

# PNEUMATIC POWER COMPRESSED AIR WHEEL FOR HANDCART

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## Abstract:

The main objective of this research work is to deliver a pneumatic powered electronically controlled system which works on principle of pneumatic and controlled by electrical action to give handcart users a leverage force, so that to decrease the work load and increase the efficiency of men who are using hand cart for their livings. The methods that were opting in this research is to make a prototype of our full scale model and showing all kinds of parameter that are to be considered while designing it and also factors that are to be considered to have a good functioning machinery with all real time efficiency and loss figures considered in a theoretical framework. In this we have also added theoretical framework to compensate how the machinery will perform in real world scenario due to current ongoing pandemic.

## 1. Introduction:

The project revolves around the basic cause to provide an extra leverage force in order to reduce the human efforts that are indulged in application and usage of, ubiquitously present hand carts in Indian market and in worldwide that are still using these robust yet cheap means of goods transfer and mobilizing other goods for different application (e.g.: street food, sale purposes etc.). The project is an philanthropic, yet innovative cause of using effective technology measures to give a leverage to these people who operate simple machines like hand carts or hand loader cart [1]. Our rationality to bring this kind of project is a useful application to provide favorable work grounds to people who are in this business of using hand carts for their living [2]. In developing countries like India, Indonesia, Vietnam, Sri Lanka, Nepal which are very extensive to use of hand carts in their vendor market and though increasing culture of street food which use these hand carts as a primary structure to their business module it is very helpful innovation [3, 4]. Due to these factors the hand carts are increasing in their weight and sometimes using of these whole hand carts from one place to another is a very tedious task [5]. The major value that we want in our project is value for money device that is available at very low price and no prerequisite needed and the whole platform can be used at universal level with no extra homologation needed. A compressed air engine or air motor is a type of motor in which all the mechanical work is done by the expansion of compressed air [6]. Air engine basically converts the compressed air energy to mechanical work by the help of either linear or rotary motion, as it is good for it and recommended too. Linear motion can be generated from a or piston actuator or diaphragm while the rotary motion is

been supplied by piston air motor, air turbine, a vane type air motor or gear type motor[7].The basic idea behind the project working is based on a study done on numerous projects that had been done in the piston providing propulsion system to motor vehicles by use of some different kind of energy source that are not fossil fuel as these are considered to be the evil behind all the emission that are widely accounted because of extensive use of fossil fuel engines[8]. Due to this fact only, many projects are been developed to build a propulsion system not using fossil fuel instead of using some fuel which neither harm our environment nor the fuel that is to be use is exhaustible. Thus, the kind of project that came up with this building a propulsion system that can use the power of air pressure and use it as a medium to transfer power by occupying operating devices like compressor and pneumatic cylinder to make a movement which can be converted to a circular motion if the motion created is not circular which in this case is linear. Thus, use of mechanics that came into play to recruit a single slider mechanism to convert linear motion of rod of pneumatic cylinder to circular force[9]. The whole use of this functionality propose in upper paragraph is implemented in our project in a same way but the use of the whole machinery is to build a force just powerful enough so that it can work in synergy with human efforts just to provide leverage force and decreasing the work done by human body on a hand cart while pushing and also while going up incline at a slow pace but with huge increase in efficiency of a human body.

## **2. Pneumatic Propulsion System:**

The basic working of the compressed air is that it enters the cylinder through the intake valve because there is difference in pressure that tends to drive the piston downwards. After the crank reaches a particular angle the intake valve closes though the Compressed air continuously pushes the piston downward and output the mechanical work. When the movement of the piston is close to bottom dead center, the exhaust valve opens. Then the compressed air with some pressure is been expelled by the impetus of piston. And when the piston moves to the top center then the CAE completes a total work cycle. The working principle of our proposed prototype is based on working mechanism of pneumatic cylinder by using it's to and for motion by the help of using compressed air and implying that linear motion to generate angular moment by employing single slider crank mechanism and supply this generated angular motion to final drive of hand cart through gears[10]. At first when the hand cart is moving and machinery attached to it is not in use the alternator connected to the front wheel of hand cart via chain drive will start moving and alternator will produce current which is supplied to battery. The second phase is when the machinery is actuated by push button mechanism while pushing the hand cart up slope the machinery will start working. At first the compressor will start and draw power from battery to produce compressed air and fed it to DCV. Now DCV in accordance to Arduino programming will actuate itself to supply pneumatic air to cylinder[11]. By this the pneumatic cylinder start working and start to supply power to gears system in the form of linear motion which is converted to rotation moment. As shown in the figure the moment is transferred from

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gearsystemtoanotherthohavereductionandincreasethespeedofrotationwhichflowsfromdrivinggear  
 ar S0tocountershaftgearonitsleftonaxleA1 and  
 afterthistherotationmomentissenttogearCS1from here it is send to final drive axle A3  
 viaCS2.Thus, power is sent in form of leverage force to wheels at the back of hand  
 cart.Afterthiswhenthehandcartisalluptheinclinethepushbuttonisreleasedandmachinerystopswor  
 rking, and alternator again start to deliver power tobattery[12]. The Schematic diagram for  
 the pneumatic propulsion system is shown in the figure.1.

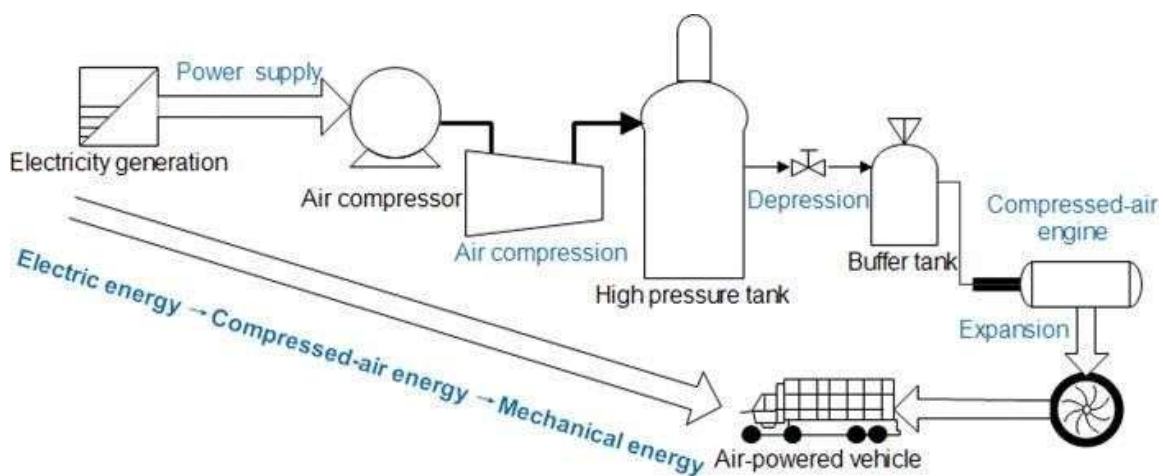


Figure.1 Schematic Diagram of Pneumatic Propulsion system

### 3. Experimental Setup

The designing of our project is based on building a small scaled project showing similarity to a full-sized resemblance of our project of how it will look like if a full-scale real-world application of our project is considered to manufacture. So, the designing of our project is done in two ways or to be more precise, the prototype that is to be build is designed by considering two aspects. The mechanical construction of the prototype & the electronic devices synergy optimization. In the first part we are considering all the mechanical construction methods and steps to be undergone to efficiently build a base framework for our prototype. In this part only selection of material used is considered from steel grade, hoses, wires, dimension and mounting, electrical devices to be used like alternator, compressor, push button and pneumatic system like double acting pneumatic cylinder, DCV. In second aspect of construction the working of electronic component in sync with pneumatic component is considered and various synergy levels of different components are considered for efficient working of system without any problem and full optimization of these synergies is obtained from various calculation that are done in the same order to get perfect working condition prerequisite to demands of

electrical components. So after considering all these aspects for manufacturing we all also consider the importance of having a theoretical figure of a physical working prototype by making a block diagram for our ease, as having a block diagram is considered as a very beneficial part of manufacturing as it act as a trail way for better design of a prototype. The next part that we are considering is part of second aspect as this also is a very important consideration to be recognized while working with the electronic devices, which is using of devices which shows compatibility with each other in terms of their parameters like volts, watt-hours, current output and input values because it is widely seen that if these parameters are not considered while designing there are very high possibility of having in appropriate flow of current and building of voltage difference across circuit which can decrease optimization levels which intern decrease efficiency and increase the cases of having huge load build up and even shorting of circuit or failure of battery which can be catastrophic at a very critical moment. The other major consideration that we have made is to have a strong framework to support our different component easily without any failure. The photographic view of the Experimental setup is shown in the figure.2.



Figure.2 Experimental Setup

#### 4. Results & Discussions:

The first part of construction is to build a framework for the prototype which is to be built by a material suitable to provide robust structure and also a flat payload carrying platform at top and a under carriage to provide necessary space to build mounting points and attach horizontal beam for supporting structure of pneumatic cylinder. For this we have used L-angled steel beam for construction of outer frame and flat metal strip for pneumatic cylinder mounting structure and mounting made from galvanized steel plate for robust fitting of various other electronic devices. The testing ground that we are setting for this part of calculation and obtaining results from it is done by considering scenarios which are important as these are the only purpose on which we want our prototype to excel and to know whether the parameters that we are going to set of payload weight increased to 20kg from 10kg and incline at various stages of 5Deg, 10Deg & 15Deg to come out clean from all these scenarios. Due to this we have not considering how our prototype will perform on flat ground but how it will perform on moving

gupincline with its own kerb weight and payload to be carried. The diagram of the designed system in software was shown in the figure.3.

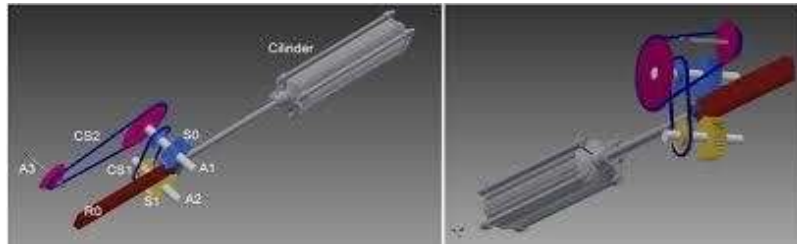


Figure.3 Design of Pneumatic system in Software

Thus, this calculation shows that the amount of energy inside an average human is considered according to average consumption of 3500 calories and considering all our cases for 100m the first 20m is executable for the human with load and next 80m for machine plus human efforts, But in this if we see the saved energy amount this makes the 100m trip with all the circumstances figured and considered there are few more trips that are possible for human to execute of same distance with same load taken above and with same inclination angle are tabulated below. The amount of energy used and saved with the help of Pneumatic system was shown in the figure.4.

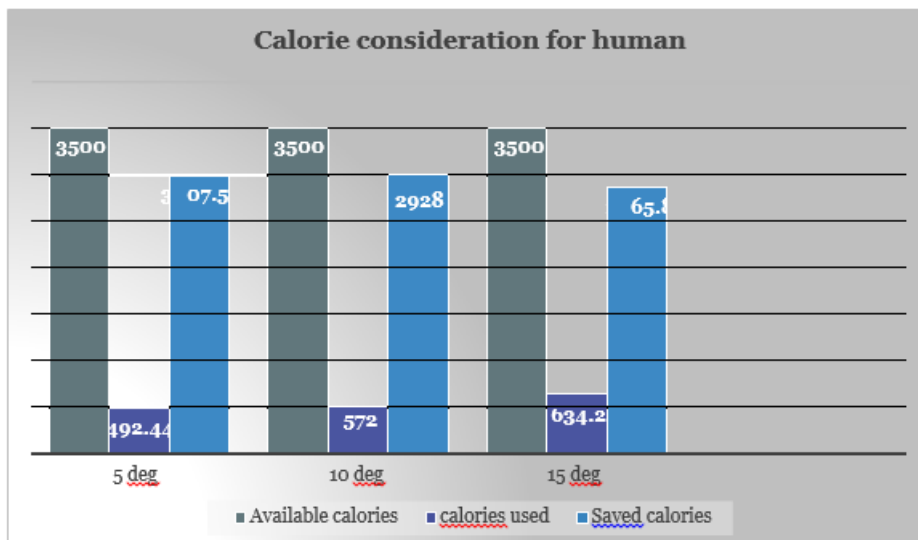


Figure.4 Calories used for transfer of load

## 5. Conclusion

The conclusion drawn from the above calculated figures is that the battery that is used to support compressor shows total bearable sign to withhold the power needed by the compressor and in terms of battery capacity, even considering the 80% efficiency prospect taken

into consideration. From this we concluded that 46% & 50.49% of total force needed is taken care by the pneumatic system for level road and in case of incline is solely, respectively, can be supported

by the pneumatics system. According to the above mentioned all calculative work it is been concluded that the alternator that is being used to replenish of battery charge is been done without any flaw but at a very slow pace. The stats that is considered is according to numbers corresponding to compressor and battery synergy. In case of testing the prototype the following conclusions that can be drawn. Now considering "effect human efficiency" data it can be concluded that with use of four machinery the human efficiency has been increased to a significant level which is seen in the prototype testing chapter and even there is a huge increase in energy saved inside human even after doing so much work with increased work load. After considering chapter "speed and force calculation" in testing it can be seen that by how much amount the amount of force that's been first exerted by the human is now totally overtaken by the machinery power and decreasing the human stress part though the load consideration was increased and even the average speed was increased which is a remarkable note. And the last part of testing which is "battery testing" it is observed that the battery that we are using has capability to support our system for such long times and even at when difficult parameters are set on which our battery lasted for long and with help of alternator is able to provide high number of work cycles which is remarkably excellent.

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