# Advancement in SCR system using Ammonia (Review)

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**Abstract:**

This paper will give you a detailed review of SCR (selective catalytic Reduction) system. SCR technology is one of the most cost-effective and fuel-efficient technologies available to help reduce emissions. SCR has been used to control NOx emissions from stationary sources such as power plants for over 20 years. More recently, it has been applied to select mobile sources including cars, trucks, marine vessels, and locomotives. Applying SCR to diesel-powered vehicles provides simultaneous reductions of NOx, PM, and HC emissions. Many engine manufacturers are now offering SCR systems on new highway heavy-duty engines sold in Europe to comply with the European Union's Euro IV or Euro V heavy-duty engine emission requirements. More than 100,000 new, SCR-equipped trucks are operating in Europe using a urea-based reductant. SCR is the system which mainly concentrates on the reduction of NOx (Oxides of Nitrogen). Urea – a liquid reductant is injected into the exhaust gases of the diesel engine through the catalyst in SCR technology. Urea reacts with the Nitrogen Oxide and converts it into nitrogen and oxygen, which is then expelled through the vehicle tailpipe. This system lowers the value of NOx by 70%. While urea is the primary operating fluid presently used in SCR systems, alternatives to the urea agent are currently being explored. Anhydrous ammonia, aqueous ammonia reductants are currently used in SCR application.

**Keywords:**Selective Catalytic Reduction, Emission Control, NOx reduction, Diesel engine, Urea, Ammonia

## Introduction:

The diesel engine has gained much attention in recent years due to its higher fuel efficiency compared to the gasoline engine. However, the NOx emission is one of the drawbacks that have been popularly discussed for the diesel engine. SCR can reduce NOx emissions up to 70 percent while simultaneously reducing HC and CO emissions by 50-70 percent, and PM emissions by 30-50 percent. SCR systems can also be combined with a diesel particulate filter to achieve even greater emission reductions for PM. SCR technology may play a key role in achieving emissions reductions that allow light-duty diesel vehicles to meet the new, emission norms.

This system uses ammonia as the reductant to convert NOx in the exhaust to N2 and H2O by the catalyst. Since ammonia cannot be directly carried in vehicles, 32.5% aqueous urea solution (AdBlue) has been used as the standard reductant of SCR at present. However, high urea solution injection would lead to ammonia slip that makes secondary pollution.

## Formation of NOx:

Nox is one of the main component in the exhaust of the Diesel engines which is produced in the large quantity than other pollutants. A diesel engine always runs lean, with more oxygen than required to burn the fuel injected. As an inevitable result, the oxygen remaining is available to combine with the nitrogen in the air (about 70% of air is nitrogen). Some combination occurs in the high pressure and high-temperature environment of the combustion chamber, forming nitric oxide, nitrogen dioxide, and other less stable nitrogen oxides.

## Selective Catalytic Reduction (SCR)-

What is Catalytic Converter?

The exhaust gases pass through the Catalytic Converter and converted from harmful to harmless gases. Harmful gases like CO, NOx & HC from the exhaust of diesel engine are get converted into harmless gases through the Catalytic Converter.

Reducing agents:

Anhydrous ammonia, aqueous ammonia or urea reductants are currently used on SCR application. All those three reductants are widely available in large quantities.

Pure anhydrous ammonia needs no further conversion to operate within an SCR but it is extremely toxic and difficult to safely store. It is typically favored by large industrial SCR

operators. Aqueous ammonia must be vaporized in order to be used, but it is substantially safer to store and transport than anhydrous ammonia. Urea is the safest to store but requires conversion to ammonia through thermal decomposition in order to be used as an effective reductant.

Components of SCR:

1. DEF Tank – The tanks will store the DEF solution on the vehicle and be available in a range of sizes dependent upon total vehicle diesel fuel volume.
2. Dosing Pump – The pump provides pressure to send the DEF solution from the tank to the doser.
3. DEF Doser – The doser delivers the DEF into a mixing pipe where it is combined with the exhaust gas exiting the Diesel Particulate Filter (DPF).

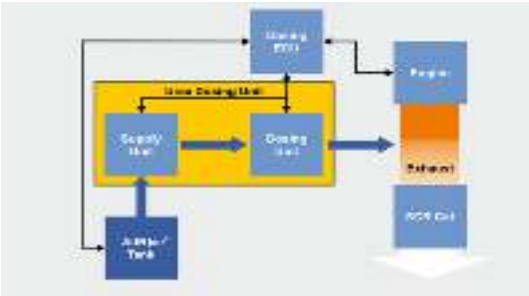

Fig 01: Schematic diagram of SCR system

## Reactions in SCR:

The NOx reduction reaction takes place as the gases pass through the catalyst chamber. Before entering the catalyst chamber the ammonia or other reductant (such as urea), is injected and mixed with the gases. The chemical equation for a stoichiometric reaction using either anhydrous or aqueous ammonia for a selective catalytic reduction process is:

$4NO + 4NH_3 + O_2 \rightarrow 4N_2 + 6H_2O$…… (1)

$2NO_2 + 4NH_3 + O_2 \rightarrow 3N_2 + 6H_2O$ …. (2)

$NO + NO_2 + 2NH_3 \rightarrow 2N_2 + 3H_2O$… (3)

With several secondary reactions:

$2SO_2 + O_2 \rightarrow 2SO_3$……. (4)

$2NH_3 + SO_3 + H_2O \rightarrow (NH_4)_2SO_4$… (5)

$NH_3 + SO_3 + H_2O \rightarrow NH_4HSO_4$…. (6)

The reaction for urea instead of either anhydrous or aqueous ammonia is:

$4NO + 2(NH_2)_2CO + O_2 \rightarrow 4N_2 + 4H_2O + 2CO_2$……... (7)

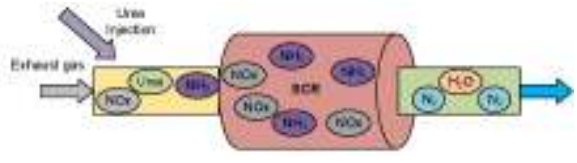

Fig 02: Conversion of Exhaust gases.

## Conclusion:

By referring through many papers and guidance, the SCR system is the most cost-effective system. NOx emissions from engines, incinerator and power plants are one of the most pro blematic pollutants. Since it is well known that NOx in the exhaust gases is e ffectively removed by NH3 in a catalytic reactor, which is called selective catalyti c reduction (SCR) Although the technology is more efficient, there are several drawbacks like ammonia slip, deposit formation, etc. that are associated with it. The nature of chemical reactions in the SCR converter is very complex, nonlinear, and difficult to measure. Accurately modeling and understanding the states in the converter across a wide range of operating conditions is still very challenging.

## Future work:

From here we are going to do some advancement in this SCR system. We will try different catalyst to reduce the value of NOx than the current value. This will reduce the value of NOx by 20-30% more.

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# Data Extraction and Classification of Machined Module Surface Structure Images Using Artificial Intelligence Techniques

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## ABSTRACT

In recent era use of artificial intelligence techniques for texture analysis of machined surface is gaining importance in the field of manufacturing. The developed vision system uses a CCD camera for scanning gray-scale images from an area of the machined workpiece Captured images of machined surface using Electric discharge machining, milling, sand blasting and shaping is decomposed in to sub images and then discrete wavelet transform is applied on the sub images. To select the base wavelet minimum permutation entropy criterion is applied and statistical features were calculated from the base wavelet. Training and testing of feature vector is performed using two artificial intelligence techniques support vector machine and artificial neural network for identifying textured surface images. training identification of textured images is obtained using support vector machine and artificial neural network testing identification of textured images is obtained using support vector machine and artificial neural network respectively. Results revealed that the present methodology identifies machined surface images with high accuracy.

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**Keyword** -**texture characterization; wavelet; support vector machine; artificial neural network**

## 1. INTRODUCTION

One of the important characteristics of any image in mechanical surfaces by different machine operation is Surface texture. Many researchers are studying to classify the different texture data by analyzing the images of the different machined surfaces using machine vision. There are an ample variety of applications of digital image processing using machine vision in machining processes such as work piece surface texture measurements. This technique has become the topic of interest because of its non-contact and online application. Machine operations like shaping [1], [2], milling [3], and grinding [4] the surface texture of machined surface images was evaluated by digital image processing. For texture analysis model-based techniques were used. In present condition, quality control as well as the performance testing of mechanical component plays an important role in the manufacturing and production. In the current study, a non-contact method using computer vision for identification of the surface texture using varying manufacturing processes like EDM, shaping, milling and sandblasting has been consider. In manufacturing applications, surface finish is a key parameter and surface metrology is used to evaluate surface texture. The method includes the study of surface texture and their correlation to the manufacturing processes which produces the component and evaluates roughness/texture of the component. To identify texture images from machining processes, Artificial Intelligence emerge as a promising technique. It has been used for classification or identification in the different fields like Fault diagnosis, EEG signals, manufacturing etc. Support Vector Machine, Artificial Neural Network, Naive Bayes, Random Forest are widely used techniques for classification of data.

## 2. METHODOLOGY

In the conventional approach for a given texture analysis various signal processing techniques are used to analyze texture images. Discrete Wavelet Transform (DWT) is another technique which is used to extract the wavelet

coefficients from different mother wavelet functions. Since manufacturing processes are generally complex in nature therefore complexity/uncertainty plays a significant role. In recent years Shannon entropy (SE) and Multiscale permutation entropy (MPE) emerges as a strong measure to detect the irregularity present in the signal. After comparing the values over multiple scales results revealed that MPE is useful to select the base wavelet [5] while Shannon entropy is useful for evaluation of the complexity of wavelet coefficients based on a single scale.

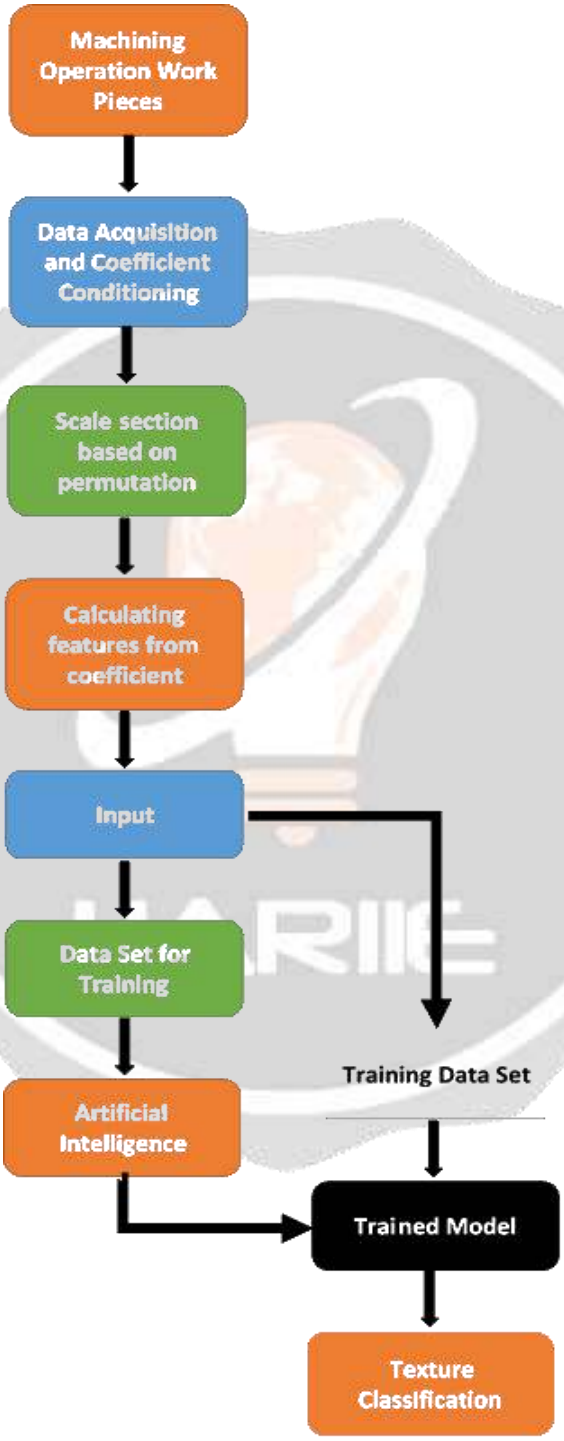


**Fig -1**: Surface Structure recognize methodology

## 3. EXPERIMENTAL SETUP

Experimental set-up for capturing texture images includes CCD camera, Image processor LC processing hardware with 4 frame buffers, Pulnix -TM6 and 1/30 s as a grabbing speed The schematic diagram is shown in fig. 2. Work piece is illuminated by a white light source which is inclined at 45o with the respect to work piece surface. Industrial interface is used to convert captured image into a digital image and the processed image was displayed on the monitor. The current study was carried out to identify machined surfaces obtained by applying different machining operations like Milling, Shaping, Sandblasting and EDM. Different surface textures images were obtained after capturing from CCD camera.

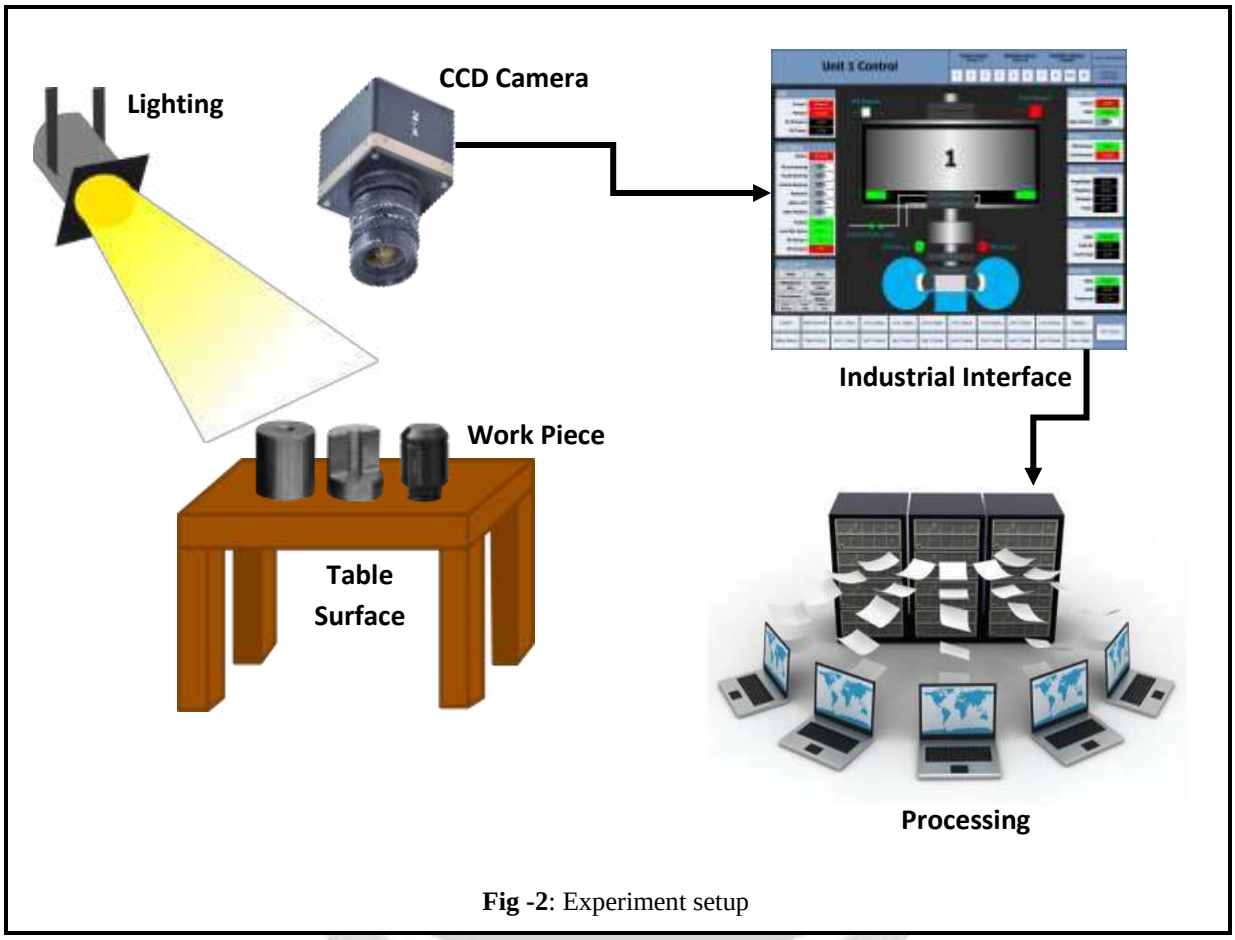


**Fig -2**: Experiment setup

## 4. FEATURES EXTRACTION

In the present study, the original image of machined component is subdivided into 16 equal parts having non overlapping images and then it is pre-processed by converting into gray scale through continuous 2D wavelet transform. Seven base wavelets viz. Symlets, Coiflets, Daubechies, Haar, Morlet, Reverse Biorthogonal and Biorthogonal are used to extract coefficients from Discrete Wavelet Transform (DWT) at the first level of decomposition (21 scales). Minimum permutation entropy criterion is applied to select the base wavelet. The coefficient which gives minimum permutation entropy was chosen and the different statistical features are calculated. Haar wavelet coefficients are selected since it is giving least permutation entropy. Twenty statistical features like Mean, Median, Maximum, Minimum, Range, Median Absolute, Standard Deviation, Mean Absolute Deviation, L1 norm, L2 norm, Maximum norm, Permutation Entropy, Energy, Shannon Entropy, Maximum Energy to Entropy Ratio, Log Energy Entropy, Sure Entropy, Threshold Entropy and Maximum relative Energy are extracted from wavelet coefficients obtained from the images of each machine operation.

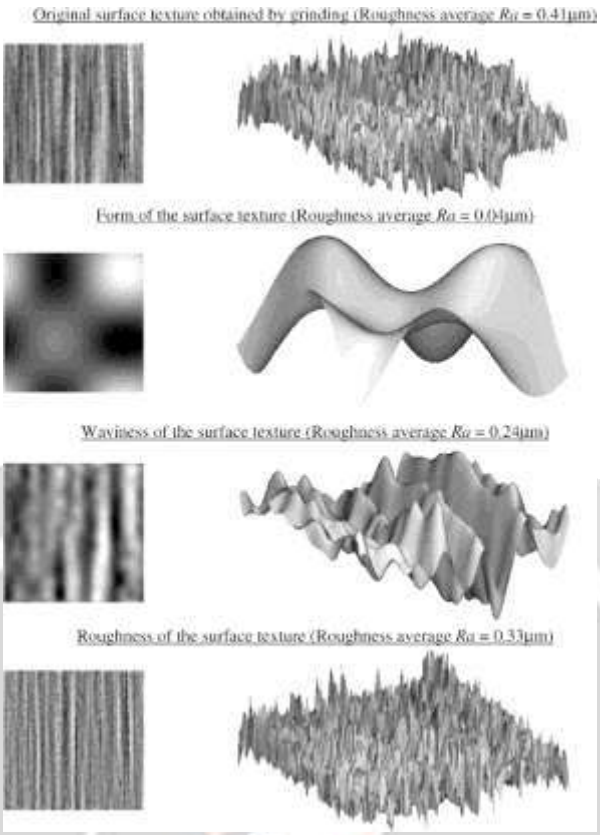


**Fig -3** Image of different machine operations

## 5. ARTIFICIAL INTELLIGENCE TECHNIQUE

A. Artificial Neural Network

Artificial neural network (ANN) has been developed and used for classification purpose. ANNs consist of interrelated processing elements known as neurons and it is adaptively changing its structure during learning stage [5]. ANN is a type of supervised learning method used for classification of features. Radial basis, multilayer perceptron are the types of methodologies used in ANN. In ANN weights are amend, for error minimization between ANN predictions and outputs.

B. Support Vector Machine

In 1998, Vapnik introduced a new statistical learning method based on the principle of structural risk minimization. A learning machine has prearranged several set of features with class labels and it's a supervised learning algorithm. In SVM, the optimal hyper plane separating the data can be obtained as a solution to the following optimization problem

$$Minimize \frac{1}{2}\|w\|^2 + C\sum_{i=1}^{M}\xi i \qquad (3)$$

subject to

$$y_i\left(w' x_i + b\right) \geq 1 - \xi i \qquad (4)$$

$$i=1,2,\ldots M$$

## 6. DISCUSSION

To identify texture surfaces of machined component Artificial Neural Network and Support Vector Machine techniques are applied on the features obtained through different machine operations like EDM, sandblasting, shaping and Milling. For illustration purpose, a sample feature vector (random) consisting of twelve features and four classes is shown in Table I. Total 64 instances are obtained from the four classes each class consist of 16 images. Training and Testing of feature vector is performed and evaluated using Artificial Intelligence technique. Table II shows the texture characterization efficiency using SVM and ANN. It is observed that both SVM and ANN gives 100 % texture characterization efficiency using training. When testing is performed on the feature vector then ANN gives 100 % texture characterization efficiency while SVM gives 87.5 % texture characterization efficiency. For testing of feature vector, one fourth of the whole data set has been taken as testing data. Table III shows the confusion matrix obtained when ANN is used as a classifier. It is clear that all classes are predicted correctly by ANN both for training and testing of data set. Table IV shows the confusion matrix obtained when SVM is used as a classifier. It is observed that SVM is able to identify all classes correctly when training on feature vector is performed, giving 100 % accuracy. For testing of feature vector SVM is able to identify three instances correctly out of four instances. Similarly, for Milling, SVM is able to identify two instances correctly out of three instances.

## 7. CONCLUSION

In the present methodology for texture characterization of machined surfaces, seven wavelets coefficients are compared and minimum permutation entropy criterion is applied to select the base wavelet. Haar wavelet is selected as a base wavelet and the coefficients obtained are used for calculation of twenty statistical features. Training and testing of feature vector is performed using SVM and ANN. It is observed form the result that ANN gives better texture characterization efficiency as compared to SVM. Based on the result obtain the proposed methodology is useful to characterize texture surfaces with high accuracy.

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# Effect of added Contaminants in Lubricants by Using Wear Debris and Vibration Analysis Technique

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***Abstract*—Condition monitoring of machines is determination of condition of machine and its change with time. Working condition of machines may be analyzed by measuring physical parameters like: vibration, noise, wear debris, temperature, oil contamination etc. Wear debris and vibration condition monitoring have great importance in machinery maintenance and fault diagnosis. This paper deals with effective analysis of both combined vibration condition monitoring and wear debris in machinery maintenance and fault diagnosis. Both techniques have their own merits and demerits associated with monitoring and fault diagnosis of machinery. However, it is seen from the past practical experience that using this techniques independently gives a small portion of machine faults diagnosis. But by combining both the techniques in a machine fault diagnosis it can provides most reliable information. The objective of paper is to analyses the co-relation between both techniques, which is achieved by experimenting worm gear box at different operating conditions, which is driven by electric motor. The worm gear box initially runs with normal conditions of working. A number of tests have performed with different contaminant particles added to various lubricants. Wear debris and Condition monitoring techniques were studied and results obtained are Compared.**

***Keywords*—*Wear debris analysis, Vibration analysis, Machine condition monitoring, Contaminant particles, Lubrication.***

## I. INTRODUCTION

Condition Monitoring sometimes referred to as Condition-Based Predictive Maintenance as its name suggests it is a condition based preventive maintenance program. Due to the high thermal and mechanical stresses worm gearbox lubrication oil is subject to degradation including corrosion, water and particle contamination that affect the efficiency of the worm gearbox and hence the overall performance. Vibration analysis has been widely applied to condition monitoring of rotating machines to identify incipient faults and facilitate root cause failure analysis in order to enhance the life cycle of rotating machinery.. Wang and McFadden investigated the use of vibration analysis as an early detection technique Tan *et al*, investigated the capabilities of the acoustic emission, vibration and spectrometric of lubrication oil for spur gears and how it affects the worm gearbox aging life cycle.. Fischer *et al*, state that lack of proper condition monitoring technique may lead to major failure to the whole system, thus, identifies and corrective actions to the main failure cause as well as a proper maintenance strategy selection will improve reliability of the wind Oil degradation leads to high thermal stress within the worm gearbox of wind turbine that increases bearing temperature and accelerates oil aging. Oil quality can be assessed through the measurements of some parameters such as level of oxidation, acidity, viscosity, water content, temperature and dissolved particles.

### *A. Wear Debris Analysis Vibration Analysis*

Wear particle analysis (WPA) is a technology that utilizes microscopic analysis to identify the composition of materials. WPA is a non-invasive examination of the oil-wetted components of machinery. The particle's size, shape and composition allow a process of elimination in which the abnormal wear of specific components can be identified. A lubricant sample is diluted with a solvent like tetrachloroethylene (TCE) and allowed to flow down a specially prepared low-gradient inclined slide while passing across a bipolar magnetic field. The force that attracts the particles is proportional to their volume, whereas the viscous resistance of the particles to motion is proportional to their surface area. When the ferrogram has dried, the wear particles and solid contaminants are stuck on the slide surface and are ready for examination under a microscope.[2]



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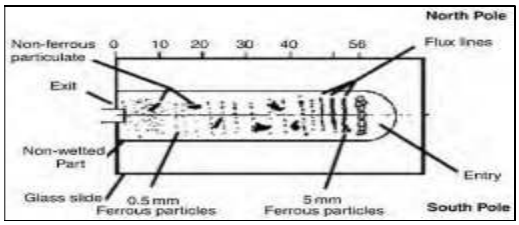


**Fig.1 Ferrogram.**

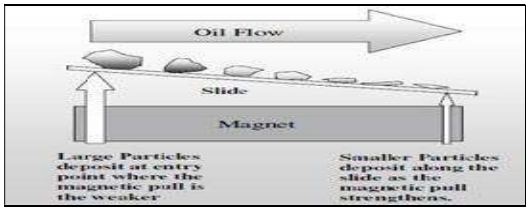


**Fig.2 Ferrogram – Schematic diagram**

### *B. Vibration Analysis*

Vibration measurements are widely used tools that have been around for decades for the monitoring variety of machines and their component. In general machines do not typically fail without some type of advanced warning, which in this case is measured as increased vibrations. Changes in both the speed and load of machinery will have a direct effect on the overall vibration levels of a machine. Most common methods for vibration analysis include measure the overall vibration of the system and spectrum analysis. Overall vibration readings are taken by examining the raw signal data from the transducers and acquiring the peak, peak-to-peak values of the signal. While this approach is simple it tends to be insensitive to considerable amplitude differences in amplitude of particular frequencies, although they make up only a small portion of the overall signal.

Uusing Fast Fourier signal processing software, the natural frequencies of specific structural components can be identified. Modal parameters are extracted from frequency data domain which is used to produce modal domain data. It also convert time domain to modal domain. While vibration monitoring used for providing quick and cost effective information, it is limited to monitoring the mechanical condition of the equipment, and not other critical parameters. Also, it is often difficult to apply monitoring at low speed machinery (less than 5 rpm).

## II. EXPERIMENTAL SETUP

Experimental setup used for the experimentation consisted of electric motor driven worm gearbox and loaded by agitating water within a reservoir tank via a paddle. It is consisting a screw worm which is driving member, that meshes worm wheel which is larger in size.[4]

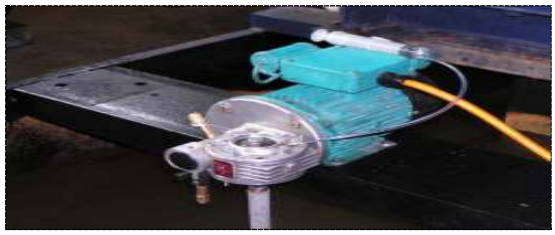

**Fig.3: Experimental set up**

Above figure shows experimental set up with assembly motor, worm gearbox, and shaft.

### EXPERIMENTAL METHOD

Five tests were conducted. First test relates to normal lubrication that is recommended oil to lubricate worm gearbox with normal working conditions. First test provides good comparison test with proceeding four tests. In Second Test, special operating conditions for worm gearbox have been created relating to the lack of lubrication. Here oil was changed with one forth viscosity that is recommended for test first. Third test introduces the contaminants to worm gearbox with normal operating lubrication conditions. Fourth test is involved in adding contaminants particle to recommended lubricants. In test five MH300.29 iron powder added to worm gearbox working under lack of lubrication [4]

For the entire test worm gearboxes were run for four weeks. In tests first and Second, worm gearbox was running continuously for full 4-week period, but for tests three to five involving in addition of contaminants in the lubricating oil, the system was running for 48 hours, after that it was flushed and cleaned.[4]

**Table.1 Experimental analysis- Test Results**

| Test No. | Lubricating oil | Contaminant particles |
|---|---|---|
| 1 | ISO VG 320 cSt | No |
| 2 | ISO VG 68 cSt | No |
| 3 | ISO VG 320 cSt | $SiO_2$ abrasive sand particles, Rockwell hardness of~700HRC. |
| 4 | ISO VG 320 cSt | NC 100 Iron powder, Rockwell hardness less than 10HRC. |
| 5 | ISO VG 68 cSt | MH300.39 Iron powder, Rockwell hardness less than 10HRC |

## III. RESULTS USING WEAR DEBRIS ANALYSIS

For to detect wear mechanisms and wear modes of the tests in detail particles were examined with standard optical microscope and then a confocal laser scanning microscope (CLSM). Particle type, all surface characteristics and colors were studied by using optical microscope. The CLSM facilitates to acquire sequential images for varying depths. Both boundary and surface definition of particles were obtained with CLSM. Surface roughness (Ra) is a numerical



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parameter used to describe surface roughness of the particles..

### C. *Wear debris analysis of test 1*

The ISO VG 320 cSt oil especially recommended for these applications which were used in test 1 on new worm gearbox. In test first, four slides were made from oil samples collected weekly for 4 weeks. Oil collected throughout test 1was clean and light in color. The Three major types of the wear particles correspond to rubbing, cutting and laminar wear were found in oil sample on first slide. Both crown gear and worm screw gear generates small rubbing and laminar particles. Few particles were found in slide 2 and decrease was because of few cutting particles. This indicate that there was an appropriate lubrication layer existed between two gear surfaces, and wear process was stabilized during the test.

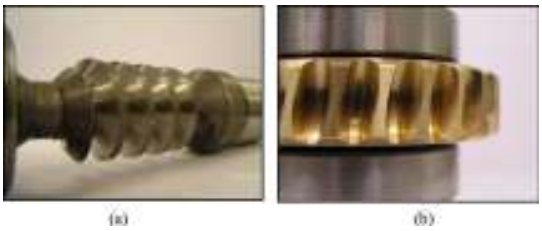

**Fig.4. (a) The new worm screw gear (b) the new crown gear.**

### D. *Wear debris analysis of test 2*

In test 2, the recommended oil was replaced with a general purpose ISOVG68 cSt oil. To avoid every possible cross contamination and compatibility issues, worm gearbox used in test first was completely cleaned and flushed. The oil samples were again collected on weekly basis for 4 weeks. Careful examination of slides from test second revealed that 5 types of wear particles rubbing, cutting, laminar, sliding, and fatigue particles were present on all slides. The decrease in particle size and number of slides four indicate that the surfaces were becomes smooth. The debris analysis shown in Table 2. The sliding particles constantly decreasing in the size during test Second, indicates that there is a lubrication problem that caused a significant amount of metal to metal contact. Substantial surface sliding contact broke away particles, and gradually smoothed the surface until the particle size was greatly reduced. Scratches caused from the worm screw gear's contact with the crown were evident. This indicates sliding and abrasion caused by high levels of metal to metal contact due to inadequate lubrication breakdown.

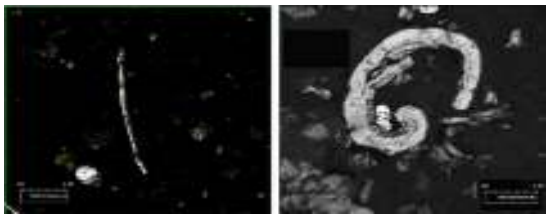

**Fig.5. Images of two typical cutting particles from test Second**.

**Fig. 6 (a) Worn surface of the worm screw gear after test Second**

**(b) Worn surface of the crown gear after test Second**.

Because of machining process, considerable particles on slide 4 have a straight or regular edge. Follows the trend explained above, the particles surfaces becomes rougher from slide 1 to slide 3, and then smoother in slide 4.

### E. *Wear debris analysis of test 3*

In test third, 1 gram of SiO2 abrasive sand particles was added to new worm gearbox with normal lubrication conditions by using ISO VG 320 cSt oil. The new oil and a measured quantity of contaminants particles were then added to worm gearbox. Inspection reveals that the significant wear has been occurred. Scratches along with the direction of contact the screw gear makes with worm crown. It can be linked to sliding and abrasion caused by the high levels of metal to metal contact. It was concluded that large particles were involved in the wear process and were thus broken down into numerous small particles, and larger particles sunk of the bottom of worm gearbox and was not get collected or have any connection with overall wear process. The contaminant particles were observed rather smooth, round and were reflective. Results of wear debris analysis for test three shown in Table 2

**Fig. 7 (a) Worn surface of the worm screw gear after test Third; (b) worn surface of the crown gear after test Third.**



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### *F. Wear debris analysis of test 4*

In test four, 0.5 gram of NC100 iron powder was added to the new worm gearbox under normal operating lubrication conditions by using the ISO VG 320 cSt oil. As compared to test first, size of the particles in test four is slightly larger. However, As compared to the wear debris analysis results from test three, there is significantly less wear of the worm gearbox by using the iron powder in test four, as compared to by using abrasive wear sand particles in test three. Posttest inspection of that gear surfaces have confirmed that the outcome of that wear test using the iron particles. The iron particles were observed to be somewhat clear and non-reflective. It was also noticed that the size of iron particles after each of test phase has decreased as that particles were breaking up during the running of the worm gearboxes. The summary of wear debris results for test four is given in Table.

### *G. Wear debris analysis of test 5*

In test five, 1 gram of MH300.29 iron powder is added to the new worm gearbox with the lack of lubrication condition by using the ISO VG 68 cSt oil. The similar procedure used in test three for oil sampling, and worm gearbox cleaning and flushing it was repeated for test five.

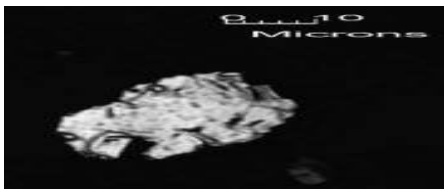


**Fig. 8 Representative laminar particle from test five.**

The chunky particles were similar to the fatigue particles, but it is also possessed with variety of features which are more common because of rolling contact between that teeth due to iron particles contaminated. Less wear of worm gear surfaces had been occurred as compared to test two, and there is significant life remains in worm gearbox. Vibration measurement was taken on the DE and NDE both of the worm screw and worm crown gears using a PCB ICP® accelerometer (PCB which is the manufacturer). Integrated circuit piezoelectric (ICP) sensors have built in, signal conditioning electronics which converts entire high-impedance charge signal generated by using piezoelectric sensor into the usable low impedance voltage signal. Hence, the ICP® accelerometer is a very suitable for the use in any dirty field of high temperature environments with the little degradation of signal.

**Fig. 9 (a) Worn surface of the worm screw gear after test Fifth; (b) worn surface of the crown gear after test fifth**

When manufactured, gears tend to be imperfect in the profiles of those teeth's. During these first few hours of the operation, high amplitudes and evidence of the wear generally subside, as this period is typically is the run-in period. As the gears wear, with the amplitude of the vibrations is observed in the frequency spectrum increases at similar frequencies. These peaks then broaden and develop sidebands. This presence of these sidebands is also provides an indication to the wear of gears.

## IV RESULTS USING VIBRATION ANALYSIS

### *H. Vibration analysis of test 1*

It was run at normal operating condition. In first test, the worm gearbox was comparatively worn free. Examinations of both time and the frequency domain plots are recorded over the whole duration of test one indicated that the worm gearbox is operating with minimum wear.

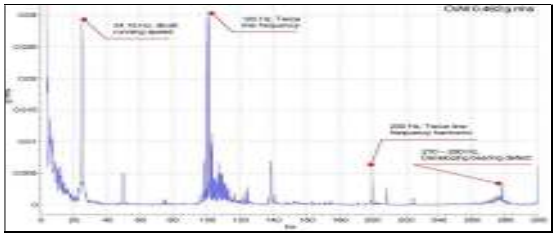

**Fig. 10 Acceleration–frequency spectrum of the crown drive end Vibration analysis- results of test no. Second**

The developed bearing defect was consistent with the inadequate lubrication, resulting into the increase in metal to metal contact with the formation of the scratches along with direction of the contact between the worm screw and crown gears.

### *I. Vibration analysis of test 3*

Fig.11 shows that the acceleration frequency spectrum is obtained at crown DE at completion of the testing. The frequencies which are present include the shaft speed peak, line frequency and twice the line frequency along with the harmonics, and outer race bearing frequency. This is the fact that the outer race bearing frequency which is present indicates a developing bearing problem. In addition to that, the region of increasing energy content and broadband noise in the frequency range of 220 to 340 Hz indicates that both have increased the wear and a\the bearing defect with the



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| Wear debris analysis | Test 1 | Test 2 | Test 3 | Test 4 | Test 5 |
|---|---|---|---|---|---|
| Particle number | low | high | Very high | Very high | Very high |
| Particle size (µm) | Several microns ~50 | Several microns ~100 | Several microns ~20 | Several microns ~50 | Several microns ~30 |
| Particle types | Rubbing, cutting and laminar | Rubbing, cutting, laminar and sliding | Rubbing, cutting | Rubbing, laminar | Laminar Rubbing and other small particles |
| Surface characteristics | Smooth surface 0.06 | Rough surface 0.26 | Smooth surface 0.48 | Smooth surface 0.13 | Smooth surface 0.18 |
| Overall observation | 90-95% ferrous, 5-10% bronze particles | 20% ferrous, 80% bronze | 30-35% ferrous particles, 65-70% bronze particles | 30-35% ferrous particles, 65-70% bronze particles | 30-35% ferrous particles, 65-70% bronze particles |

energy levels which are not significant or raised from baseline compared to test third.

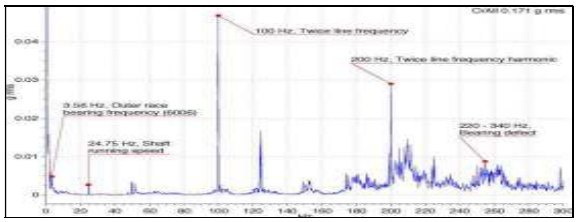


**Fig. 11 Acceleration–frequency spectrum of the crown drive end. Vibration analysis- results of test no. Third**

This region represents that the bearing defect and mound of energy indicates the increased wear.

### *J. Vibration analysis of test 4*

During test four, vibration amplitudes were shown aa slight increase in shaft running speed, which indicating an increase in wear rate.

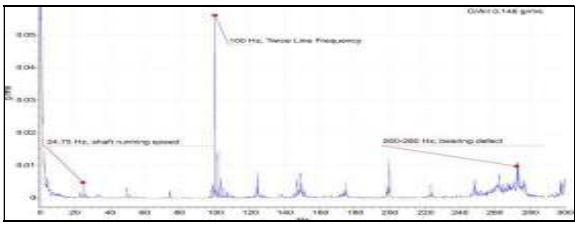


**Fig. 12 Acceleration–frequency spectrum of the crown drive end.**

**Vibration analysis results of test no. Fourth**

The harmonics of shaft running are also present. Fig. shows that narrowband region of the increasing energy content around 260 to 280 Hz, Narrowband region of the increasing energy content which is around 260 to 280 Hz, though the energy levels are not that much significant or raised from the baseline as compared to the test 3. Shafts running speed are also rises.

### *K. Vibration analysis of test 5*

Fig. shows that the acceleration frequency spectrum obtained at the worm crown DE at completion of test fifth. The specific frequencies which are present include the shaft speed peak and the line frequency, and twice the line frequency along with the harmonics. Now line frequency and its harmonics have observed due to the fact that the drive end of the worm gearbox which is directly fastened to the motor causing all vibrations that are directly transmitted through the shaft and housing.

**Table.2 Wear debris analysis- Test Results [4]**

**Result Using Vibration Analysis [4]**

Fig.13 also shows that numerous smaller harmonics of the running speed, which are attributed to the mechanical looseness within the worm gearbox. Even under the lack of lubrication conditions, there is no any noticeable bearing. fault that is developing from the vibration spectra that is attributed to anti wear properties of MH300.29 iron powder. Now the vibrations data have consistent with both wear debris analysis and posttest visual inspections

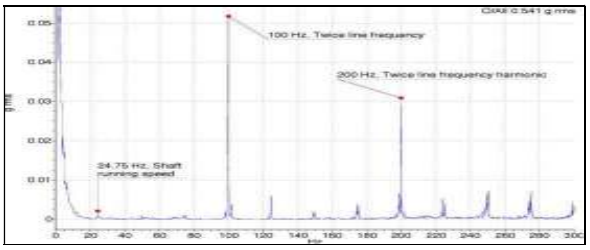


**Fig. 13 Acceleration–frequency spectrum of the crown drive end. Vibration analysis- results of test no. Fifth**

## V. CONCLUSION

- Both the wear debris and vibration analysis techniques were used to assess the condition of the worm gearbox and diagnose if any problems.
- Wear particle analysis provides most conclusive results Presence of these sliding particles due to metal to metal sliding is better indicator of the lubrication breakdown.
- The inclusion of the abrasive sand particles greatly accelerated the gear wear rate.
- Vibration analysis concluded that there is considerable damage of bearings due to motor problems.
- Three-body abrasive cutting is major contributor for abnormal wear results into catastrophic failure..



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- Vibration and oil analysis are most effective techniques for monitoring of machinery.
- Wear debris include the calculation of wear rate, metal in contact, and lubrication breakdown at boundary.
- Both the techniques are used to monitor the performance of worm gear under different working conditions.
- Both the techniques are used to monitor the performance of worm gear shows similar results.
- After comparison of results of both techniques, most appropriate analysis of condition of the experimental setup can be possible.

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# FRICTIONLESS MAGNETIC LEVITATION WINDMILL

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## ABSTRACT:

Magnetic levitation or maglev technology is a technique which is used to lift the objects with the help of magnetic field. Pressure of the magnetic field is used to supress the effect of gravitational and other forces. As wind is a form of renewable source of energy, it can be used to generate electricity by converting kinetic energy into electric energy with the help of wind turbine. The advantage of a maglev windmill over a conventional one is, mechanical friction is totally eliminated as the rotor is floating in the air due to levitation. Magnetic levitation (Maglev) is a method by which an object is suspended without any support with the help of strong magnetic field. Vertically oriented blades of the wind turbine are suspended in the air above the base by using neodymium magnet which produces magnetic force to lift up the plates.

By the principle of magnetic levitation, the friction is less in wind turbine. The system requires wind for operation and does not require the electricity to operate because no electromagnets are involved.

It can operate in wind speed as low as 1.02 m/s. This technology provides efficient output for power generation as compare to other wind turbine.

There are lots of materials published about the usage of these devices internationally and the real wind turbines are being sold.

## 1 INTRODUCTION

Wind turbines, like aircraft propeller blades, turn in the moving air and power an electric generator that supplies an electric current. Simply stated, a wind turbine is the opposite of a fan. Instead of using electricity to make wind, like a fan, wind turbines use wind to make electricity. The wind turns the blades, which spin a shaft, which connects to a generator and makeselectricity.

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## WIND TURBINE TYPES

Modern wind turbines fall into two basic groups; the horizontal-axis variety, like the traditional farm windmills used for pumping water, and the vertical-axis design, like the eggbeater-style Darrius model, named after its French inventor. Most large modern wind turbines are horizontal- axis turbines.

## SMALL WIND TURBINES ARE GENERALLY CATEGORIZED AS:

### Horizontal axis wind turbines (HAWT):

In these models the shaft is parallel to the ground. Although they must self-align with the wind, HAWTs are mechanically simple and require a relatively small „footprint" on the ground to mount and secure the tower. The majority of small and large turbines installed today are HAWTs

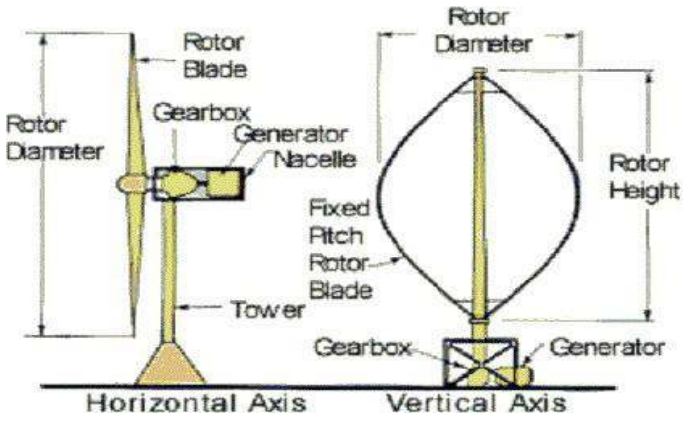


**Fig.1. Orientation of turbine**

### Vertical axis wind turbines(VAWT):

In these models the shaft is perpendicular to the ground. These turbines typically require a relatively large 'footprint' on the ground to mount and secure the tower.

## MAGLEV WIND TURBINE

Wind Power Technology has played a significant role in power production since decades. It is the cheapest available energy resource. Wind Power has become essential to use and can now be considered as a valuable supplement to conventional energy sources. Use of non-renewable sources is not sustainable because they take billions of years for formation. Example: According to BP, 53 years of oil left at current production rate. So these non-renewable sources, not only are in short supply but also extremely harmful to the environment. For centuries farmers have used windmills to harness the wind for benefit of mankind. Wind Turbine converts kinetic energy of wind into mechanical power. Mechanical power can be used for specific tasks such as grinding

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grain or pumping water. Generator helps to convert mechanical power to electricity.

The project dwells on implementation of a vertical axis wind turbine for the generation by using magnetic levitation. Maglev Wind Turbine was first presented at the Wind Power Asia Exhibition in Beijing 2007. India was the first country in Asia to develop wind power on a commercial scale. In July 2015, India had installed 23,588MW and is one of the countries in the world with most wind power on line. Currently, wind power has become commercially viable in India and the fact that 99 per cent of the investments in wind power are made by the private sector is a good indicator that wind power are made by the private sector is a good indicator that wind power can successfully compete with order sources of energy . The Wind Turbine is suspended without any support with the help of strong magnetic field, so it has less friction while rotating which is one of the merits of this Wind Turbine. This Maglev Wind Turbine gives more efficient output than any other horizontal axis Wind Turbine. Magnetic levitation (Maglev) is a method by which an object is suspended without any support with the help of the strong magnetic field. The repulsive force of magnets used for reduction of effect of gravitational force significantly. Magnetic force is used for reducing of gravitational force and to lift up the objects in air. By this technique implementation of this vertical axis wind turbine is used for having negligible friction.

**Fig.2 Magnetic Levitation Wind Turbine**

## 1. PROBLEM STATEMENT

1. To design and manufatyre magnetic levitation wind turbine prototype.
2. To compare magnetic levitation wind turbine with other vertical axis wind turbine.

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3. To estimate the amount of generation of electricity.

4. To generate electricity which will help light single bulb.

## 2. METHEDOLOGY

The aim of this project is to design and implement a magnetic levitated vertical axis frictionless wind turbine. The main advantage is to make this prototype is, it can be implemented under most working environmental conditions on any place or buildings and can be work in less wind. We selected this project to generate electricity. Power generation is directly proportional to size of assembly which majorly includes number of blades, number of magnets and number of coils. The basic prototype was made as per the calculations by using the components available in local market. The solid stable shaft was mounted on the base. The lower acrylic plate consists of copper coils fixed above on it. Another hollow oriented shaft was putted through the fixed solid shaft over which upper acrylic plate was mounted. Two big permanent ring magnets were attached between the two plates.

The vertically oriented blades were attached to the rotating hollow shaft. The wind turbine blades were rotated due to the force produced by wind, which leads to the rotation of the upper plate which consist of small magnets. Due to this, magnetic lines were cut by coils, through which magnetic flux get generated and produces EMF. The generated output EMF is measured by multi-meter.

## 3. DESIGN OF THE SYSTEM

With the proposed optimized turbine blade angles the mechanical structure is constructed as shown in Fig.4. The whole of the turbine system is set up to a common shaft and the mechanical bearing is replaced with a magnetic bearing that encloses two high power density NdFeB magnets. The magnets are positioned such that they generate the resilient force. This magnetic levitation concept used in this design aids in reducing the vibration effects and at the same time

increases the output power considerably. The PM assisted generator consists of 14 inner and outer coils with a set of permanent magnets. This is the modifications of the existing induction motor with the additional PM assisted field at the outer surface of the motor. This type of arrangements can be modified depending upon the speed constraints at different operating conditions. However the drawback of the cogging and effect of magnetic pull is not considered in this paper as the major purpose of this work is to demonstrate the implications of using magnetic levitation concepts in the vertical axis wind technology. Fig. 3(a) shows the cut way section of the modified generator used in this investigations. The prototype modified structure is shown in Fig.3 (d- e). Fig. 3(c) shows the levitation conceptual design with two magnets stationed with similar polarity facing each other.

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The corresponding flux flow is shown in Fig. 3(g). Fig. 3(f) shows the physical positioning of the magnets in the structure. This replaces the mechanical bearing in the conventional VAWT based system structure. The experimental setup is investigated for performance in the laboratory environment. Fig. 4 shows the characteristics of voltage speed at different wind speed. It can be inferred that the use of the proposed structure in the system increases the turbine speed and increase also the voltage generating capability. without magnetic levitation is compared under different loading turbine voltage is around 12V for a cut- in speed of 2m/s at a expected the performance is improved with the use of ML in the introduces the reduction in the vibration compared to that of t and thereby stable

the vibration is reduced by 30% compared to that of the turbine bearing. This proves the efficiency in terms of the operational cap VAWT in terms of performance improvements. Fig.5 shows the built in with the ML structure.

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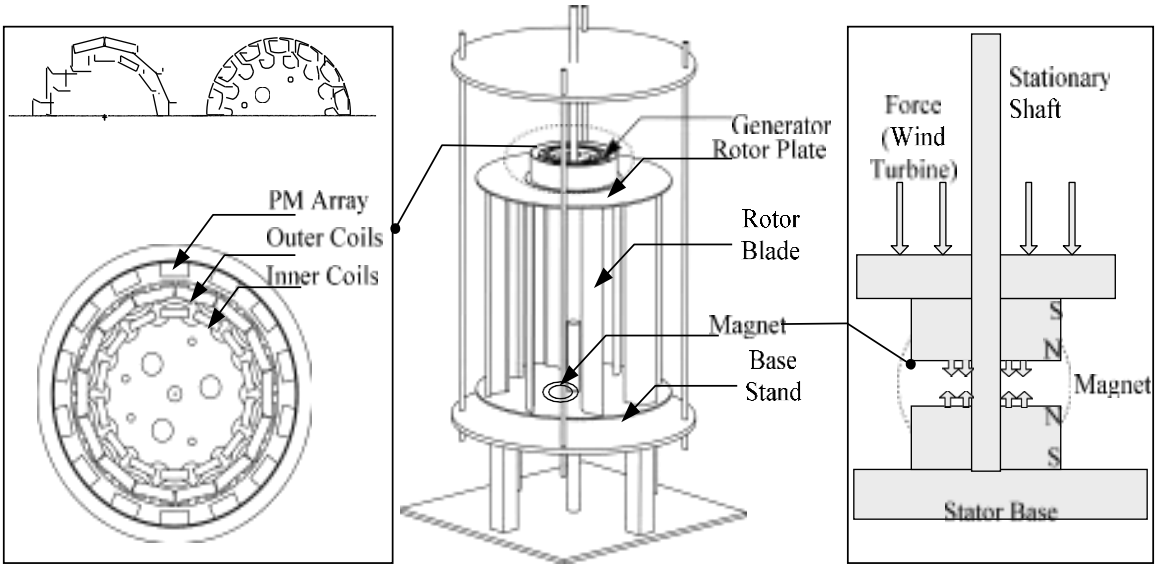
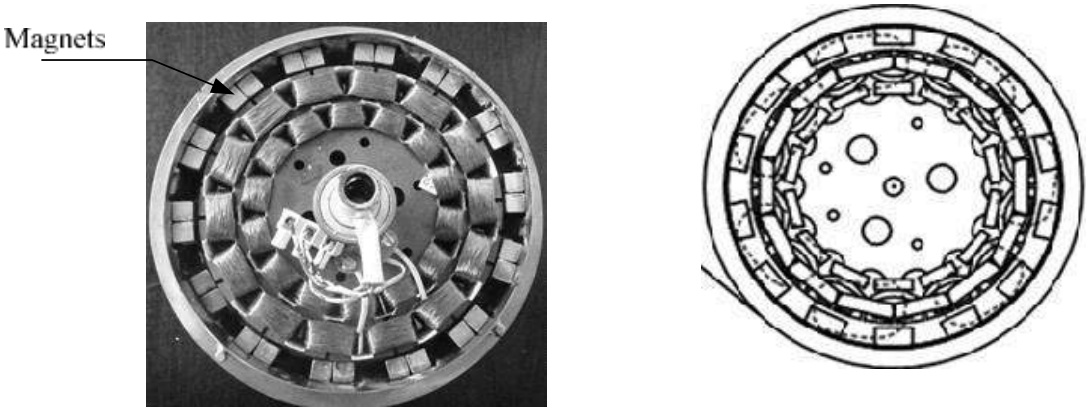



(a) PM assisted generator (b) ML-VAWT (c) Magnetic bearing




(d) Modified Induction motor as PM assisted generator

(e) Flux flow in PM assisted generator

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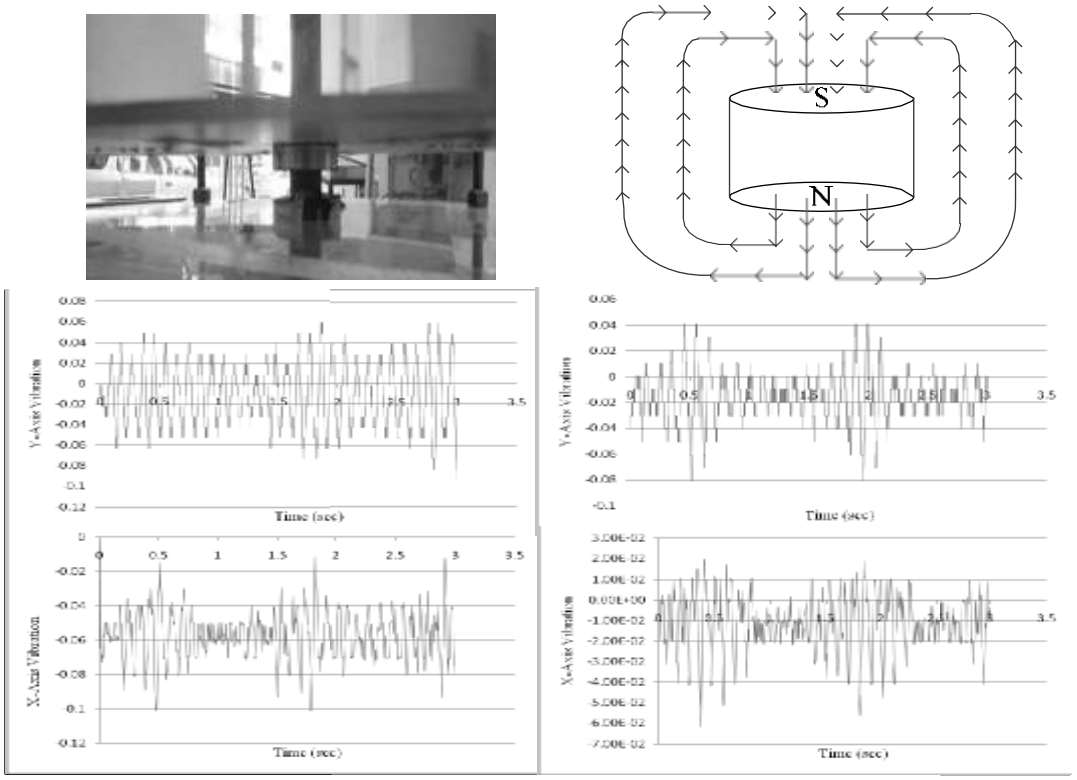
**(f)** MagneticBearing (g)FluxFlowintheMagnetSurface **Fig.3.ML-VAWT**

**structuraldesignconfigurations**




(a) Without levitation (b) With levitation

**Fig.4. Vibration analysis with and without levitation at a typical wind speed**


**Fig.5. Experimental setup of the ML- VAWT**

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## 4. CONSTRUCTION:

Theimplementationofthisprojectconsistofheavybaseonwhichashaftispunchedcentrally. Twoplatesareusedi.e. upperandlowerplatewhichismountedonshaft.Upperplatehaving 24smallmagnetswhichareattachedinround shapewhichisplacedalternativelynorth-south systematicallyandoneneodymiumringmagnetwhichismounted centrallyonthebottom face.Lowerplateisfixedonthebase.Thereare12coilsofcopperareattachedtoit.Eachcoil has280turnsandtheyareconnectedinseries.Turbineismountedontheupperplate.When the turbine rotatesby the wind sources, upper plate also rotates.

**Fig.6.RotorAssembly**

**Fig.7 Statorcoils**

## 5. WORKING OF SYSTEM

Therotorassemblyplacedwithhelpofwoodenrodoverstatorduetotwopermanentmagnets placedatcenterof statorandrotor,itprovidesrepulsiveforce,sotherotorandstatoris magneticallylevitatedbecauseofstrong repulsiveforce.Hence,nodesiredcontactbetween stator and rotor as well as the whole assembly become frictionless.Assoonasrotorrotatesduetowindthemagneticfieldofsmallneo-magnetsplacedatbottom of assemblygetsinducedincoils,soduetochangeinmagneticfieldtheACvoltageobtained at output of coils.

Theoutputvoltageisfunctionofwindspeed;thevoltagegetsvariedaccordingtomovement ofrotordue towind speed. Themore istherotationofrotor,more istheoutputvoltageand vice versa.

In addition, the RPM of rotor is measured using Arduino UNO controller. The IR sensor counts the rotation of blades and RPM is measured. This RPM is displayed on the LCD display as well as send to the mobile through Bluetooth module.

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Fig.8CAD Model

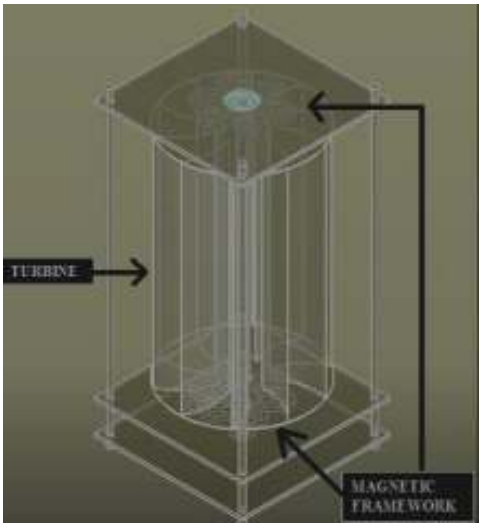


Fig.9 Prototype

## 6.TURBINE

## CALCULATIONS

**Density of air** = 1.225

kg/m^3 **Power**

**Coefficient(Cp)**=0.59

**For generating Power of**

**1 Watt, Radius =?**

$$\therefore P = Cp \times ½ \times \rho \times A \times V3$$

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= 0.59 × ½ × 1.225 × A × 27

∴ **A** = 0.1025

∴ **A**

= 2RH

0.1025

= 2RH

∴**R**= 0.1025/(2×0.25) ∵ Assuming **H** as 25cm = 0.25m

∴ **R** = 0.2m

**Therefore for generating Power of 1Watt from Turbine of Height 25cm Radius will be 20cm.**

∴ **Tip Speed Ratio**

**Circumference** = $2\pi r$

= 2 × π × 0.2

= 1.256m

**This is the distance that is travelled by the blade in one rotation.**

**Rpm at the tip of blade** =
52rpm

= 52rpm x 60min/h

= 3125.271rph

(revolutions per hour) **Distance the blade tip travels in 1 hour**=

3125.271x1.256

= 3925.34 m/hour

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**Tipspeedratio**= bladetipspeed/windspeed= 3925.34/(3x3600)

= 0.36

***Angular velocity (ω)*** = *(λ x v)* / r

= (0.36 x 3) /0.2

=5.4 rad/sec **Torque of**

**the turbine**

∴ **T** = 0.5 x Cp x ρ x Aw x $V^3$ / ω

= 0.5 x 0.59 x 1.225 x 0.1025 x 27 / 5.4

∴ **T** = 0.18 N-m

## 7. POSSIBLE OUTCOME

- Can generate power up to gigawatt.
- This turbine can generate power up to 60 watt.
- Friction less turbine so minimum losses.
- More energy generation rate.

## 8. FUTURE SCOPE

After few years maximum power generation would be done by using renewable sources , so it is very beneficial according to future point of view .

1. The home for the magnetically levitated vertical axis wind turbine would be in residential areas. Here it can be mounted to a roof and be very efficient and practical. A home owner would be able to extract free clean energy thus experiencing a reduction in their utility cost and also contribute to the *"Green Energy"* awareness that is increasingly gaining popularity. The maglev windmill can be designed for using in a moderate scale power generation ranging from 400 Watts to 1KW.

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2. Also it is suitable for integrating with the hybrid power generation units consisting of solar and other natural resources.
3. Power generated from this turbine can be utilized in remote places where traditional method of supplying power is costlier.
4. Power generated from turbine can be efficiently used for Street/domestic lighting and domestic appliances.

## 9. CONCLUSION

- Concept of magnetic levitation is successfully illustrated in this project.
- Rotor blades are designed using concept of aerodynamics and parameters like tip speed ratio, power coefficient, solidity, material used, design of blades, all are incorporated while designing.
- At the end of the project, the magnetically levitated vertical axis wind turbine was a success.
- This project demonstrates the utilization of the renewable resource (wind energy) in an efficient way. This type of generation can be used in remote places, where conventional power supply is uneconomic.

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# Dual Mass Flywheel

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Abstract— The Dual Mass Flywheel (DMF) is primarily used for damping of oscillations in automotive power trains and to prevent gearbox rattling. The dual mass flywheel (DMF) can create an improved driving experience for manual shift vehicles. Vibrations and noises that occur during vehicle operation are absorbed. Fuel consumption is reduced. This results in economical driving comfort. Dual mass flywheel is a multi-clutch device which is used to dampen vibration that occurs due to the slight twist in the crankshaft during the power stroke .When the power stroke subsides, the crankshaft untwists. One wouldn't think a crankshaft would twist to any significance, but any piece of metal always deflects a little when a force is applied to it. The rate that these vibrations occur is referred to as the torsional frequency. Transaxles experience torsional vibrations also. When torsional frequencies of the crankshaft match those of the transaxle an effect known as torsional resonance occurs, which may cause excessive wear on the drivetrain components.

**Keywords:** Flywheel, Gearbox

## I. INTRODUCTION

The rapid development of vehicle technology over the last few decades has brought ever higher-performance engines paralleled by an increased demand for driver comfort. Weight-saving vehicle concepts and wind tunnel optimized bodies now allow other sources of noise to be perceptible to the driver. IN addition, lean concepts, extremely low-speed engines and new generation gear boxes using light oils contribute to this. Since the middle of 1980, this advancement has pushed the classic torsion damper as an integral part of the clutch driven plate to its limit. With the same or less installation space available, the classic torsion damper has proved inadequate to outbalanced constantly increasing engine torque. Extensive development in this field resulted in a simple solution the duel mass flywheel (DMF) a new torsion damper concept for the drive train. All the referred papers referred to various generation methods of flywheel by which we can produce power and store in battery for further use, or method and implements to reduce the weight of the flywheel using composite material. In our case using the two spring two mass system and to produce useful vibrations which will be employed to increase the inertia of the system and thereby enable us to ether reduce the weight of existing flywheel or increase power output using existing weight of flywheel also we will be able to improve acceleration characteristic of given system.

In today's world power train control system need accurate torque information to perform various tasks... These tasks include for example the clutch actuation in automated manual transmission (AMTs) and duel clutch transmission (DCTs) as well as the control of electric motors in hybrid power trains. Indirect torque transmission is needed because the direct measurement of the transmitted torque using strain gauges cannot be done in volume production cars for economic reasons. One source of power train torque estimation is the engine itself. However, the torque estimation provided by the internal combustion engine is based on complex thermodynamic models. The periodic combustion cycles of a 4 stroke engine produce torque fluctuations which excite torsional vibrations to be passed down the drive train. The resulting noise and vibrations, such as gear rattle, body boom and load change vibrations, result in poor noise behavior and driving comfort. Here the possibility of torque estimation using the Duel Mass Flywheel is analyzed. Such that DMF is used to detect engine misfire which is similar to power train torque observation. The objective when developing he duel mass flywheel was therefore to isolate torsional Vibration from the drive train as much as possible caused by the engines rotating mass. Owings to its integral damper system, the duel mass flywheel almost entirely absorbs these torsional vibrations. The result is very good vibration damping.

## II. PRINCIPLES OF DUAL MASS FLYWHEEL

In a DMF design, the flywheel inertia is split up into two parts: the primary mass is still attached to the crankshaft while the secondary is belongs to the clutch. Both mass have two small stoppers, each one able to pick up two are springs. As the springs are deflected within the arc channel, they transfer torque from one flywheel to other. When the arc springs slides through their channel, friction adds damping characteristics to the DMF.

## III. EXPERIMENTAL SETUP

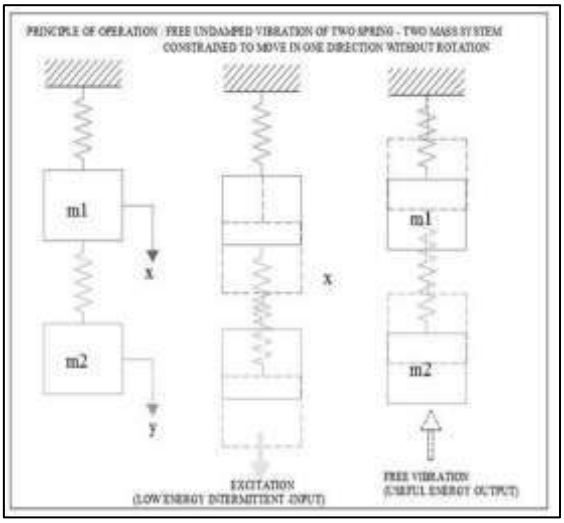



Fig. 1: Graphical Model of spring mass flywheel system

The figure shows free un-damped vibrations set up of two mass- two spring system. As shown in the figure the

input to the system is in the form of an low energy intermittent input from any power source (excitation) , this results in free undamped vibrations are set up in the system resulting in the free to and fro motion of the mass (m1)& (m2) , this motion is assisted by gravity and will continue until resonance occurs, i.e., the systems will continue to work long after the input (which is intermittent) has ceased……Hence the term free energy is used.

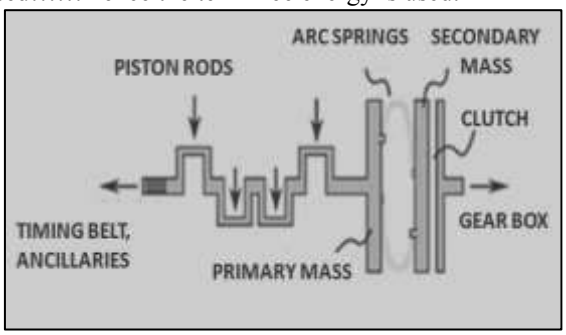



Fig. 2: Construction of Dual Mass Flywheel with Engine

From fig.2 we can conclude that using two such masses instead of a single rigid mass may be helpful for continuous rotary motion in case of flywheel. Therefore flywheel will be divided into two masses i.e., primary and secondary masses which will be connected by lubricated spring sets. It effectively isolates torsional vibrations.

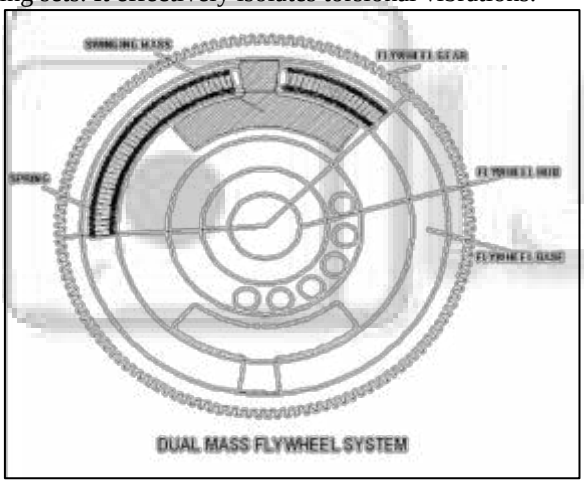



Fig. 3: Dual Mass Flywheel System

From Fig.3. it is clear that in addition to the mass of the flywheel , the couple owing to the centrifugal and centripetal forces keeps the flywheel into motion for longer time …thereby increasing the work done by the system…hence the output from the given system increases.

## IV. RESULT

### A. Conventional Flywheel

| Sr. | Load (gm) | Speed (rpm) | Torque (N-m) | Power (watt) | Effiency (%) |
|---|---|---|---|---|---|
| 1 | 1500 | 1315 | 0.4708 | 64.8516 | 31.63 |
| 2 | 2000 | 1275 | 0.6278 | 83.838 | 40.89 |
| 3 | 2500 | 1245 | 0.7848 | 102.332 | 49.91 |
| 4 | 3000 | 1205 | 0.9417 | 188.853 | 57.97 |
| 5 | 3500 | 1185 | 1.0987 | 136.361 | 66.51 |

Table 1: Result Table of Conventional Flywheel

Sample Calculation

1) Output Torque = W × 9.81× Radius of dyno-brake pulley
   Top = 1.5 ×9.81 ×0.032
   = 0.4708 N.mm
2) Output Power = 2πNT/60

$P_{out}$ =2π× 1310× 0.4708 /60
= 64.58 Watt

Efficency = (Output Power/Input Power)
= 64.58 / 205
= 0.3150 × 100
= 31.50 %

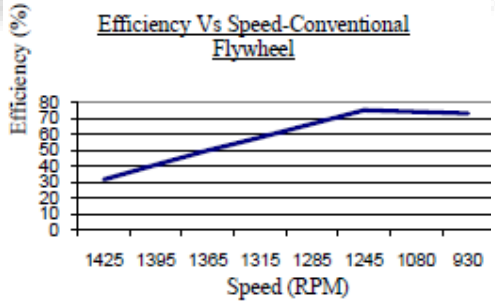
### B. Dual Mass Flywheel

| Sr. No | Load (gm) | Speed (rpm) | Torque (N-m) | Power (watt) | Effiency (%) |
|---|---|---|---|---|---|
| 1 | 1500 | 1425 | 0.47088 | 65.2513 | 34.27 |
| 2 | 2000 | 1345 | 0.6278 | 84.2461 | 43.11 |
| 3 | 2500 | 1365 | 0.7848 | 102.98 | 54.69 |
| 4 | 3000 | 1315 | 0.9417 | 119.17 | 63.22 |
| 5 | 3500 | 1285 | 1.0987 | 137.18 | 72.08 |

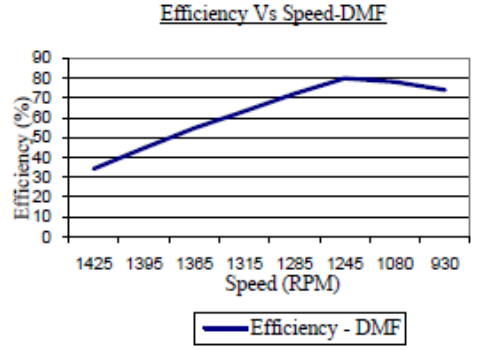
Table 2: Result Table of Dual Mass Flywheel.

Sample Calculation

3) Output Torque = W × 9.81× Radius of dyno-brake pulley
   Top = 1.5 ×9.81 ×0.032
   = 0.4708 N.mm
4) Output Power = 2πNT/60
   $P_{out}$ =2π× 1425× 0.4708 /60
   = 70.25 Watt
5) Efficency = (Output Power/Input Power)
   = 70.25 / 205
   = 0.3427× 100
   = 34.27 %




Graph of Efficiency Vs Speed for Conventional Flywheel




Graph of Efficiency Vs Speed for Dual Mass Flywheel

## V. ADVANTAGES

1) At low engine operating speeds fuel is saved.
2) Reduced drivetrain noise.
3) Reduced emissions.
4) Easily adjusted to vehicle design.
5) Long service life.
6) Outstanding vibration damping throughout the entire RPM range.

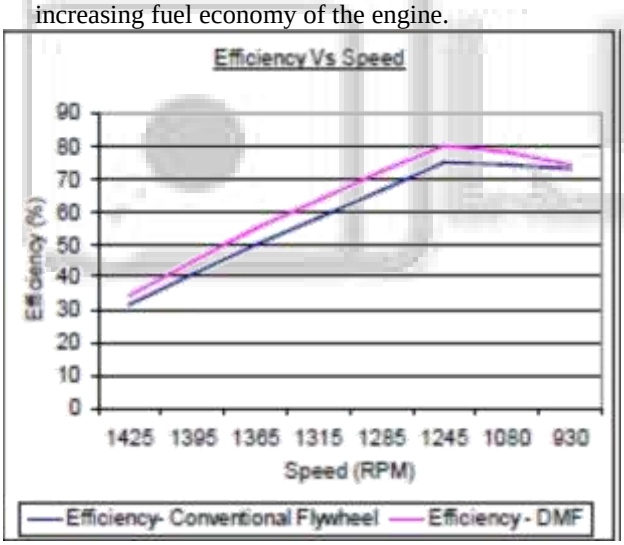
## VI. DISADVANTAGES

1) More expensive
2) Only torsional vibration will be considered.
3) Replacement cost is more.
4) It cannot be resurfaced and must be thrown away once worn.

## VII. CONCLUSION

At the end of these research work, after taking all the reading and doing calculations it is observed that this study have fulfill all the objective in it. And also with all the plots of parameter like power, torque and efficiency it concludes that;

1) It is observed that there is approximately 7-8% increase in power output by using the dual mass flywheel.
2) The dual mass flywheel is 5-6% efficient than conventional flywheel which will also result in increasing fuel economy of the engine.

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# Design and Fabrication of Weight Operated Material Handling System

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**Abstract -** *Material handling is main operation in industry. Material handling involves transfer of jobs from one machine station to another storage and packaging. Weight operated material handling device has large load carrying capacity, less or no maintenance. This project is basically weight operated material handling device. This device has more reliability. This material handling equipment paper is not only based on for material handling, it is not required external power i.e., electrical, it totally operate and depends on weight of material or job. Industrial material handling device are operating on electrical power but this device does not required electricity, it is operating on weight of job.This project develops the problem of different types of material handling equipment in a typical material handling system. Spring operated material handling equipment has large load carrying capacity, easy maintenance and high reliability of operation. Material handling equipment is the media of transportation of material from one point to another in a commercial point or space.*

***Key words— material handling1, less cost2, free energy, 3 less maintains4.***

## 1. INTRODUCTION

Material handling is process of movement of job or material from one place to another place i.e. from one machine to another store room to machine shop or from machine shop to store. In many industries material handling is automated but it requires more electricity and it is main contribution of price of the product. Some small-scale industries material handling is manually material handling is risk full or harm full to workers or manpower. This may lead to back pain or muscular pain. This material handling device eliminates the manual material for short distance between two machine stations. These material handling devices also reduce the pries of the product by minimizing material handling cost. These also reduce the cost of power. In this device potential energy of the job is used to transfer of the job. Nowadays, major, medium as well as small local automotive manufacturing industries are experiencing rapid development in concept of technology and system applied, resulted by stronger domestic and global market demands. As the companies grow, the need for efficient material handling system also arises especially in the manufacturing area.

Material handling system is one of the basic components that complement the whole manufacturing operation. Material handling system basically refers to any equipment, activities and procedures related to the moving, storing, controlling and protecting of materials flow in a manufacturing system. It provides the manufacturing system with smooth material flow without excess inline and outline inventory. The material handling system is categorized as non-value added (NVA) activities which implying that the less material handling involved is the better. However it is impossible to totally eliminate the material handling activities in any manufacturing operation. Hence an efficient and effective material handling system is always the ultimate objective by many companies. Material handling operations involve raw material movements, subassemblies; work in process (WIP), tools, finished products, and other support materials from one point to another in the plant. Basically material handling equipment is used to the picking an object from one place and travel to it and place at another location without much power of man wasting.

A material handling equipment is separated into four main parts :-
1) Storage and handling equipment,
2) Engineered systems
3) Industrial trucks,
4) Bulk material handling.

According to industrial review the power or electricity which has been utilized for production out of which 32 to 35% of power is only utilized for material handling during the product ion which is unnecessarily wasted and hence the total value of final product will increase. So, if we want to decrease

the total value as well as the unnecessary electricity consumption either we have to reduce material handling or try for alternative handling like that this concept. As the first option has several limitations we are trying for alternative handling system like that weight operated material handling equipment.

## 2. LITRATURE REVIEW

### A. Overview of Material Handling:

Material handling (MH) involves ―short-distance movement that usually takes place within the confines of a building such as a plant or a warehouse and between a building and a transportation agency.‖1 It can be used to create ―time and place utility‖ through the handling, storage, and control of material, as distinct from manufacturing (i.e., fabrication and assembly operations), which creates ―form utility‖ by changing the shape, form, and makeup of material. It is often said that MH only adds to the cost of a product, it does not add to the value of a product. Although MH does not provide a product with form utility, the time and place utility provided by MH can add real value to a product, i.e., the value of a product can increase after MH has taken place;
for example:

• The value (to the customer) added by the overnight delivery of a package (e.g., Federal Express) is greater than or equal to the additional cost of the service as compared to regular mail service—otherwise regular mail would have been used.
• The value added by having parts stored next to a bottleneck machine is the savings associated with the increase in machine utilization minus the cost of storing the parts at the machine.

### B. Design of MH Systems:

A common approach to the design of MH systems (MHSs) is to consider MH as a cost to be minimized. This approach may be the most appropriate in many situations because, while MH can add real value to a product, it is usually difficult to identify and quantify the benefits associated with MH; it is much easier to identify and quantify the costs of MH (e.g., the cost of MH equipment, the cost of indirect MH labor, etc.). Once the design of a production process (exclusive of MH considerations) is completed, alternate MHS designs are generated, each of which satisfies the MH requirements of the production process. The least cost MHS design is then selected. The appropriateness of the use of MHS cost as the sole criterion to select a MHS design depends on the degree to which the other aspects of the production process are able to be changed. If a completely new facility and production process is being designed, then the total cost of production is the most appropriate criterion to use in selecting a MHS—the lowest cost MHS may not result in the lowest total cost of production. If it is too costly to even consider changing the basic layout of a facility and the production process, then MHS cost is the only criterion that need be considered. In practice, it is difficult to consider all of the components of total production cost simultaneously, even if a new facility and production process is being designed. Aspects of the design that have the largest impact on total cost are at some point fixed and become constraints with respect to the remaining aspects of the design.

### C. Principles of Material Handling:

Although there are no definite ―rules‖ that can be followed when designing an effective MHS, the following ―Ten Principles of Material Handling,‖3 as compiled by the College-Industry Council on Material Handling Education (CIC-MHE) in cooperation with the Material Handling Institute (MHI), represent the distillation of many years of accumulated experience and knowledge of many practitioners and students of material handling:

• **Planning Principle.**
All MH should be the result of a deliberate plan where the needs, performance objectives, and functional specification of the proposed methods are completely defined at the outset.
• **Standardization Principle.**
MH methods, equipment, controls and software should be standardized within the limits of achieving overall performance objectives and without sacrificing needed flexibility, modularity, and throughput.
• **Work Principle.**
MH work (defined as material flow multiplied by the distance moved) should be minimized without sacrificing productivity or the level of service required of the operation
• **Ergonomic Principle**
Human capabilities and limitations must be recognized and respected in the design of MH tasks and equipment to ensure safe and effective operations.
• **Unit Load Principle.**
Unit loads shall be appropriately sized and configured in a way that achieves the material flow

and inventory objectives at each stage in the supply chain.

**• Space Utilization Principle.**

Effective and efficient use must be made of all available (cubic) space.

**• Automation Principle.**

MH operations should be mechanized and/or automated where feasible to improve operational efficiency, increase responsiveness, improve consistency and predictability, decrease operating costs, and to eliminate repetitive or potentially unsafe manual labor.

**• Life Cycle Cost Principle.**

A thorough economic analysis should account for the entire life cycle of all MHE and resulting systems.

## 3. Problem Statement:

The normal material handling systems & conveyor assembly normally involves the use of channels, rollers and shaft that are heavy by virtue of their structure and the material used as steel also they will have operated on power sources. There is continuous power consumption. To overcome this problem, we can use weight & spring-operated material handling system.

## 4. Objectives: ,

1) To make use of mechanical material handling devices to reduce manual work.

2) To ensure safe, effective and flexible material handling.

3) To arrange material and material handling devices in a manner, not to disturb the production activities.

4) To make use of gravity forces for material movement, wherever possible.

5) To use the principle of containerization, unit load or palletization and move optimum number of pieces at a time.

## 5. Work methodology to solve the problem:

**Step 1:-** Identification of problem: In day-to-day life electrical energy have evolved as one of the most basic needs of human being. We know that for the material handling we need to more human effort and need of more electrical energy. Today we required material handling equipment should be cheap and challenge to safe. To reduce material handling cost so we choose material handling equipment for our project work.

**Step 2:-** Literature Survey: Various studies have been made in different industries to indicate that the cost of handling alone accounts for about 20-25% for the total manufacturing cost.

**Step 3:-** Design of Mechanical Part: This phase involves the design of various elements such as spring, shaft & gear.

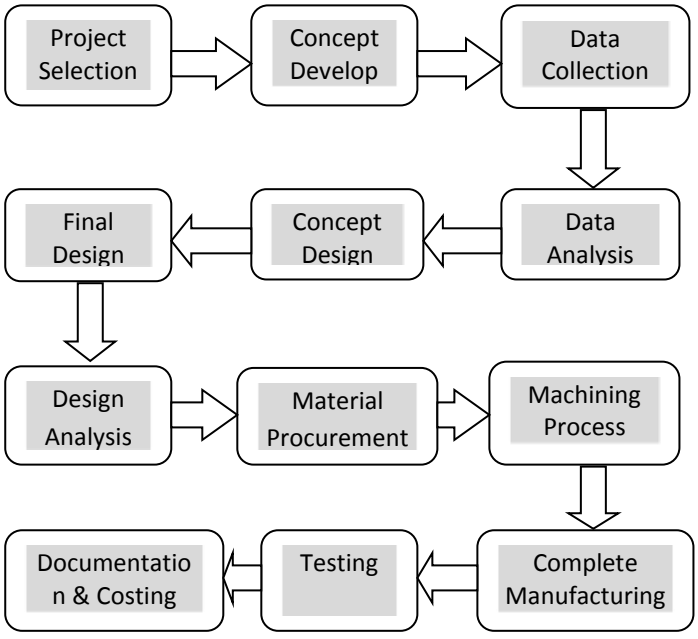
**Step 4:-** Software Modeling: Detailed drawing using AUTO-cad software, creo software ANSYS software. Designed part is drawing using AUTO-cad.

**Step 5:-** Fabrication: All the designed elements are manufactured in the workshop such as frame, shaft as per design and also select the part as per specification for e.g. rack and pinion, support rod chain and sprocket etc. Upper frame, lower frame, cross bar are manufacturing in workshop

**Step 6:-** Assembly: All the manufactured and selected parts are assembled together. The assembly of the equipment is in two steps

1. Assembly of main frame with Rack & Pinion.
2. Assembly between main frame and cross bar tension mechanics.

## 6. Process flow chart:



## 7. Design of the Model

## 8. ADVANTAGES& LIMITATIONS

### 8.1. Advantages:

1) It can handle the job without any power consumption at packaging& machining destination with prepared time limits.
2) Machine work on the no power consumption.
3) It increases the safety and working condition.
4) Only simple support structures are required
Design & fabrication is easy.
5) It is a faster material handling process.
6) Initial investment is low.
7) More accurate and economical in mass production Packaging.
8) It minimizes misalignment & less floor space is required.

### 8.2. Limitations:

1) This material handling system can perform a motion only within design length maximum 4-5 feet.
2) This material handling system is required precise alignment of all moving parts to perform more rigid & smooth operation.
3) If any transmission losses & misalignment in system, it will affect the distance travel.

## 9. CONCLUSION

We conclude that we completed project named Material handling equipment It works on the self-weight of job object which has to be transfer from one place to another place without using electricity or fuel. By using this system we save energy as well as save cost Material handling equipment is the media of transportation of material from one point to another in a commercial point or space. Industrial material handling device are operate on electrical power but this device does not required electricity, it is operate on weight of job. Hence we are satisfied with our work.

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# GROUNDNUTS SEPERATION MACHINE

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**Abstract –** *Generally two types of methods are there present in India to separate the groundnuts from the plants. One is manually means by hand cut the single groundnut from the plant and another one is keep the plant in sunlight for the 15 to 20 days and then put in automatic machine in bulk. But there is some limitations and problems to handling with this two technique. From one, Fingers get wears and damage due to continue working and also work is not more efficient. One person can maximum cut the groundnuts 20-25 kg per day. This work is doing humans that means performance get reduced in next day. From this all we can conclude that first method is not reliable. Now let's talk about second method, First problem with this method is that machine is too bulky and costlier, so this is not reliable for smaller landholder/Farmers. Another problem is quality of groundnuts is not too good. From this all we can say till now we were not any reliable and quality mechanisms for separate the groundnuts from the plant. But Now Me and my partner innovated new mechanism for separate the groundnuts from the plant manually. Mechanism is manual machine, by using this mechanism we can cut groundnuts at time 3 plants. From the practical we get output of this machine is minimum 500 kg per day. Only two people is need to operate this machine. This most reliable cost for everyone. Main things is maintenance costs is about negligible. In this machine we used the spooked wheel, which can attached to handle with gear and chain mechanism. All things covered with proper metallic casing to insure the safety.*

***Key Words***: Groundnuts, reliable, cutting machine, Gear and chains, metallic casing.

## 1. INTRODUCTION

Now it's time to focus on development in agricultural techniques. Because conventional techniques are not too good in performance as well as time required to complete that process is to large with needs more man power. So we are introducing new mechanism for agricultural development and that is groundnut separator machine. If we think about present, then some mechanical and electrical operated mechanism are there. But as per abstract there is so many problems with that all mechanism. So in this mechanism we tried to solve that kinds of problem. In this mechanism machine will operate manually with least power, only two human are needed to operate this machine and this machine will work of 10 to 15 human per day. Apart from two, one person have to rotate the handle and another one have to put that groundnuts plant in the machine. So this is the very simple way to separate groundnuts from its plant. Machine contains spoke type wheel as cutter and chain sprocket type assembly is connected to handle which have circular motion.

Now-a-days climatic condition also a reason for unavailability of workers in these fields. With the use of groundnut thresher, farmers can do their harvesting operations and do their work at right time which helps in prevention of damage of groundnuts due to late harvesting or unavailability of workers at needed time.

**MODEL DIAGRAM:-**

Fig (1) model diagram

**PARTS OF MACHINE:-**

**a) Cutter:-**
In this machine cutter is used as rim and spoke type assembly is used. This rim is mounted on axel. Diameter of rim is used as 75 cm and diameter of spokes are 8mm.

**Fig (2) cutter**

**b) Chain and sprocket:-**
There is two sprocket are there, one is connected to axel another one is connected to handle. This two sprocket is inter connected with help of chain. Same arrangement as bicycle.

Fig (3) chain and sprocket

**c) Intermediate gear:-**
There is one intermediate gear placed between two axel and front sprocket, purpose is that to avoiding slippage of chain.


Fig (4) Gear

**d) Bearing :-**

A bearing is a mechanical element that's constrains relative motion to desired motion as well as reduce friction between moving parts. In this we used two ball bearing at axel and intermediate gear respectively.

Fig (5) Bearing

**e) Axel:-**

An axel is a central shaft for rotating gear. It simply supports the rotating member. This member is non-movable. In this machine rear all assembly is mounted on this axel.

Fig (6) Axel

**f) Square pipe:-**

Simple steel square pipes are used in this machine for structural arrangement purpose. This arrangement supports whole mechanism.

Fig (7) Square pipe

**g) Casing:-**

In machine metallic casing is used. Simple steel sheet is used. Purpose is

- To avoid spreading groundnuts during operation.
- To protect inner parts from atmospheric debris and dust.
- Protection to injuries

Fig (8) Metal sheet

**Layout diagram:-**

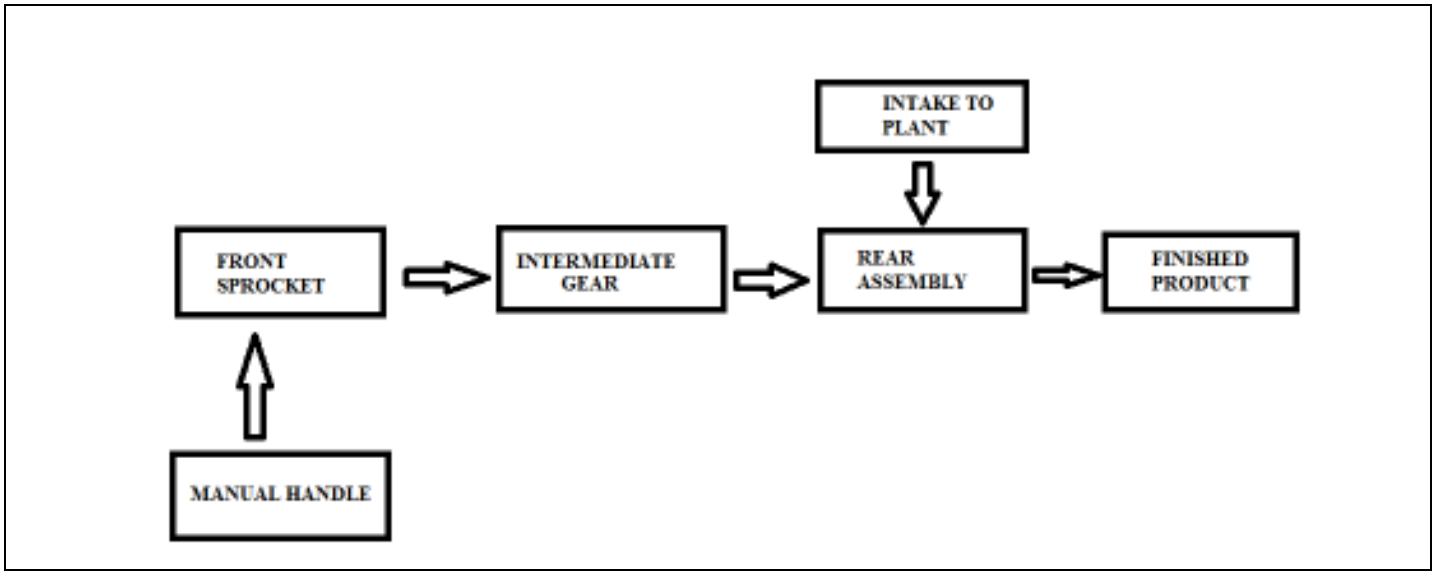


Fig (9) Layout

**PROCEDURE:-**

Step to follow for this machine is as follow,

- Take 4 to 6 plant in bunch
- Hold this bunch at intake position , and hold it till all groundnuts is not separated
- Then start moving handle at manual handle position
- This circular motion is get transferred to rear assembly through chain and sprocket mechanism
- Now motion is reached to cutter and groundnuts get separated and falls down on net
- Net is kept as tapered to separate groundnuts from mud and dusts
- Finally finished groundnut get at finished product position.

**MATERIALS:-**

| Elements | Material |
|---|---|
| Cutter | Stainless Steel |
| Sprocket | Stainless Steel |
| Chain | Steel |
| Bearing | SAE52100 |
| Axel | Steel |
| Net | MS |
| Square Pipe | MS |
| Casing Sheet | MS |

**ADVANTAGES:-**

- Easy to operate
- Least maintenance
- Less injuries
- More life span
- Less cost
- More productive

**DISADVANTAGES:-**

- Oiling is necessary
- Two people is essential to operate this machine

**CONCLUSION:-**

So in this way we conclude that groundnuts can easily separate with the help of this mechanism. This is the simplest method. . So in this mechanism we tried to solve that kinds of problem. In this mechanism machine will operate manually with least power.

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# SOLAR POWERED BATTERY OPARATED ELECTRIC BIKE

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## ABSTRACT

Present rendition of Electric bike accessible in business sector is not self-charging and this bike endures with more weight. Such bicycles utilized for short separation. The expressin "SOLAIR" (Self charging electric bike) is utilized to depict "Electric-engine controlled bikes," including both completely and incompletely engine fuelled bikes. This anticipate is comprise six separate parts: The Battery, Dynamo as a wind generator, the BLDC engine, controller, charging framework and sun oriented board. Utilization of disentangled Mechanical outline and less weighted dry cell batteries to defeat the above issues. Wind- sunlight based blend is utilized for self-charging. Because of that bike get to be brilliant and pace is expanded. Charging time required for battery of this bike is less and releasing time is more. A few parts, for example, engine, controller, battery, senator were introduced in like manner bike, it is called electric bike. The rate of electric bike is controlled by controller, which guarantee the electric bike security and it is additionally the centre part. Fulfilled capacity of limit discovery, under- voltage insurance et cetera, as a result of PIC16F72 was taken as the principle control chip, make present day electric bike progressively more have a tendency to be wise. The main thrust of customary electric bike totally originate from engine, it diminish battery life extraordinarily as well as waste more power vitality. The configuration is exceptionally productive, savvy, and one day mass-made, particularly in creating nations where car transportation is an unthinkable. Here, the self-charging electric bike business sector would profit by further research both on the battery and on the drive innovation and their utilization with electric bikes. A self-charging electric bike in light of a brushless de engine drive which has high effectiveness, zero contamination, spotless and helpful, is then planned and executed in this anticipate.

**Key words: Solar Panel, Battery, DC Motor, Thtrottle.**

## INTRODUCTION

Right when considering possible senior exercises, we overall inferred that we expected to fulfil something that would by some methods be useful to the planet. We picked that the electric bicycle would be the best fit. The electric bicycle offers an all the more spotless other choice to travel short-to-moderate detachments instead of driving a gas controlled auto. Starting late, the World has logically bolstered a cleaner circumstance and less dependence on outside oil. The expense of foul petroleum has extended on a very basic level over the span of late years and there is all in all no turning back. The earth has in like manner been to a more prominent degree a middle all through the world in the past couple of years, and it gives the idea that cleaner alternatives have been reliably on the rising with not a solitary end to be found. The electric bicycle is an errand that can progress both

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cleaner development and moreover a lesser dependence on oil. It will continue running on clean electric power with the ability to resuscitate the battery 3 separate courses: through the 230 VAC divider source, by creating power through the dynamo-sun based blend. An extra point of interest to building the electric bicycle is that it can in like manner show the general populace how a great deal less costly it would be to change over their typical bicycle into an electric bicycle instead of driving solely in their gas-powered vehicles. The more conspicuous importance of the earth on the planet prompts an open entryway for understudies in our position. With the economy endeavouring to escape a standout amongst the most perceptibly dreadful downfalls of the century, there are different open entryways for us to help. This is our opportunity to contribute a greener and more profitable planet. Bleeding edge electric bicycles join various advancements from development and arrangement, particularly in the earlier year. These progressions charm for the thought of various customers. The time is right biological and fiscal motivations favouring electric vehicles have never been more critical, nor the choices so contrasting, for such a substantial number of people. A couple parts, for instance, motor, controller, battery, delegate were presented in like way bicycle, it is called electric bicycle. The pace of electric bicycle is controlled by controller, which ensure the electric bicycle security and it is furthermore the middle section. Completed limit of point of confinement revelation, under-voltage protection and so on, by virtue of PIC16F72 was taken as the rule control chip, make propelled electric bicycle continuously more tend to be insightful. The primary force of customary electric bicycle thoroughly begin from motor, it diminish battery life remarkably and squander more power essentialness. The trust is that this framework can end up being astoundingly capable, fiscally canny, and one day mass-conveyed, especially in making countries where auto transportation is an unfathomable probability. Each of these will be based upon and upgraded advance anyway this is our opportunity to contribute a greener and more capable environment.

## OBJECTIVE

The objectives of this project are to:
1) For Using Of electric bike we reduce polution
2) To reduce fatigue stress of human body.
3) for reducing dependency in Fuel dependent Vehicle

## LITERATURE REVIEW

The paper presents a review on Portable Electric Bike (PEB). This was first developed in 1890's in US and those were documented within various US patents. On 31st Dec, 1895 Ogden Bolton designed a battery powered cycle. He designed using 6 pole brush and commuter DC hub motor connected to the rear wheel. He was then granted a US patent. Couple of years later, Hosea W. Libby invented electric bike which was propelled by double electric motor. This motor was so designed that it was attached with the crankset axle. Later in 1990's torque sensors and power controls were developed including some modified versions of bike with NIMH, NiCad and/or Li-ion batteries which offered lighter, density capacities batteries. But this bikes faced decrease in production when petrol and diesel resources came in existence. Taking considerations of recent events of meager resources and facilities at their disposal, over increasing traffic, snags problem of parking and the need to make automobile a more environmental friendly, designers of vehicles are back with a view to hit upon a novel concept that completely alter the conventional design. Recent developments on Electric bike which are pedal operated are tremendously increasing all over the world market. In China 9 out of 10 Electric bikes are sold, thereby proving that they are not only energy efficient but also relative cheaper than other electric automobiles. It enables to ride in hilly areas and also in windy areas with much less human effort. The below table shows and gives the review of the world who have implemented this electric bike system successfully and have been benefited. The table consists of the following; the type of bike, speed limit (km/ hr.), watt, weight limit (kg), Age requirements.

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## METHEDOLOGY

There framework as appeared are numerous key parts inside the piece chart for this Solar Panel Battery Controller Mechanic al Output Motor Dynamo + Solar + Throttle + Brake + Manual Indicator In Figure. They comprise of a Lead corrosive battery, engine controller, photograph voltaic sun based board, dynamo generator and a brushless DC engine. The force throttle controller are straightforward frameworks that are utilized to trigger the capacities for expanding speed, keeping the velocity steady, and killing the engine. The force hotspot for the framework was a DC battery Source yield 48V.The battery piece is interfaced with the engine controller square. The engine controller controls all the utilitarian capacities and is the focal part of the framework. The fundamental necessity for the control is to manage the measure of force connected to the engine, Particularly for DC engines. The engine controller can be acclimated to synchronize with different brushless engines. There are additionally numerous implicit capacities for this controller that fluctuate from recognizing any breakdowns with the engine corridor sensors, the throttle and secure capacities against extreme present and under-voltage. The control permits the battery to interface with the engine to be bidirectional which can supply and get power. Programming is given the controller with the goal that it can alter the setting and operations for a few of the controller's capacities. Another wellspring of battery charging originates from the photovoltaic sun oriented board and wind mix. At first a Light-weight and adaptable sun oriented board was coveted. The sun oriented board with the same necessities of yield 12V and 20 watts, 12V and 11W was found. This two sun based join with two 12V and 12W dynamo generator. Every one of the four are associated in arrangement .Once a voltage and current is created through the sunlight based wind square, it gives the 48V to battery

➢ **6.1.1. Solar Panel:** based cell. Sun powered cells are gadgets that change over the vitality of daylight straightforwardly into power using the photovoltaic impact. The photovoltaic impact includes the production of a voltage in a material upon introduction to electro-attractive radiation the photoelectric and photovoltaic impacts are connected through daylight, yet are diverse in that electrons are shot out from a material's surface upon presentation to radiation of adequate vitality in photoelectric, and created electrons are exchange to various groups of valence to conduction inside the material, bringing about the development of voltage between two anodes in photovoltaic. - One way we considered charging the battery is using a sun

➢ **6.1.2. Battery:** - In spite of having a low vitality to weight proportion and a low vitality to-volume proportion, its capacity to supply high surge streams implies that the cells have a moderately extensive energy to-weight proportion. This element, alongside their minimal effort, makes it appealing for use in engine vehicles to give the high current required via car starter engines.

➢ **6.1.3. Motor Controller**: driven gadget. The engine controller is practically equivalent to the human cerebrum, preparing data and encouraging it back to the end client. Obviously, the utilizations of an engine controller change taking into account the errand that it will perform. One of the least complex applications is an essential switch to supply energy to the engine, therefore making the engine run. As one uses more elements in the engine, the intricacy of the engine controller increments. - The engine controller is a vital gadget for any engine

➢ **6.1.4. Motor**: - The sprocket is utilized to transmit revolving movement between two shafts. To change riggings and rates of the bike, the breadth of the sprocket should be changed. Rather than having various estimated sprockets in parallel, the underlying thought was to put numerous miniaturized scale engines in parallel to expand the measure of current supplied to the sprocket for more yield force. This framework appeared to be over confused and the smaller scale engines would not supply enough power and torque to bolster a bike at high speeds.

➢ **6.1.5. Dynamo**: - A dynamo is an electrical generator that produces direct current with the use

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of a commutator. Dynamos were the first electrical generators capable of delivering power for industry, and the foundation upon which many other later electric-power conversion devices were based, including the electric motor, the alternating-current alternator, and the rotary converter. Today, the simpler alternator dominates large scale power generation, for efficiency, reliability and cost reasons.

➢ **6.1.6. Throttle**: operates, When the throttle is engaged the motor provides power and propels you and the bike forward. A throttle allows you to pedal or just kick back and enjoy a ufree" ride! Most throttles can be fine-tuned like a volume dial between low and full power. A lot of e-bikes in the US have the throttle feature. In some countries the throttle electric bike is not allowed; only pedal assist. Here are a few of the different types of throttles found on electric bikes. The throttle mode is similar to how a motorcycle or scooter

➢ **6.17. Power Brake**: - The throttle mode is similar to how a motorcycle or scooter operates. When the throttle is engaged the motor provides power and propels you and the bike forward. A throttle allows you to pedal or just kick back and enjoy a "free" ride! Most throttles can be fine-tuned like a volume dial between low and full power. A lot of e-bikes in the US have the throttle feature. In some countries the throttle electric bike is not allowed; only pedal assist. Here are a few of the different types of throttles found on electric bikes. In this a DC waveform which is obtained id made sinusoidal.

## WORKING

operational transistorized D.C. to A.C. amplifying circuit by switching the electric the form of electric current which flows from battery to D.C. to A.C. converter circuit. B energy using amplifier circuit the small A.C. current is amplified again. In order to drive the circu through the condenser, this amplified current is fed to the stator winding of the A.C. motc The condenser which is used acts as a storage of electric energy and delivers at the time requirement. The sprocket wheel installed on motor shaft is driven by the motive power the electric energy. The rear sprocket wheel is being rotated by the chain drive mechanism which the other two remaining sprocket wheels are installed. The wheel is driven by the re wheel installed on the rear sprocket. Thus the electric bike is mobilized by using elect. power.

## DIAGRAM AND PROJECT

➢ **Solar Panel**

➢ **Battery**

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➢ **Motor Controller**

## CALCULATIONS

**Design of Electric Bike:** dor with 250 watt power and 2100rpm. The motor runs on 48volts and 7.5amps power - Here we have used permanent magnet self-generating.

P = 2 x 3.14 x N x T /60
250 = 2 x 3.14 x 2100 x T /60
T = 1,13 N m = 1136
N-mm
Reduction in chain drive
R chain = 66/11 = 6:1 Torque at wheel shaft = T x R chain = 1136 x 6 = 6820 N mm Speed of wheel shaft = 2100 /6 = 350 rpm

**4.2 Designing of Shaft: -**

A) Bending: The force which develops across a specific cross section of the shaft, it generates stress at that point of cross section that are subjected to maximum loading. This internal or resisting moment gives rise to the stress called as bending stresses.

B) Torsion: When the shaft which is twisted by the couple such that the axis of that shaft and the axis of the couple harmonize, that shaft is subjected to pure torsion and the stresses generated at the point of cross section is torsion or shear stresses.

C) Combined Bending and Torsion: In actual practice the shaft is subjected to combination of the above two types of stresses i.e. bending and torsion. The bending stresses may occur due any one of the following reasons:

1. Weight of belt
2. Pull of belts
3. Eccentric Mounting of shafts/gears
4. Misalignment of shafts/gears On contrary, the torsional movement occurs due to direct or indirect twiṣting of the shaft. FHence at any given point on cross-section of the shaft, the shaft is subjected to both bending and torsional stresses simultaneously. Following stresses are taken in consideration while designing the shaft:

**4.3 Shaft Design**

T= 36000 N mm
T= 3.14 / 16 x đs, x $d^3$
Fs allowable = 80 N/mm2
6820 =3.14 x og x d/16 os = 34.73 N/mm2
Material = C 45 (mild steel) Out = 320 N/$mm^2$

**4.4 Factor of safety = 2**

O; = Ob = Out/ fos = 320/2 = 160 N/mm
O; = 0.5 o = 0.5 x 160 = 80 N/mm

os is less then allowable so our shaft design is safe.

## CONCLUSION

This project brought together several components and ideas to achieve a common goal: to aroject as a whole is finished, we hand it over to future generations to design and improve each component. Possibly future projects may include:

1) Design of a charge controller for the battery: The battery management system (BMS) built within the battery was very hard to access, so we couldn't get an idea of how it was designed. Having a BMS with the ability to take in a wider range of voltages and currents will be ideal.
2) Design of the motor controller: The current motor controller is a very nice size and weight,

but the connections that it provides are not as stable and protected as it can be. Limiting the amount of wiring and connections may also be desired. We understand that this bicycle can be intimidating because of its weight and its ability to go 30 MPH. This bicycle has become very special to all of us, and we hope that it will be well taken care of and improved upon.

With the increasing consumption of natural resources of petrol, diesel it is necessary to shift our way towards alternate resources like the Electric bike and others because it is necessary to identify new way of transport. Electric bike is a modification of the existing cycle by using electric energy and also solar energy if solar panels are provided, that would sum up to increase in energy production. Since it is energy efficient, electric bike is cheaper and affordable to anyone. It can be used for shorter distances by people of any age. It can be contrived throughout the year. The most vital feature of the electric bike is that it does not consume fossil fuels thereby saving crores of foreign currencies. The second most important feature is it is pollution free, eco friendly and noiseless in operation. For offsetting environmental pollution using of on – board Electric Bike is the most viable solution. It can De charged with the help of AC adapter if there is an emergency. The Operating cost per/ km - S very less and with the help of solar panel it can lessen up more. Since it has fewer components it can be easily dismantled to small components, thus requiring less maintenance.

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