chassis. The spring element can be a coil spring, leaf spring, torsion bar, or an air spring. The damper element is usually a shock absorber. Different forms of suspension systems such as

McPherson, double wishbone, and multi-link suspensions have been adapted to passenger vehicles.

Rotating version of this is designed for NASA's Mars rover (National Aeronautics and Space Administration (NASA)). The low temperature, lack of atmosphere, and also weight restrictions prevent the use of inflatable rubber tires in projects like

the Mars rover. Another example is that of Michelin active wheel which integrates an electrical motor, the power-train, the suspension system, and the braking system inside the wheel. Likewise, Siemens VDO's eCorner concept embeds an automobile's drive-train, shock absorbers, brakes, and steering, into its four wheels.Although the Michelin and Siemens wheels embed different automobile subsystems, including the suspension system, inside its wheels, but the suspension system is still limited to isolation in the vertical direction. However, adding an additional degree of freedom to the suspension system of a high speed automobile requires more in-depth studies and considerations which are beyond the scope of this project.This chapter has presented a survey of some of the researches for using the available space inside a vehicle's wheel. This place is used for placing useful parts such as suspension components, steering mechanisms, and even the power-train. However these researches are still in the primary stages, and there is no precise performance data or design guidelines presented. In the following chapters the practicality and performance of placing a suspension system inside a vehicle's wheel is studied in more detail. Loop wheel is one such reinvention of wheel. A Loopwheel is a wheel with integral suspension, designed for better shock-absorbing performance. The carbon springs absorb tiring vibration, as well as bumps and shocks. Loopwheels provide tangential suspension, meaning they work in every direction. So they respond to a force hit head-on in the same way as they do to a force from below.

Our idea is also to reinvent the wheels but with a different shape, material, aesthetic and ergonomic properties.

3. Problem Statement

In the fundamental bicycle wheel, strength is determined by the number of spokes , arrangement of spokes , interfacing of spokes with the hub and the rim . If you look at a normal "three cross" wheel, the spoke leaves the hub at an angle nearly tangential to the hub circumference. This way the stress on the hub is minimized. Hence the strength of the wheel depends on the number of spokes.

.Weight is reduced by using more exotic materials (especially for the rim), and by reducing spoke count. The more exotic the rim, the more intimately the design of the rim ties into the spoking scheme. Some slight weight reduction is also possible by reducing the "cross" of the spoking.

Bladed spokes are marginally more aerodynamic than round spokes. At the very high end, there are some wheels that use fettucini-like strips of carbon fiber in place of steel spokes—these may cost as much as a very nice bike themselves.

The spokes in the wheelchairs tends the disabled to apply more efforts due to the above mentioned problems. Hence a new change in the wheel is necessary so that it will be more effective for the disabled along with the cost efficiency.

The spokes which is present in the conventional wheels needs to be well maintained at regular intervals. Stiffness plays an important role in the soft riding of the bicycle. Stiffness of the conventional spokes is high as compared to the bow spokes being used in our project. To improve the stiffness of the wheel the spokes are adjusted. During this a stress is produced which in turn damages the rim. A fatigue crack is the result of this high stress.

A check with the dishing tool showed it to be offset 2mm to the non-drive side, which is expected in this circumstance. In a 'dished' wheel, where the rim does not lie exactly centered between the two hub flanges, the spokes on the non-dished side – non-drive in the case of a rear wheel for derailleur gears – have a more effective axial, or sideways, pull on the rim thanks to the angle at which they act on it.

Air resistance obviously increases with spoke count, and is affected by the profile of the spoke as well. Although air resistance is important to pro racers because the top of the wheel is moving forward at twice the speed of the bicycle, it's probably safe to say that the air resistance due to spokes on a standard 32-spoke three-cross wheel would not be noticed by most average bikers, even at fairly high speeds.

The most common wheel problem is a lateral or sideways bend. Wheels that are severely bent cannot be repaired easily. You cannot have the spokes pulling hard against a rim that is very bent. This would cause a weak wheel that may bend again, or perhaps some spokes may break eventually. Bending of the wheel due to uneven distribution of force is a common problem faced by high-end bicycle riders.

4 . Methodology

This chapter covers the Design and stepwise process of manufacturing the SIBW. It contains the material and weight of all the parts used, the manufacturing and finishing process along with the Solidworks modeling and analysis. Following are the steps followed during thisprojet work , Designing the the project wheel in Solidworks , Analysis of the same design using Ansys by applying load at different points , Determining the dimensions of all the components , Selection of Stainless Steel as the basic material , Laser cutting of the parts according to the dimensions. The Hub was prepared by cutting the designed profiles phase by phase. The profiles were introduced to reduce the overall weight of the wheel , The phases were then welded together to form the hub for the wheel , The bearings and the bolt for holding the wheel were then welded to the slot , Grinding of the surface was done for finishing of the component , For spokes stainless steel strips were used of 3mm thickness. These strips were also laser cut and then grinded for finishing , The straight strips were then bent using a motorized jig , Holes were drilled on the strips to attach it to the hub using nut and bolts , The rim to be used was dismantled from the cycle and the conventional spokes were removed along with the hub and bearing. The same bearings were then used in the new designed hub , Finishing process was done on the rim to remove any rust or decolourisation , Then the bend steel strips, hub and rim were assembled together using nuts, bolts and washer , The tire and tube were then assembled on the rim , The wheel was then attached to the cycle by the bolt present on the hub , Final detailing and finishing was done along with spray painting of the wheel.

5 . Fabrication

This chapter consist of the designing and fabrication method of the hub, spokes and the rim. The designing of the same was done in Solidworks and the material selection was done on the basis of the values obtained by calculations. After the manufacturing, Finishing process was also conducted.

TABLE 1

PARTS	WEIGHT (kg)
Nut	0.750
Hub	1.130
Spoke	0.400
Rim	0.800

Considering the weight and the load to be applied dimensions are determined:

Strength : The cold work hardening properties of many stainless steels can be used in design to reduce material thicknesses and reduce weight and costs. Other stainless steels may be heat treated to make very high strength components.

Aesthetic appeal :Stainless steel is available in many surface finishes. It is easily and simply maintained resulting in a high quality, pleasing appearance.

Hygienic properties : The cleanability of stainless steel makes it the first choice in hospitals, kitchens, food and pharmaceutical processing facilities.

Life cycle characteristics : Stainless steel is a durable, low maintenance material and is often the least expensive choice in a life cycle cost comparison.No.4 Finish was applied for the final finishing of the hub and bow spokes.

The No.4 Finish is the brushed finish you see in most restaurants and professional kitchens. You can use the custom cut feature to design stainless sheet to fit as required. Other material used can be Copper or Brass. The width used is 3mm for optimum stiffness and damping.

6 . Working

We invented the wheel which is having incorporated suspension. It includes newly designed square hub made of stainless steel for higher stiffness and durability. The present invention relates to a shock-absorbing performance wheel comprising bow-shaped spokes which act as bows or springs to dampen acceleratory jerks brought on by unwanted shock. The said invention also comprises a non-circular hub onto which a plurality of "bow-spokes" are directly affixed to the periphery of said hub. A system that incorporated shock absorption directly into the wheels, making them capable of flexibly rolling over bumps instead of just rebounding . If any damaged occurs in hub can be designed and manufactured at home and by increasing or decreasing the length of bow spokes different stiffness can be achieved.

7 . Calculation

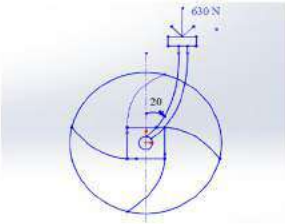
The 5th chapter of the report contains the calculations required for designing the hub, spokes and rim are calculated. This is important so that appropriate quantity of material is used to absorb all the loads.

Passenger weight 157kg

Weight distribution in bicycle is around = 60-40 %

Wheel fork is at 20 degree angle so weight on hub = 60sin20 =50kg

[1] STIFFNESS OF ONE CURVED SPOKE:



Total weight of the cycle = 150 kg+ 7 kg(cycle) = 157 kg

Weight distribution= 60(rear)/40(front)

Weight at front wheel = 40% of 157 = 63kg

Vertical weight on the wheel = 533 N

K= stiffness = force / x

Where x=displacement

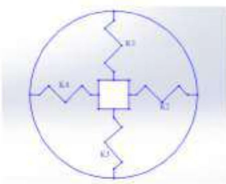
=1 inch

=25.4mm

Therefore,

K= 533/25.4 = 23.35 N/mm

Therefore the stiffness is,



K= K1+K2+K3+K4

But K2=K3=K4=K1

K= 4K1

K1= 5.84 N/mm

Therefore stiffness of one curved spoke is 5.84 N/mm

[2] MATERIAL STIFFNESS WHEN FLAT (actual values)

Width = 35mm , Length = 490mm

Thickness = 3mm , Stiffness of plate is,

Where, A= cross section area ie 35*3 = 105

E= 190 to 203 GPa , Consider E= 197 GPa = 197000 N/

L= 490 mm . Therefore,K = 42212.3 N/mm ,

K= 42214.3 N/mm

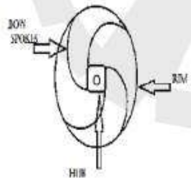
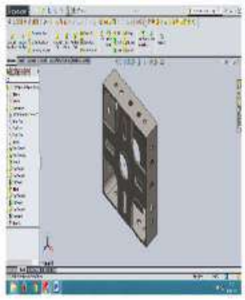
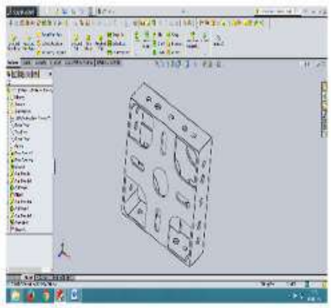


Fig 4.8 Modelling of hub





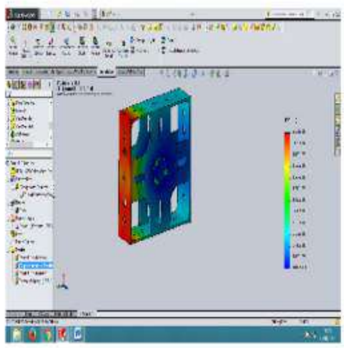


Fig: Solid works Simulation

8 . Result and Conclusion

The shock absorbing capacity of the wheel mainly depends on the weight of the wheel. In our model we removed the spokes from the wheel and replaced it with bow shaped spokes. What we observed was increase in the weight of the wheel which was 2.2 kg to 3.08 kg. So as the weight of the wheel increases the toughness also increases and hence the shock absorbing capacity. In our newly fabricated wheel the comfort we obtained is far better than the earlier conventional wheel. Also the life span is better than earlier. The increase in weight results in better stiffness of the spokes making it durable. The observations we achieved from the calculations and the analysis were similar rather what we obtained after design were as expected.

In this project a idea of suspension system was studied. The studied suspension system is placed inside a vehicle's wheel and is also called an Suspension incorporated in wheel system .a mechanism based SIBW which was previously designed for a wheelchair by static methods was investigated for dynamics response in. The dynamics simulations demonstrated the influence of different design parameters on the wheel. The results from these showed the feasibility of designing a rotating suspension with a linear stiffness rate and minimal fluctuations. The results also concluded that a rotating suspension system's performance is undermined at higher speeds. Moreover, the effectiveness could be improved by reducing the mass of the suspension's rigid links. Experimental results verified the simulation results with less than five percent of error. The cause of the increase in stiffness is short length and large width. This can be rectified by increasing length and decrease the width of the curved spoke.The SIBW system, like other suspensions should provide desired stiffness and damping rates. It should also allow the maximum possible wheel travel. For the rotating SIBW in addition to the conventional suspension properties, the stiffness fluctuation should be considered as well. The rotation of the suspension system which is embedded inside the vehicle's wheel, changes the orientation of the suspension elements at each rotation angle of the wheel. Consequently, the change in the suspension component's orientation can lead to undesired stiffness fluctuations. These fluctuations are sensed by the sprung mass as periodic vertical or horizontal vibrations when moving on a flat surface. The major challenge in the SIBW design is the space limitation. The suspension system should fit inside the vehicle's wheel without altering its outer dimensions. This design requires selection of proper materials for flexible suspension components and optimization of the shape of the components for most energy absorbance efficiency. Furthermore, the design should be simple, easy to manufacture, and also retrofit.

9 . Future Works

The developed wheel shows the feasibility and practicality of the SIBW concept. However, employing the current design in a commercial application requires further optimization and tuning. Moreover, this research has studied the simple case of a non-powered, rotating concept wheel for low speed vehicles; however future researches can be conducted on more complicated SIBW designs such as powered applications and designs for road vehicles. The main challenge in the powered rotating incorporated suspension design is achieving infinite rotational stiffness in addition to the requirements of a non-powered wheel. In a rigid mechanism design, the rotational stiffness can be attained by using parallel mechanisms. However maximising the rotational stiffness for a compliance design is a more significant challenge. Preliminary results show enhancements in the rotational stiffness, yet the unsymmetrical configuration of the spokes about the wheel axis yields different rotational stiffness rates in clockwise and counter clockwise directions.

The suspension incorporated in wheels can be used in low speed vehicles by further research on material and stiffness. Non heavy duty vehicles can use this wheel as maintaining and changing the wheel does not require trained personals. The braking used for this wheels can be improved by adding a disk brake or a wireless braking system for long run. The slots for placing the disk is added during the manufacturing stage.The different materials that can be used are materials with flexibility and appropriate stiffness to take the loads and behave as suspension system. For example Aluminium alloy, different types of composites, Carbon Fibre etc.

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Design of Cableless Braking System For Bicycle

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***Abstract*— The bicycle's invention has had an enormous effect on society, both in terms of transport and way of living. Several components that eventually played a key role in the development of the automobile were initially invented for use in bicycle, including ball bearings, pneumatic tires, chain-driven sprockets, and tension-spoked wheels. The aim of this project is to design and fabricate a braking system that avoids use of a cable to apply brakes in a bicycle. The use mechatronics is made in this project for the application of brakes. As the cost and size both are comparatively smaller, this concept is selected for this specific project. Comparison of materials is done for the construction of support of the components or the base for the project. Electronic components are selected on the basis of minimum requirement of power or force so as to reduce the size of the system. A perfect combination of mechanics and electronics is made so as to make it user friendly. The forces related to the system are done with respect to all conditions to gain maximum output. The vision is to create a system with less complexity and more efficiency to be used in everyday life.**

1. INTRODUCTION

From the day of invention, bicycles have played an important role in human life. Bicycles were modified according to their use and so were their components. Military uses of bicycles include communications, troop movement, supply of provisions, and patrol. The bicycle is also used for recreational purposes, such as bicycle touring, mountain biking, physical fitness, and play. Bicycle competition includes racing, BMX racing, track racing, roller racing, sportive and time trials.

A BMX bike is an off-road sport bicycle used for racing and stunt riding. BMX means bicycle motocross. Though originally denoting a bicycle intended for BMX Racing, the term "BMX bike" is now used to encompass race bikes, as well as those used for the dirt, park, street, flatland and BMX freestyle disciplines of BMX. Brakes and their cables are said to add extra bulk to the simple appearance of a fixed gear bicycle, and they prevent trick manoeuvres that involve spinning the front wheel in a full circle, unless equipped with special 360° freedom "detangler" system already known on trail or BMX bicycles. Riding brakeless can be dangerous, is prohibited by law in many jurisdictions, and may jeopardize the chances of a claim in the event of an accident. [1]

Track bicycles do not have brakes, because all riders ride in the same direction around a track which does not necessitate sharp deceleration. Track riders are still able to slow down because all track bicycles are fixed-gear, meaning that there is no freewheel. Without a freewheel, coasting is impossible, so when the rear wheel is moving, the cranks are moving. To slow down, the rider applies resistance to the pedals, acting as a braking system which can be as effective as a conventional rear wheel brake, but not as effective as a front wheel brake. [2]

Due to certain movements of the front wheel the use of cable brakes causes drawbacks in the functioning of bicycle or the sport. In this project we look forward to eliminate the use of cables for braking.

2. LITERATURE REVIEW

The Saarland researchers have installed the system on the front wheel of a cruiser-type bicycle. The cruiser bike is more similar to an Easy Rider motorcycle without an engine block than it is to a traditional bike. However, looking at the straight, elongated stem, it is readily apparent what makes the newly developed system so special. The bicycle has neither a protruding brake lever to control the front brake, nor a brake cable snaking down the frame. To brake with the wireless brake, a cyclist has just to clench the rubber grip on the right handle. The more tightly the grip is clenched, the harder the disk brake on the front wheel works. It seems as if a ghost hand is in play, but a combination of several electronic components enables the braking. Integrated in the rubber grip is a pressure sensor, which activates a sender if a specified pressure threshold is crossed. The sender is integrated in a blue plastic box which is the size of a cigarette packet and is attached to the handlebar. Its radio signals are sent to a receiver attached at the end of the bicycle's fork. The receiver forwards the signal to an actuator, transforming the radio signal into the mechanical power by which the disk brake is activated. To enhance reliability, there are additional senders attached to the bicycle. These repeatedly send the same signal. In this way, the scientists hope to ensure that the signal arrives at the receiver in time, even if the connection causes a delay or fails. To give the system a reliability boost, multiple senders attached to the bicycle repeatedly send the same signal. This means it should arrive at the receiver in time, even if there's a connection delay or failure. The wireless connection between sender and receiver is accomplished with TDMA, MyriaNed wireless nodes, and the 2.4 GHz ISM band. It takes roughly 250 milliseconds for the cruiser bike to brake once a rider squeezes the rubber grip (150 ms for wireless communication between the components). [3]

Presently, the system is able to stop the bicycle within 250 milliseconds. At that speed, a cyclist traveling at 30 km/h (18.6 mph) would have to react at least two meters (6.6 feet) before the point at which they needed to stop. The scientists aren't satisfied with this figure, and believe that it would be relatively simple to add anti-lock and traction control functionality to the system. Professor Holger Hermanns, who is leading the research, has been in contact with bicycle brake manufacturers and hopes to commercialize the technology. . Anti-lock wireless braking (to prevent skidding in wet conditions) and traction control may not be far behind. Even if the Saarland system never makes it to the marketplace, he believes that lessons learned from the project could be applied to larger-scale, more complex wireless systems in which failure must be kept to an absolute minimum. The wireless bicycle brake research was funded by the German Research Foundation. The results are documented in the scientific paper *A Verified Wireless Safety Critical Hard Real-Time Design*, published by the Institute of Electrical and Electronics Engineers (IEEE). [4]

Fig 2.1 wireless brakes by Professor Holger Hermanns [4]

3. PROBLEM STATEMENT

Wireless technology has shown great advancement in many of the areas in a short span of time. The advancement is show in the field of satellite, automobiles, communication and pretty much in everything. Wireless advancement is more because of effective, less cost and reliable work. Advancement in wireless technology creates a benchmark for ease of use and quality, for a mechanical component of a bicycle.

The full form BMX is bicycle motocross.BMX is a sport built on the premise of racing fast, off-road tracks on a bicycle smaller and lighter than a **road bike** or mountain bike. Most of the BMX bicycles from companies like Dayton, Redline, Eastern, MirraCo, etc do not install front brakes. Most of the street riders prefer to go brakeless for some tricks and stunts and they think it makes the bicycle look better. The brake cables make it hard for a rider to pull up a bar spin. The front brake is not installed for avoiding resistance for bar spins and it makes it simpler and lighter.

Brake cables are said to add extra bulk to the simple appearance of a BMX bicycle, and more importantly they prevent trick manoeuvres that involve spinning the front wheel in a full circle, unless equipped with special 360° freedom "detangler" system making the cycle bulky. What differentiates a BMX bike from any bikes is the ease of performing stunts. The use of brake cables destroys the sole purpose of using a BMX bike.

A Bowden cable is a type of flexible cable used to transmit mechanical force or energy by the movement of an inner cable relative to hollow outer cable housing. However use of Bowden Cables has certain disadvantages. The outer insulation cover can sever and break, causing loss of continuity, when insulated covers are twisted with an incorrect pitch length or pitch direction. The cable core cannot absorb the mechanical load while flexing so it cannot transfer the force to the brakes, which causes them to break under the increased tensile load.

Additionally, Bicycles which are not frequently used have jammed brakes due to lack of maintenance hence need low maintenance brakes. Also disabled people have problems in driving vehicles with foot brakes or hand brakes which require more force to be applied.

4. METHODOLOGY

This chapter covers the Design and stepwise process of manufacturing the cableless braking system. It contains the material and of all the parts used the manufacturing and finishing process along with the Solidworks modeling and analysis. To actuate the brake, a servo motor is used which needs to be clamped to the bicycle fork. The servo needs to be tightly fixed to the fork so that it can help actuate the brakes when the lever is pressed. In order to clamp the servo, a CAD model of the clamp is designed. It is designed according to the dimensions of the bicycle fork and the distance of the operating link. The diameter of the fork is found to be 320mm. the link is located at a distance of 70mm from the fork. The servo motor needs to be tightly clamped into this model. The servo motor of length 40mm, height 47mm and width of 20mm is tightly fitted into the slot. According to these dimensions, the model was constructed accordingly. The lever is used to apply brake in a bicycle. Unlike bikes, the lever is incorporated in the handle. The shaft of the potentiometer acts a pivot for the lever to operate. The diameter of the brake handle is found to be 20mm. The pivot is placed at a distance of about 15mm from the brake handle. The potentiometer shaft has a diameter of 4mm. The brake lever is attached to this pivot position.

It was found that the brake lever which was incorporated in the bicycle had a large amount of force acting on it. Thus, the lever is designed such that minimum amount of force is applied on it. Ergonomics places an important role in the design of brake lever. The brake lever is fitted in the pivot position of the lever clamp. The lever is designed similar to the present system lever. The total length of the lever is 110mm. At a distance of 55mm, the lever is angled about 45 to a height of 20mm.

5. FABRICATION

The servo clamp is constructed out of a wooden block (soft wood). The servo clamp needs to be tightly fitted into the bicycle fork. The servo motor helps to actuate the braking mechanism. Hence it needs to be tightly clamped. The wooden block helps to easily mould the clamp. The dimensions of the bicycle fork and the servo motor are marked on the wooden block. The hole for the fork is drilled and the case for servo is chiseled out. For easy clamping, the servo block is made into two parts. These parts are then bolted tightly together around the bicycle fork.

The lever needs to be clamped to the bicycle handle. This is done with the help of a lever clamp. On the basis of the CAD model, the lever clamp is fabricated. This is done by 3D printing the clamp. The CAD model created in SOLIDWORKS 14.0 in then converted into STL file format which is a supporting file format for 3D printing. 3D printing is a process used to create a three-dimensional object in which successive layers of material are formed under computer control to create an object. Various types of materials are used for 3D printing of which in our project, we have used Poly Lactic Acid (PLA). The new lever which is designed is similar to the present system lever design. The lever is fabricated by the help of laser cutting. In this method, a focused laser beam is directed at the material, which then either melts, burns, vaporizes away, or is blown away by a jet of gas, leaving an edge with a high-quality surface finish. For using the laser cutting machine, the CAD file is converted into DWG file format. This serves as an input to the laser cut machine. An acrylic sheet of specific thickness is used for this purpose. A program controls the transmission and reception of signals by the rf module. Similarly, the control of servo and potentiometer is done by this program fed into the arduino board. The arduino board itself is powered by a battery which is available easily in the market. This battery connected to the arduino board itself provides power the servo motor and the potentiometer at the receiver and transmitter respectively. The components are assembled by connecting them to the arduino boards with the help of jumper cables.

6. WORKING

The transmitting device consists of the following parts-brake lever, potentiometer, arduino board, radio frequency modules and a power supply. The brake lever is used to apply force so as to convert the mechanical energy to electrical energy. The design of brake lever is changed in order to vary the potentiometer. The potentiometer is provided with a gear which is connected to the brake lever and in turn rotates it to vary the force applied. The arduino initiates the program and sends signal via the rf module. The transmitter is compacted in a box along with power supply without which the transmitter won't work. The receiving device consists of following parts-, arduino board, radio frequency modules, servo motor, brakes along with brake pads and a power supply. The nrf module receives the signal and the arduino board initiates the program to be followed. The arduino sends current to the servo motor via a power supply. The servo motor which is connected to the brakes rotates through an angle causing tension in the brakes. Thus, the brake pads compress against the rim of the wheel causing friction and bringing the bicycle to a halt. The arduino provides current to the servo motor as much as the variation in the potentiometer causing only the amount of angle of rotation needed in the servo depending upon the force applied on the lever by the use

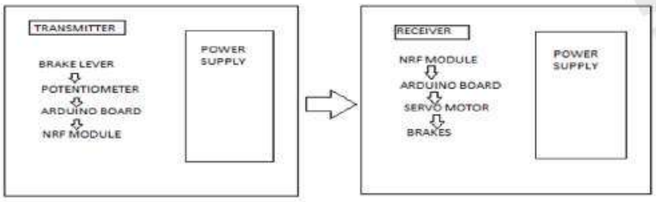

Fig 6.1 Process diagram of transmitter and receiver

7. CALCULATION

BRAKING FORCE

The braking force is the measure of braking power of vehicle. Considering the bicycle with high speed which is MTB the maximum braking force needed is 0.5 times gravitational force i.e. approximately 50N on concrete. For an upright bicycle on dry asphalt with excellent brakes, pitching will probably be the limiting factor. The combined centre of mass of a typical upright bicycle and rider will be about 60 cm (24 in) back from the front wheel contact patch and 120 cm (47 in) above, allowing a maximum deceleration of 0.5 times gravitational force. Assume the COG of the rider is in the hips, so about 10cm above the seat. A line from there through the front contact patch will be roughly 45° above horizontal (give or take, say 15°), so an upper limit of 1times gravitational force is likely. [7]

FORCE ON LEVER

The force applied on the lever creates tension in the cable and the brake shoes compress against the wheel rims. A normal cable brake on flat handle bar would need about 40-50 N (3-4 kg) for hard stop, about 20-40 N (1-3 kg) for normal deceleration. Same stopping power with drop handlebar and caliper brake would need about 1.5 to 2 times as much. Same stopping power with hydraulic disc brake needs about 0.5-0.7 fold. [8]

SERVO MOTOR TORQUE

For actuation of the brakes the servo motor can be tested. According to the specifications the MG995 servo has a torque of 9.40 kg-cm or 130.54 oz in. Torque is force times perpendicular distance to axis of rotation. If a link attached to the arm of the servo while the arm is horizontal, 1 cm from the axis of rotation, then 9.40 kg-cm means that the servo could lift a 9 kg weight with the string i.e. a force of approximately 90 N. [12]

POTENTIOMETER TORQUE

The force applied at the lever is transmitted to the brakes through the cable. For the cableless braking system the force has to be transmitted by some other way such that the force could be varied according to the grip of the rider just as in a normal bicycle. For this purpose, a potentiometer needs to be used. The torque of a10kΩ, linear rotator potentiometer is 20-204 Kgf.cm i.e. 0.019Nm at maximum. Torque is force times perpendicular distance to axis of rotation so if the potentiometer is rotated at 1cm from axis of rotation then a maximum force of 1.9N is to be applied. [10]

ANGLE OF THE CALIPER LINK

The length of the caliper is 40mm and the height of link is about 25mm. According to the hypotenuse theorem the angle of the inclination of the caliper link was calculated to be 51.38°.On operating the brakes the caliper link turns around its pivot and rises to horizontal position in order to push the brake pads onto the disk. The angle of the link therefore changes. The height of the link from pivot changes to around 5mm thus changing the angle. According to the hypotenuse theorem the angle calculated is 82.82°.

8. RESULT AND CONCLUSION

Thus we can conclude that the cableless braking system is better than the existing braking system in terms of life, efficiency and economy. The system if manufactured on an industrial scale may be available for a very les cost compared to the cost of single components. The life of the electronic components is way too longer than the components of the existing braking system.

The cableless braking system can be programmed to act as ABS and can be developed to control by gesture. The electronic components do not require maintenance and are operated by battery. However the braking distance and response time of the cableless braking system is comparatively more than the existing braking system. The force required to apply brakes at the lever is much less due to the existence of potentiometer which requires less torque for operation. The weight of the cableless braking system may depend on the material used and the weight of the electronic components and might be heavy or light accordingly.

Parameters	Existing	Cableless
Distance	100m	100m
Speed	16.65kmph	16.1kmph
Time	29sec	31sec
Braking time	2.12sec	2.5sec
Braking distance	Approx 1.5 m	Approx 2m
Weight	100gm	168gm
Lever force	20-40N	9N
Brake force	50N	50N

Response	Depends on condition of cable	Constant but comparatively slow
Life	Low	High
Maintenance	high	Low

Table 8.1 Comparison of parameters

The different parameters of existing and cableless braking system have been compared. From the comparison, it has been found that the new cableless system is higher in cost but has a greater life expectancy. It requires less maintenance as compared to the current system. The system constructed is a prototype and with more development, a much effective cableless braking system can be constructed. In turn, with increase in mass production, the cost of the cableless system will decrease. This will make it cost effective.

9. FUTURE WORKS

The cableless braking system has vast area in automobile industry as well as the mechanical industry to conquer. This braking system might prove a milestone in the subject of safety. Although the system has some disadvantages, they can be further resolved to create the perfect system.

This braking system can also be further developed to be used in motor scooters an motor bikes. Considering a Bajaj pulsar motor bike of 150cc the speed is much greater than a bicycle hence needs more braking force. Most bikes have disc brakes in the front and drum brakes in the rear. the rear drum brakes are applied by pedal while the front disc brakes are applied by a lever provided on the handle bar similar to bicycles. As the speed of motor bike are more than bicycles a braking force of 465N is required for the front disc brakes by applying a force of 196N on the lever. On the rear wheel a maximum braking force of 3879Nis obtained after application of 350N of force on the pedal. [17]

To obtain such braking force the actuating mechanism at the receiver should be designed accordingly. New components should be selected considering all the factors of the motor bike and assembled accordingly. This technique or method can be followed as same for other vehicles. While the transmitting and receiving device remains the same changes are needed to be done at the actuating mechanism only.

The cableless braking system can gain importance in the following ways-

- In vehicles secondary brakes can be introduced to prevent accidents.
- For the disabled below the waist this brake might prove to be a boon.
- In racing cars for the cause of safety this brakes should be provided.
- In bikes to reduce complexity, these brakes might prove useful.
- BMX bikes do not have front brakes, so these brakes might be useful for performing stunts with brakes.
- In electric cars where most components work on power supply.

In aircrafts and industries also.

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DESIGN OF AUTOMATIC RAIN OPERATED WIPER SYSTEM

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Abstract-With drivers exposed to an ever-increasing number of distractions, automatic rain-sensing wiper systems become an even more appealing feature, as they work to minimize the time the driver must take his/her hands off the wheel.Most traditional systems offer intermittent as well as variable speed operation. The traditional wiper system however requires driver constant attention in adjusting the wiper speed. Traditional windshield wiper speed constantly varies according to time and vehicle's speed. Because the manual adjustment of the wiper distracts driver's attention, which may be a direct cause accidents. This is a paper for Rain sensing wiper in various method and explain the basic skeleton for adjust speed of wiper automatically cording to the amount of water on the windshield.[1]

Keywords:Rain sensor, windshield

I. INTRODUCTION

Windshield wiper is an important component in vehicles. It plays an important role in auto vehicle. It provides a good visibility in rainy season to the driver. Wiper helps to clean the windshield and provide good visibility through it. It helps to reduce the accident in fog and rainy season.. A manual wiper needs driver attention to On/Off the knob and set the speed of the wiper because of this driver gets off his attention from the road and the chances of the accident will increase. So to reduce the accident or to prevent the accident the automation is required in auto vehicles.So that driver can focus on the road. Therefore, Automation is most needed in auto vehicle for the safety purpose it will reduce the work of the driver so he can get better focus on the road while driving. Therefore, Automatic operated wiper needs in the vehicles it will increase the safety of driver as well as passengers. And it will also give the better visibility on road and reduce the effort of driver.[1]

A. Sensor

A sensor is a device which transducer whose purpose is to sense and responds to some type of input from the physical environment. The specific input could be light, heat, motion, moisture, pressure, or any one of a great number of other environment phenomenon. The output is generally a signal that is converted to human-readable display at the sensor location or transmitted electronically over a network for reading or further processing. [2]

1). *Types of Sensors*

- Temperature Sensor
- Pressure sensor
- Ultrasonic sensor
- The acceleration sensor
- Displacement sensor
- Holzer switch sensor

2).*Need for Rain Sensing Wipers*

a) *Safety:* The rain sensor helps keep driver safe as well as other drivers. Paying attention to the road in front can be difficult if driver is distracted, where even turning on the windshield wipers can be an effort. With a rain sensor, driver doesn't have to worry about turning on or off the windshield wipers because it is taken care of. If the rain sensors are more advanced, they can turn up the speed of the wipers to match the amount of rain on your windshield to improve the sight lines on the road. If other vehicles splash or spray water or debris on the windshield, the rain-sensing system automatically intervenes by starting the wipers to keep visibility unobstructed.[3]

b) Convenience: In the present automobiles, the number of facilities is much higher. The driver must concentrate on road while driving, and with increased traffic, things get frustrating. The features in the car like GPRS to trace the route, music system, air condition system etc may drive away the attention of the driver. Thus, an effort has been made to reduce the effort put by driver in controlling the speed of the wiper and put more concentration on his driving. Since this system is put into use in many higher end cars and has been successfully working, an effort was made to reduce the cost of the system so that this system can be implemented in common economic cars where a common man can also enjoy the benefits. It was found that the rain sensor is the expensive unit in the present system and an effort is done in making a sensor which is reasonable by price, the Sensor. The sensing device used here is basically a conductive spot. When the rain begins and the sensor conducts, the system must trigger the wiper to wipe the water on the screen.

II. Problem Definition

A. Manual Handling

The manual handling of the current wiper systems cause trouble to the driver while driving in tough situations like heavy rainfall or during foggy conditions. In these conditions, it becomes uncomfortable or inconvenient for the driver to switch the wiper ON and OFF repeatedly.

1) Switching of Wiper: The switching of wiper can cause distraction while driving which can lead to accidents on highways or sharp turns if precautions are not taken. Current systems require the driver to switch the wiper according to need.

2) Speed Control: During rainfall with changing intensity or stormy conditions, there is need to change the speed of wiper according to the requirement. Current systems require manual speed control which can again cause trouble during driving.

B. Upgrades For Older Cars

The previous system used to activate the wiper manually. Thus, this system is proposed to solve these problems. The objectives of this project are to upgrade the older cars system by providing automatic wiping system, to improve the system by using sensor with actuator and to design a basic program that will fully operate with the system.

III. Methodology

The methodology for this project are being divided into two different parts: hardware and electronic components. Hardware component will describe on the circuit used to build the prototype of the system. Meanwhile, the electronic component describes about the control of the system and to achieve the objective.

A. Hardware

This section describes the hardware required for actual implementation and the software used.The speed of the wiper is controlled electronically with the help of the integrated circuit. The rain sensor is used to detect the amount of the rain and give the signal to the IC. The IC detects the sensor input and gives the signal to the driver circuit. The motor driver actuates the motor to run at high speed or low speed based on the amount of the rain level detected. The rain sensor will detect the amount of water content on the windshield and based on the amount of water deposited on the windshield, the speed of the wiper is controlled.

Fig.1 Rain Sensor

IV .Experimental Setup

Motor and its arrangement. The glass frame is the main part of this paper, because the wipers in the automobiles are mainly used for removing the rain and debris from a glass. Glass, Conductive sensor is fixed on the wood stand.The Conductivity sensors or conductivity guard are designed for detection of electrically conductive liquids. This is fixed to the glass frame.

V. Working Operation

The battery supplies the power to the sensor as well as rain operated motor. Wiper motor is automatically ON during the time of rainfall. The sensor is fixed in the vehicle glass. The conductive sensor is used in this project. It senses the rainfall and giving control signal to the control unit. The control unit activates the wiper motor automatically. This operation is called Automatic rain operated wiper.

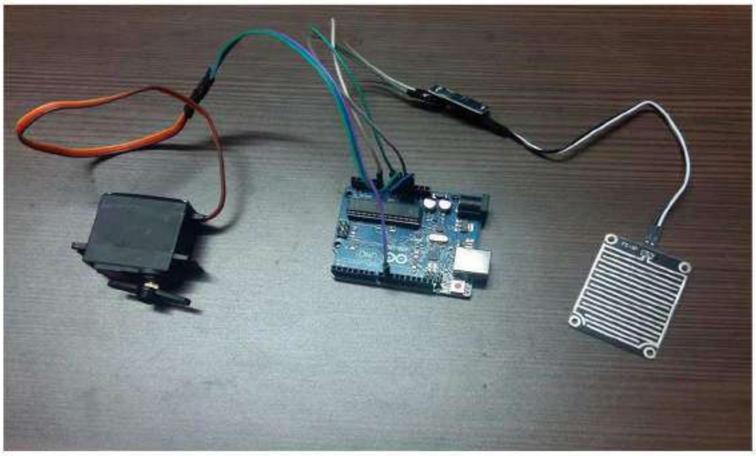

Fig. 2 Circuit

Advantages:

□ Low cost automation project.
□ Free from wear adjustment.
□Less power consumption.
□ Operating Principle is very easy.
□ Installation is simplified very much.
□ It is possible to operate Manually/automatically by proving On/Off switch.
□ Sensor cost is very low due to optical sensor.

VI. Future Scope

Using more appropriate rain sensor we can make more precise automatic wiper system. By adding microcontroller based system we can implement some security features for automobiles. Using micro controller can make this project more effective as it will enable the wiper to rotate through desired angle rather than 180. We can use an optical sensor which will enable it work along line of sight.

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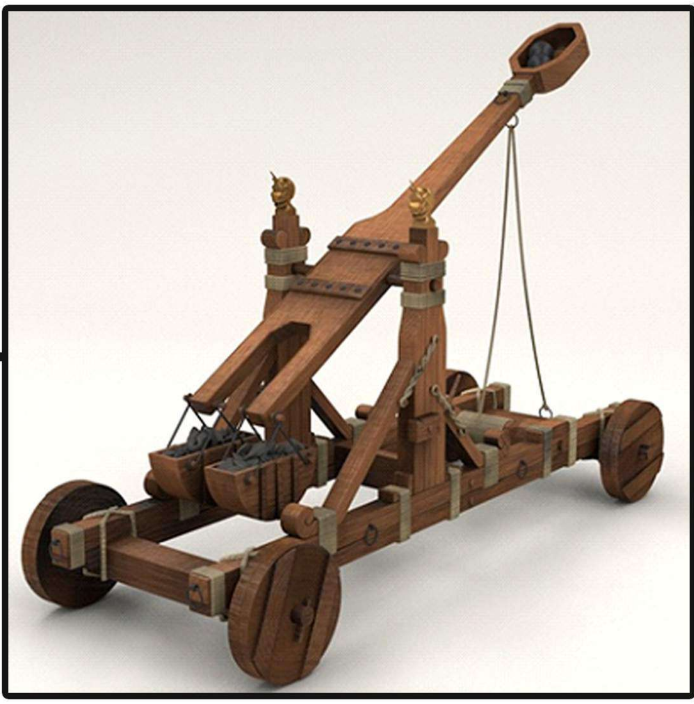
FOUR BAR CATAPULT



INTRODUCTION :

According to the Buck Institute for Education (BIE) Project Based Learning is a teaching method in which students gain knowledge and skills by working for an extended period of time to investigate and respond to an authentic, engaging and complex question, problem, or challenge. As the students of second year mechanical and automobile engineering,we were studying subjects such as Strength of materials (SOM), Theory of machines (TOM), Material technology , Industrial electronics, Production process and Computer-aided design (CAD).So the faculty decided to put together a real time problem statement for students to apply the knowledge gained by the above mentioned subjects . Students were given few constraints or parameters which could help them to achieve their objective within the given period of time.But other than that they were allowed to use their imagination and knowledge to their desired extent.

FOUR BAR CATAPULT

THE PROJECT aka The problem statement

The project was to develop a Catapult system that could be used to throw a squash ball as far as possible,maintaining some degree of accuracy with the Mechanism. A catapult is a device which converts either elastic or torsional or gravitational energy into kinetic energy. The transmission of the energy takes place from the driving link to the driven link with the help of a connecting element.

The magnitude of success was to be determined by how accurately the mechanism could be utilised to commute the ball from one point to another.

But there were some certain rules that had to be followed

1.The catapult mechanism must be a four bar kinematic chain.

2.Triggering mechanism must be electronically actuated.

3.The container which would hold the projectile before launch should be mobile over the link. It must be free to move from 20cm to 30cm from the pivot point.

4.The firing angle must be variable.

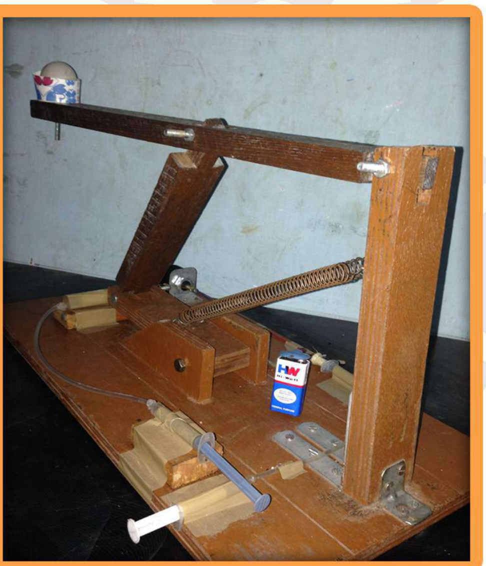
Main approach adapted

Students,at first,did some research on different mechanisms that could be used for optimised results and then they made the necessary designs on CAD softwares of their“prototype”. The final models were not so similar to the initial ones. Lot of mistakes were made which were equally nullified by the improvements. After deciding on the materials and creating trigerring mechanism that could be electronically actuated, everyone tested their catapult and documented the project. Students used various formulae that they had learnt in theory lectures to do the certain calculations, predictions,graphs for various inputs and outputs,etc.Finally students presented their models and reports in front of the faculty

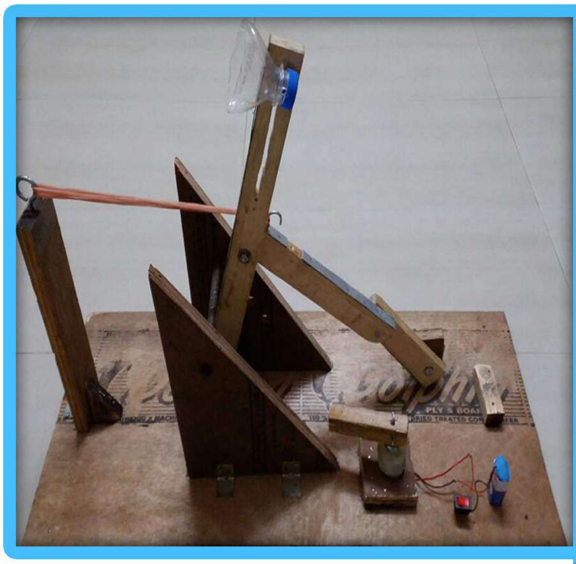
REVIEWS

"It was a wonderful experience. We got to apply the knowledge that we grasped in the lectures of Theory Of Machines. Plus the involvement of other subjects like Fluid Mechanics and Industrial Electronics helped us to make the project more technically sound and innovative. In all, we learnt a lot and we eagerly look forward to grab such wonderful opportunities."

~Ankit Arun Gupta (SE MECH A)



Team - Mitali Dhuri, Sankalpa Hirlekar, Akshay Gupta,Yogesh Kadam



"Project Based Learning provided a way to understand the theoretical concepts practically.It granted us the opportunity to have a hands-on experience on various tools and machineries. Plus working in a team of 4 helped us to produce the expected output with much accuracy and precision."

~Shubham Lokhande (SE MECH B)

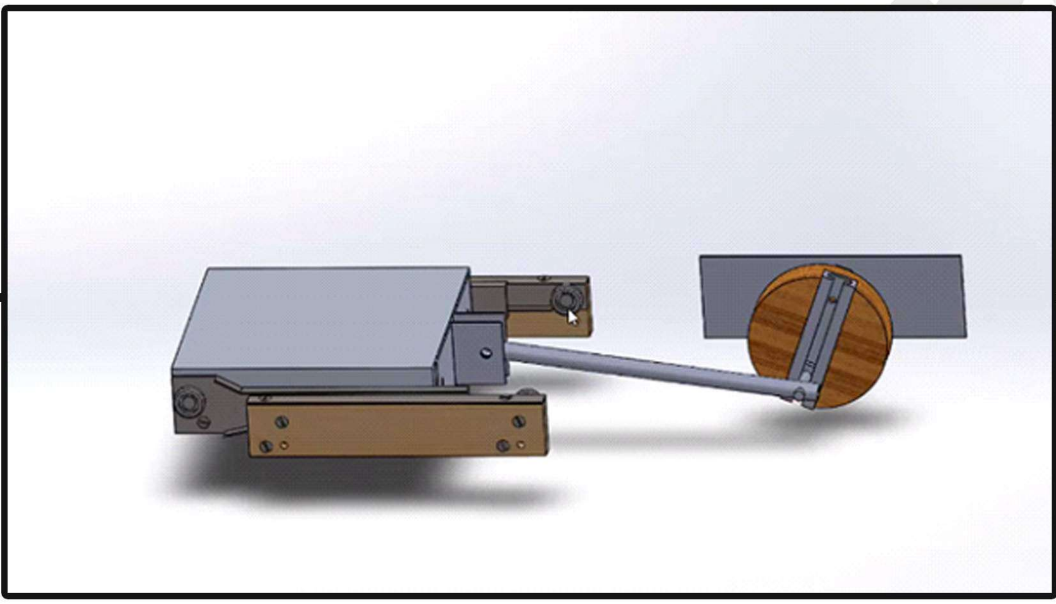
Team - Tanvi Shirsat, Pranav Nair, Aditya Poojary

"PBL was a good new venture carried out by the college. It helped us to gain insight on our subjects and their practical applications."

~Saish Oak (SE MECH B)

Team - Ashish Tomar, Harshvardhan Patil, Muhammad Pakar, Nitish Krishnan

SHAKER TABLE



INTRODUCTION :

A Vibrating table (Shaker Table) has got numerous applications when it comes to industries dealing with Powder Metallurgy and to study response of structures due to earthquakes. So, we were given a task to replicate the same on a smaller scale. The major objective behind this was to familiarize the students the difficulties faced during actual fabrication of a working prototype. The main focus was to see how students implement the basic laws, calculus, engineering concepts, experimental data, and assumptions during the designing process.

SHAKER TABLE

Problem Statement:

The Problem statement was defined to prepare a shaker table which could be used to produce oscillations required. While doing so, the following mentioned conditions should be fulfilled.

- The table dimensions should not exceed 15 cm x 15 cm and should be made only of Aluminium.
- The oscillations of the table should vary between 0-1 cm while the range of frequency should be within 0-10 Hz.
- The oscillation produced should be purely sinusoidal.
- The final table should be designed for resisting the dynamic load produced during working of the prototype.
- The entire setup was to be automated and controlled with the help of laptop or smart phones.

Main Approach Adapted:

The construction of the required prototype begins with the basic knowledge about the subjects like Theory of Machines, Machine Design, Vibration, Finite Element Analysis and Mechatronics. After modeling and analyzing the required table design in and SolidWorks & ANSYS, the final design of table was finalized. The second most important concept was selection of the required mechanism necessary for producing the required oscillations. The mechanisms selected were slider crank, eccentric drive, cam and follower mechanism and rack and pinion mechanism. After simulating the entire design in Solidworks and determining the required dimensions, the motor was selected which could drive the mechanism. Apart from fabricating the actual design finalized, the students also meanwhile linked the project to electronics front. Many of the students used arduino to electronically control the frequency at which the setup oscillated. Some of them also used potentiometers. The graphs, procedure and the other necessary information were documented. The project was then presented in front of the faculty for the final testing purpose. Overall, it was a complete package which not only helped to bridge the gap between theoretical knowledge and practical experience but also helped to nurture values like team building, working in groups and time management.

REVIEWS

"PBL was a nice exposure for practical knowledge.We learned different skills such as time management, leadership and group coordination.It was a perfect platform to put our theoritical concepts in practical use."

~Sagar Ganjale (TE MECH A)

Team - Ketan Jain, Kasute Akash, Abrar Khot

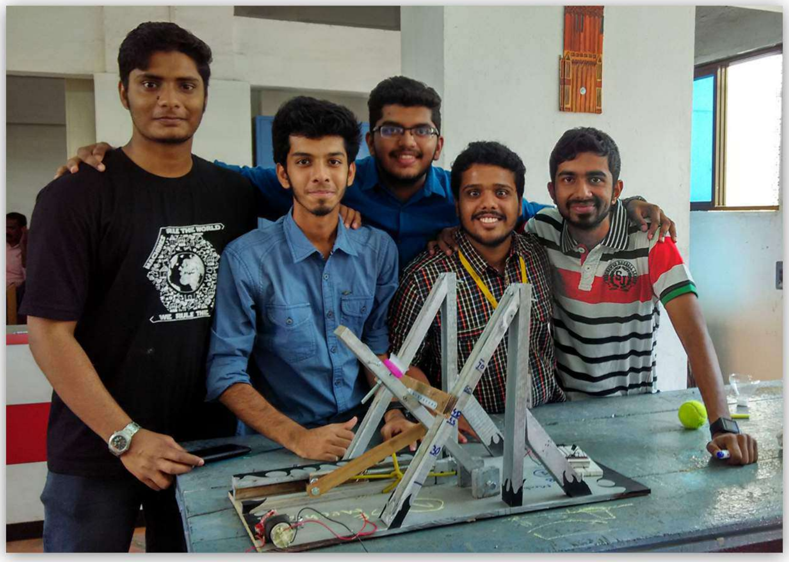
"Project based learning was truly a turning point in my engineering life. It was a great experience and added the practical approach to be followed while dealing with problems in real engineering of things. You see, the course of engineering is so designed that one gains a good theoretical knowledge about many fields but the actual gap between the knowledge gained by engineering and that required in industries is wide. Such things like PBL make a good chance for students to understand the practicality of the theories studied during Engineering.

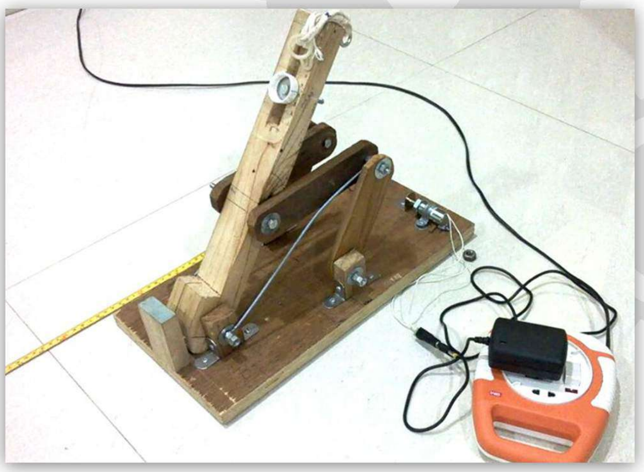
Also it helps building many values like working in groups and team building. It was an amazing experience and it helped the students to gather immense knowledge and command over the subject."

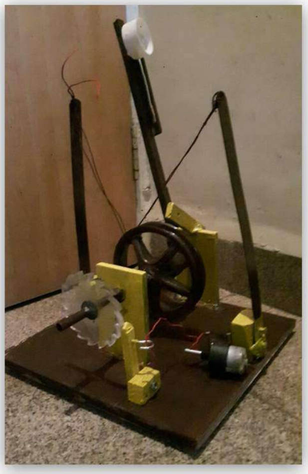
~Abhishek Pandey (TE MECH B)

Team - Amogh Ogale, Kaustubh Pawar, Akshay Pal

GALLERY








BASIC WORKSHOP PRACTICE
CARPENTRY
FITTING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CARPENTRY
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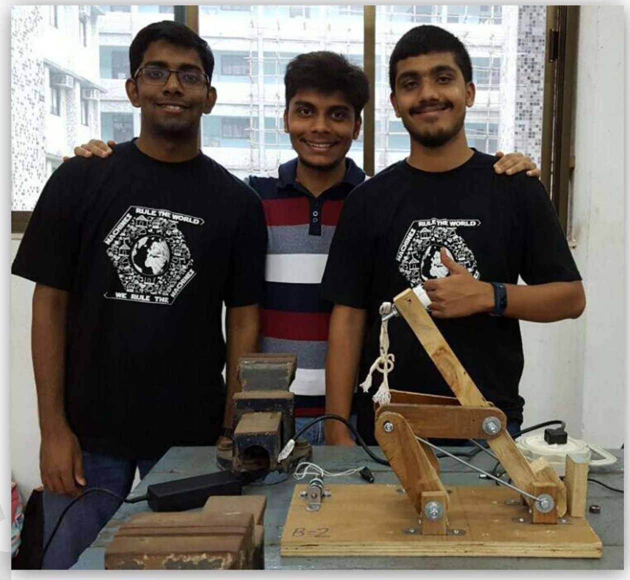

A VISIT REPORT TO

DEEPAK NITRITES, TALOJA

Introduction

Deepak Nitrites, Taloja is a division of Deepak Group of Industries with other manufacturing facilities at Nandesari and Dahej in Gujarat, Roha in Maharashtra, Hyderabad in Andhra Pradesh.Instituted as fully indigenous sodium nitrite and sodium nitrite plant in 1970, Deepak Nitrite has grown today into a 700 million USD Global Group. They are global supplier offering a wide spectrum of chemical ingredients with diverse applications ranging from Agrochemicals, Rubber, Pharmaceuticals, Paper, Textile, Colourants, Petrochemicals to Speciality and Fine Chemicals.The branch at Taloja focuses on production and supply of Aromatic amines by Hydrogenation and Distillation which are used by industries for various cleansing and conditioning purposes.

Visit to the Plant:

Field Visit to Deepak Nitrites was organised by Pillai's College of Engineering, New Panvel. We, the group of 25 Students and a Faculty Member left the college campus on 4th March, 2017, at 9:30 am and reached Deepak Nitrites, Taloja by 10:00 am.Since company was observing Safety Week students were made familiar with different safety instruments used at the plant. Students were then instructed about the safety precautions to be taken while on the tour of the plant by their Training Department Supervisor and divided us into two groups for the same.

The students were first taken to Demineralization Station – wherein hard water was treated to obtain demineralized water for further use. The process consisted of the tank that removed turbidity in water and the same water was then passed through Caustic soda - HCl tower (anion – cation bed)to remove the salts present in water,if any. This water was then sent to Degasser to remove unwanted toxic gasses from water. The treated water was the stored in Utility Tank having capacity of 750 kL.

The Second station was Oil Station – wherein the oil used for heating purposes in the boiler furnace was treated. The boiler was heated using Furnace Oil,specially for firing purpose.The oil was then transferred to compressor. The compressor was of reciprocating-type which compresses the oil to set pressure. This oil was then passed through an air dryer to remove the moisture present in it. The oil was then passed through the Thermite Fluid Heating Section. It consisted of helical coils with multi-pass arrangement heat exchanger to heat the oil upto desired temperature required for burning in the boiler.

The Third station was Boiler Station which was used to convert water into high pressure steam. The plant had 3 boilers,with two in production and one in standby mode. The exhaust to boiler was used for reheating of oil.The treated water stored in Utility Tank was fed constantly to the boiler and heated oil was sent to furnace section of boiler for heating purpose.The pressurized steam was then sent to PRS(Pressure Reducing Station) to reduce the pressure of steam to required pressure.The steam obtained from boiler is used for curing of chemicals at the main station. Students were also given the description of how the chemicals ,as desired by the clients, were synthesized at the main station. The product obtained was stored in tanks at the store room.

The last station was Cooling Tower - wherein the steam which was converted into hot water at exit of Main station was reduced to it's room temperature

It was not possible to complete the visit in a day and see each and every plant, but the supervisors present over there guided us well and cleared all our doubts. At last refreshments were provided to the students. We thanked the entire staff of Deepak Nitrites for such a wonderful tour of their plant and gave a small gift on behalf of AESA-MESA as token of appreciation. We left the company and reached college by 2 pm.It was a great experience for us and we sincerely thank our guide, Prof.Rashid Ali for guiding us throughout the visit.