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Design And Development Of Prototype Of Regeneration Of Energy By Using Exhaust And Utilizes To Lifting Four Wheeler

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Abstract - Due to mechanical failure automobiles get stuck at the mid path of their journey. So there is a need to design and develop a system which can sideline the failed automobile. The main aim of our project is to design and development regeneration of energy by using exhaust and utilizes to lifting four wheeler which is helpful to move the car from one place to another place. In this project we are study of the energy generation from thye the exhust of four wheeler and lifiting the car. The main components used in the system are Hydraulic jack, Wiper motor. The 3 D model will be drawn with the help of CATIA V5 R20 software and accordingly calculations are done. After that the components which are required for our project are manufactured and then assembled together. After making the assembly, the testing of model will be carried out. The result and conclusion will be drawn after the testing of the mode

Keywords: Exhaust energy recovery, Thermoelectric generator (TEG), Hydraulic lifting mechanism, Automotive sustainability, Energy efficiency, Waste heat utilization

1. Introduction

The continuous rise in global energy consumption, coupled with environmental concerns, necessitates the exploration of innovative energy recovery and utilization methods. Automotive exhaust systems, often overlooked as a source of waste heat, present a significant opportunity for energy regeneration. This research investigates the potential of harnessing energy from automotive exhaust systems to perform auxiliary functions, specifically focusing on the application of this recovered energy to lift four-wheel vehiclesThe fundamental concept behind this study revolves around the thermodynamic potential of exhaust gases emitted by internal combustion engines. These gases, typically dissipated into the atmosphere, carry substantial thermal energy. By converting this thermal energy into mechanical or electrical energy, we can create a more efficient and environmentally friendly automotive system. This approach not only improves overall energy efficiency but also contributes to reducing the carbon footprint of vehicles.

In this research, we present the design and development of a prototype system that captures and utilizes exhaust energy for the purpose of lifting a four-wheeler. The prototype integrates a thermoelectric generator (TEG) to convert thermal energy into electrical energy and a hydraulic lifting mechanism powered by the regenerated energy. This dual-functional system exemplifies a novel approach to energy recovery, demonstrating both practicality and potential for real-world automotive applications.

2. Literature Review

Gaurav R. Jawale , Anil S. Kadam , Roshan S.Kamble et.al "Fabrication of Emergency Car Towing Machine" Due to mechanical failure automobiles get stuck at the mid path of their journey. So there is a need to design and develop a system which can sideline the failed automobile.[1]

Ninad Patil, Bhushan Gaikwad, Siddhesh Kale et.al "EMERGENCY CAR TOWING MACHINE" Towing of cars and trucks may be a distinctive kind in business. 2 truck vehicles are most frequently to use in business lately. the most aim of our project is to style and develop automotive towing machine that is useful to maneuver the automotive from one place to a different place. [2]

Ahmed Abdelmoamen Ahmed et.al "A Real-Time Car Towing Management System Using ML-Powered Automatic Number Plate Recognition" Automatic Number Plate Recognition (ANPR) has been widely used in different domains, such as car park management, traffic management, tolling, and intelligent transport systems.[3]

Ko Stroo, Robert Hekkenberg et.al "Emergency Towing Vessel, concepts for a new century of emergency towing" An emergency towing vessel is a seagoing tug which can perform emergency towing operations. The emergency towage can avert the grounding and wrecking of the vessel and the associated oil spill.[4]

Akash L. Nirmal', Mallikarjun B.Katte et.al "Emergency car Towing Mechanism"Due to mechanical failure automobiles get stuck at the mid path of their journey. So there is a need to design and develop a system which can sideline the failed automobile. The main aim of our project is to design and develop car towing machine which is helpful to move the car from one place to another place.[5]

E Ayimba, Cislaghi et.al "Copy-CAV: V2X-Enabled Wireless Towing for Emergency Transport" As smart connected vehicles become increasingly common and pave the way for the autonomous vehicles of the future, their ability to provide enhanced safety and assistance services has improved. [6]

Shinde Sumit VishwanathTe,jas Balasaheb Zol et.al "Design and Development of Remote Operated Car Towing Machine" When the vehicle stop working in a middle of the road it can cause many problems like traffic or accident. By using Remote operated car towing machine we can shift the car to the side of the road without any use of towing vehicle and it require less effort. [7]

Sreya Fernandes , Nisha Mariam Thomas et.al "Vehicle Towing Automation System" Vehicle towing is the procedure of towing away vehicles parked in non-parking areas or areas causing hindrance to ongoing traffic, including wrecked vehicles. [8]

Septian Hadinata, Elvanisa Ayu Muhsina et.al "Towing Car Booking System Using Android and Web Based Application" To deal with broken cars on the road, a towing car booking system using android operating system is built. By using GIS (Geographic Information System) for the development, ensuring the location of the customer become easier. Furthermore, the system is developed using PHP programming language. Data management in this application uses the MySQL database engine. GPRS (General Pocket Radio System) channel is used for sending customer data.[9]

3. Methodology

- We have started working with finding and studying of research papers from different portals like science direct.
- Then we collected all the topic related data from these research papers and studied them in detailed manner along with the standard reference books and academic books.
- Then we finalized the working methodology of our prototype and used CATIA to design the model.
- After finalization of prototype functioning, we have done the calculations and accordingly detailed force analysis is done, where which type of material is used for prototype is finalized.
- After the final analysis and material selection we go out in the market to purchase the required components with required specifications.
- In this purchasing process we approximately estimated the cost required to purchase the components and for machining.

Finally, our product will be manufactured in second semester and results and testing will be carried out.

4. Design of The Basic Components

Computer-aided design (CAD) is the use of computers to aid in the creation, modification, analysis, or optimization of a design. CAD software is used to increase the productivity of the designer, improve the quality of design, improve communications through documentation, and to create a database for manufacturing. CAD output is often in the form of electronic files for print, machining, or other manufacturing operations.

CAD is used as follows:

1. To produce detailed engineering designs through 3-D and 2-D drawings of the physical components of manufactured products.
2. To create conceptual design, product layout, strength and dynamic analysis of assembly and the manufacturing processes themselves.
3. To prepare environmental impact reports, in which computer-aided designs are used in photographs to produce a rendering of the appearance when the new structures are built.

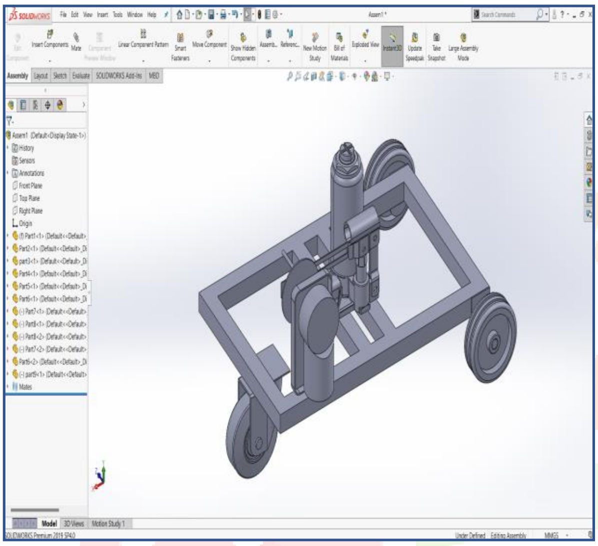
A layout represents a drawing sheet. It typically contains a border, title block, dimensions, general notes, and one or more views of the model displayed in layout viewports. Layout viewports are areas, similar to picture frames or windows, through which you can see your model. You scale the views in viewports by zooming in or out. Manual drafting requires meticulous accuracy in drawing line-types, line-weights, text, dimensions, and more. Standards must be established in the beginning and applied consistently. With CAD, you can ensure conformity to industry or company standards by creating styles that you can apply consistently. You can create styles for text, dimensions, and line-types..

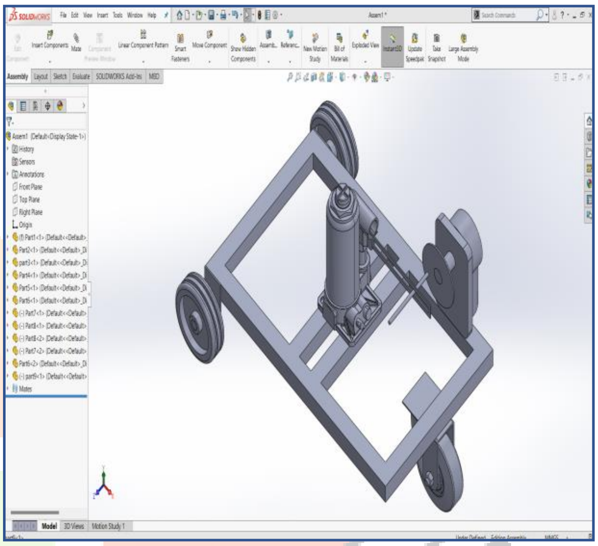
1. Most popular CAD software like AutoCad, ProgeCAD, Microstation are high priced for individuals. Alternatively, individuals can try free opensource CAD drafting software QCAD, LibreCAD and OpenSCAD.

2. Every new release of the CAD software, operator has to update their skills.

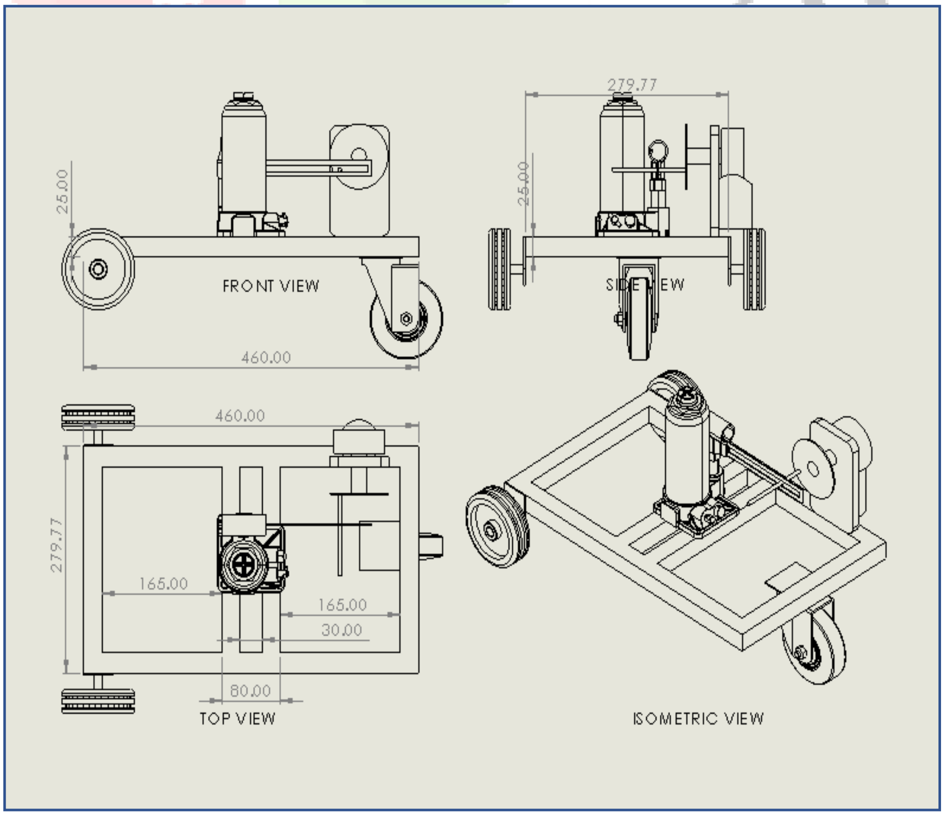
3. Improper use of blocks and layers make updating and modification of the drawings a cumbersome task for another person

3 D MODEL

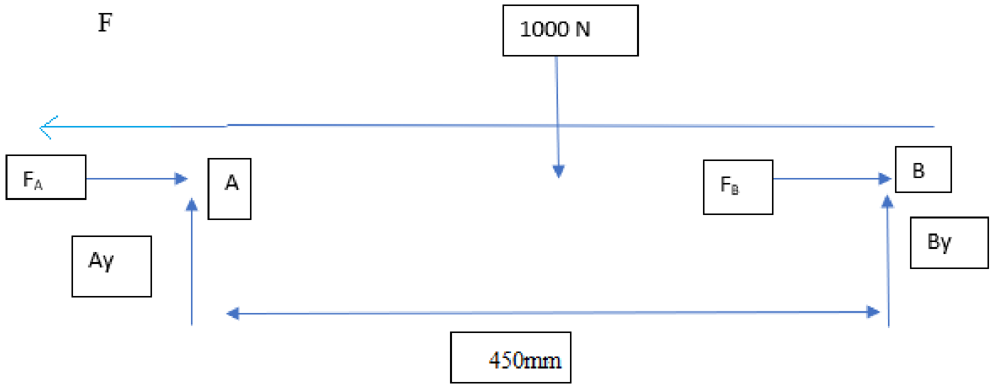




2 D Drafting



5. Basic Design Calculations



Considering Equilibrium Conditions,

€ M_A = o

- By (450) + 1000* (225) = 0

By = 500 N

F_y = 1000

Ay + By = 1000

Ay = 500N

Fx = 0

500*0.3 + 500*0.3 – F = 0 ……………… (0.3 = Coefficient of Friction between horizontal surface)

F = 300 N

5.1 Plunger motor design-

As we have to lift 1000N force vertically acting we will need a DC Wiper motor. Wiper motors are used to transmit high torques.

For 12 Volt and 24 Amp current motor, Power generated is calculated as,

P=V*I

=(12*24)

P=288 Watts.

Now as per our model the disc with radius 0.07 m which is connected to motor and transferring power is given as,

P=(2*3.13*N*T)/(60)

Now for 35 rpm=N

$T_{supplied}$=78.57 N-m-----------------------A

Now the required torque to move the disc is calculated as,

$T_{required=}$Vertical force*Radius of disc.

=1000*0.07

$T_{required=}$70 N-m--------------------------B

As the B<A, our design is safe. So we can select the 12V and 24Amp DC Wiper motor.

5.2 Motor used to drive-

As per the above force diagram, the horizontally acting force is 300N. As the friction between the ground and wheel is dry we need to consider the dry friction coefficient.

Hence actual working force(F)=300*0.3

F =90N

Now the required torque to move the vehicle is given as,(0.035-Std market available wheels)

$T_{required}$=(Force)*(Radius of the wheel)

=(90*0.035)

$T_{required}$=3.15 N-m-------------------------A

So to move the vehicle the supplied torque must be greater than the required torque,

P=(2*3.13*N*T)/(60)

For 60 rpm and 12V and 24 Amp DC Wiper motor, P=288 Watts.

$T_{supplied}$=45.83 N-m--------------------------B

As the A<B, our design is safe. So we can select the 12V and 24Amp DC Wiper motor.

5.3 Hydraulic Piston Design-

Now to design the cylinder used for lifting we need to calculate the force required to lift the load.

Theoretically to lift the 1000N downward acting force we need to supply 1000N vertically acting force.

Now we are supplying 78.57 N-m torque, and radius of the disc is 0.07m

Hence,

$T_{supplied}$=F*R

78.57/0.07=F

F=1122.42 N

As the supplied force is greater than the downward acting force our design is safe.

Now we have to go for try and error method to find out the diameter use to lift the load,

For 25mm diameter 75 mm is the stroke length-------------(Standard available in market)

Hence area is given as,

$A=(3.14/4)*D^2$

$=490\ mm^2$

Now the pressure generating is,

P=F/A

=1122.42/490

$P=2.290\ N/mm^2$

Now as we know that the S_{yt} of the Mild Steel is very less than the Pressure generated. Our design is safe.

5.4 Amount of oil sent in one stroke-

V=A*L

=(498*75)

$V=3.7*10^{-5}\ m^3$

5.5 Design parameters

Diameter of blade is 100 mm

Swept area

The swept area is the section of air that enclosed the turbine

$S=2r^2$

S=2×0.05*0.05

S=0.005 m2

Power and power coefficient

The power available from exhust can be found

For the following formula

$P_w = \frac{1}{2} \times \rho \times s \times v_o 3.$

Where,

ρ =density of air = (1.225 kg/m3 at 15c)

S= swept area

V_o =velocity of air

Power coefficient

$C_p = \frac{Captured\ mechanical\ power\ by\ blade}{available\ power\ in\ wind}$.

$C_p$value represent the part of the total available power that is actually taken form wind which can be understood as its efficiency.

For the theoretical calculation for 2.5 m/s

Wind is as follows

$P_w = \rho \times s \times v_o 3.$

$= \frac{1}{2} \times 1.225 \times 0.005 \times (2.5)^3$

=0.04 watt

Power available at 2.5m/s is 0.04 watt

6. Cost Estimation

Bill of material

Sr. No	Material	Material of construction	Quantity	Cost per Unit Rs.	Total cost in Rs.
1	Material cost	MS		3000	3000
2	Nut and Bolts	M6		150	150
3	DC motor	DC 12 Volt	04	1200	4800
4	Battery	12V,5A (Lead acid battery)	01	1200	1200
5	Wheel		04	200	1000
6	ARDUINO		01	800	800
7	BLUETOOTH SENSOR		01	450	450
8	Hydraulic jack		01	**2000**	**2000**
9	Wiper motor		01	**1400**	**1400**
10	Dynamo		01	**3000**	**3000**
				Total	**17800**

7. Conclusion

The success of this project underscores the potential for innovative approaches to energy recovery in transforming the automotive landscape. Future research and development can build upon these findings to optimize system efficiency, explore broader applications, and integrate advanced control systems. The promising results of this study not only contribute to the field of sustainable transportation but also inspire further exploration and innovation in energy utilization technologies.

Hence, the prototype system developed in this research represents a significant advancement in harnessing exhaust energy for practical applications. By demonstrating the viability and benefits of this approach, the project lays the groundwork for future developments that will contribute to a more efficient, eco-friendly, and sustainable automotive industry.

Acknowledgements

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[5] Akash L. Nirmal', Mallikarjun B.Katte et.al “Emergency car Towing Mechanism”-Vol 13 2020

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