

## **A Review Paper on Design and Modeling of Solar based Tyre Inflation System**

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**Abstract :** *Solar energy is renewable source of energy which can be used for many applications like power generation, water heating, and cooling. The hard part is capturing the sunlight. Air compressor, sometimes referred to as gas compressors, are devices of tools that reduce volume of gas thus creating pressure and heat in the gas being compressed. Most common application of this technology is the common or garden air compressor that you might have used at home for inflating tyres or using with a spray painting tool.*

**Keywords :** *pressure control, tyre, tyre inflation, TPMS.*

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### **I. Introduction**

In ancient time, after the discovery of wheel by man, it has been used extensively for various purposes and it is vital part of human life for ages. These wheels run human life faster and faster with new technology. And one such technology is on board air inflation system used in automobiles.[2] Tyres are the second-highest cost for the trucking industry. The on board Solar based air inflation system is used to maintain the pressure of tyres in running condition. The environmental conditions varies according to the region, seasons because of this, it requires maintaining the tyre pressure for better performance according to conditions. The most important application of this system in military vehicle. For the military vehicle the environmental condition, land conditions are continuously varying and they have to face very worst conditions like heavy rain falls, deserts, snowfalls, etc. At those remote places no such devices are available for maintenance of the tyres. At some crucial time like war conditions or any flood condition there is not time for filling air. Thus there arises a need for automatic tyre inflation system. This can be done by employing appropriate technique. This project deals with the design and fabrication of automatic tyre inflation system. [9]

### **II. Literature Review**

[1] **Mark Reiter and John Wagner**, studied the effect of Tire pressure on vehicle handling based on the automated automotive tire inflation system.[1] The opportunity to modify vehicle handling through an automated tire inflation pressure system can change the chassis performance. In this paper, a vehicle's handling behavior has been investigated for various under-inflated tire cases. The front tire pressure may be decreased to offer greater under steer. A front tire pressure may be reduction leads to larger steering wheel angles, while rear wheel tire pressure reductions produce larger vehicle slip angles[9] (less vehicle stability and higher vehicle over steer).Directional instability becomes evident with weight shift towards the rear combined with rear wheel tire pressure reduction per the increase in slip angle. Future research will study the control methods. [1]

[2] **Sadda. Mahendra, N. Amara Nageswara Rao**, studied the effect of tyre Overload and inflation pressure on rolling loss and fuel consumption of automobile. [2] In this thesis, the effect of tyre over load and inflation pressure on the rolling loss and fuel consumption is analyzed. The investigations are made on two models on two models of tyre Skoda rapid and Ford classic. [7] The analysis is done by applying the loads of car weight and persons weight. When the car is overloaded, also analysis is done. Modeling is done in Pro/Engineer and analysis is done in Ansys. By comparing the results ford classic tyre is best which is getting less stress values compared to Skoda tyre in the case of overloaded condition and the fuel consumption also more for Skoda compared to ford classic.[3]

[3] **Joao M. Serrano, Jose O. Peca, Rafael Silva**, studied the effect of liquid ballast and tyre inflation pressure on tractor performance.[3]The paper presents the result of evaluation of effect of liquid ballast and tyre inflation pressure on traction parameter and performance of an agricultural tractor under field working conditions, on dry sandy loam soil.[13]It is shown that there were no significant differences either in work rate in fuel consumption per hectare between the tyre inflation pressure specified by the tractor manufacturer and that specified by the tyre manufacturer.

[4] **T. Smerda, J. Cupera**, studied the tire inflation and its influence on drawbar characteristics and performance of energetic indicators of a tractor set. The paper presents the results of realized measurements revealed that reducing tire inflation of appropriate tire types can improve the drawbar characteristics and consequently fuel consumption. [4]It was seen that the presented characteristics, the tractor transferred larger drawbar pull to the surface at the same ground speed and lower inflation pressure. Larger transferred drawbar pull means an increase of drawbar power and tractor performance.[1]

[5] **V.Senthilraja, S.A.Srinivasan, M.Magudeshwar, S.Dhayananth**, studied the automatic air inflation system in tire with pressure control and monitor system. [14]The paper presents us the techniques used to reduce the process time and human efforts of the conventional manual air filling system. The system helps to reduce cost and friction between surface of tire and road so that it will reduce the wastage of tire material.[5]The result obtained that if the system utilization will be executed in proper by taking and concerning all the relevant according to the project demand the process time, cost and human efforts can be reduce in a great manner.

[6] **Shreedhar Urade, Akshay Parkad, Dhiraj Bobade**, studied air filling in a moving tires. Studies have shown that due to drop in tyre pressure by just a few PSIS can result in reduction of tire life, gas mileage, and performance of vehicle. The paper presented that the self-inflating system would be capable of succeeding as a new product in the automotive supplier industry. It specifically addresses the needs of the consumers by maintaining appropriate tire pressure conditions [6].

[7] **Loya Chandreshkumar, Joshi Pranav, Chaudhari Hemraj**, studied the tire pressure monitoring system and the fuel leak detection in automobiles. The paper presents a kind of scheme of direct TPMS, introduces the principle of the system. The communication can greatly improved through carefully choosing the RF module. The transmission module has low power property. The wireless signal transmission is solved by adopting FSK, The test results indicate that the system meets the needs of the real application well. [7]

[8] **Sivarao, T.J.S. Anand and M. Warikh**, studied the engineering of tire pressure controlling device which is an invention towards successful product development. [2]The paper presents an important role of tire pressure in ensuring safe and economical driving. But still a number of vehicles with under inflated tires are observed on the road due to the unawareness of the fact that properly inflated tire can save tire life up to 20%. [8]So the development of ATPC has proven that the users inflate their tires more frequently at home over weekends and found to be as an easier application towards sustaining correct tire pressure at all times. [6]

[9] **Tyre pressure model for predicting fuel consumption of vehicles on GHANA's raods P.Y.Andoh , F.Davis , Y.A.K. Fiagbe, T.Alhasan** Tyres are the backbone of car , truck and the construction equipment. Vehicle tyres can affect not only the way vehicles are handle but also can affect the overall performance of fuel economy of vehicles. [11]Main terms- measurement of tyre pressure, effect of tyre pressure on fuel consumption measurements of fuel consumption. [9]The result of research shows that only 3% of vehicles in KUMASI METROPOLIS have their tyre pressure as recommended, 97% had tyre pressure deviated. This implies that 97% are optimum and may be consuming more fuel.

[10] **CHALMERS – Requirements of TPRS ( Tyre Pressure Regulating System) Dept.Of Applied Mechnics,Div Of Vehicle Engg And Autonomus System, CHALMERS UNIVERSITY OF TECH,SWEDON. 2013** The inflation pressure indirectly affects the side wall, stiffness and foot print of the tyre which play an important role in determining vehicle handling and write characteristics .Numerous tests have also shown significant fuel consumption benefits obtained by simply maintaining appropriate tyre pressure in all wheels.[10]Influence of tyre inflation pressure on fuel consumption, vehicle handling and ride quality.[7]

[11] **Industrial Technologies Sector of Ingersoll Rand Corporation By Nader Jalili, Ph.D. Dept. of Mechanical Engineering, Clemson University, South Carolina, 29634-0921** The Rolling resistance of inflated tires is an important component of resistance to vehicle motion and contributes to the total land and fuel consumption. [12] Reducing rolling resistance of tyres has positive influence on fuel economy and life of truck tyres. This prevents premature wear of truck tyre. By inflating Truck tyres with nitrogen, fuel economy has been increased by about 23.3% and tyre life be increased by 50%. Overall cost incurred on fuel and replacement tyres is drastically reduced and CO2 emission into the atmosphere is cut down by 19%. All this improvement help reduce the money spent on fuel and replacement tyre. This provides the technical support for the statement that nitrogen fill tyres have a positive effect on vehicle fuel economy and tyre performance.[2]

[12]**M.J.Raguvaran, A.S.Dahlan, K. Kadirgama and M.A.Amaran, Faculty Of Manufacturing Engg. University Technical Malaysia, Melaka.**In this research the factors that affects the air permeation that causes natural pressure loss to the tyre has been critically investigated and it show that a normal passenger car tyre experience pressure drop both in static unloaded and worse still during dynamic loaded condition.[11] At static unloaded tyre condition, the tyre pressure drops mainly because of air permeation by means of inflating via compressed air which have the properties of oxygen molecule but during dynamic loaded condition; pressure drops more due to increased air permeability upon excessive operating temperature and with the presence of load. Therefore, this research gives an important response and valuable outcome in order to develop the

reasonable solution for tyre to retain pressure and literally minimizing the rate of air pressure which causes pressure loss at any circumstances. [12]

**[13] Ambarish G. Mohapatra, Dept. Of Applied Electronics And Instrumentation Silicon Institute of Technology, Bhubaneswar, India** A tyre pressure monitoring system (TPMS) monitors air pressure and temperature in the tyres of motor vehicle, and that generates signal indicative of tyre pressure and temperature in each of the tyres to increase the performance and safety. TPMS is based on direct method of tyre pressure measurement. The system was designed successfully and also tested with different tyre pressure levels at different environmental conditions.[1] The pressure sensor was designed using the self temperature compensated diaphragm type strain gauge, operating temperature range of  $-75^{\circ}\text{C}$  to  $+95^{\circ}\text{C}$ , tested at a temperature range of  $33^{\circ}\text{C}$ - $70^{\circ}\text{C}$ . The pressure data was successfully transmitted with new other transmission scheme to minimize the power consumption and maximize the transmitter battery life. [7]

**[14] Ishtiaq Rouf, Rob Miller, Hussen Mustafa, Travis Taylor, Dept .Of CSE, University of South Carolina, Colombia, SC USA** This Paper has evaluated the privacy and security implications of TPMS by experimentally evaluating to representative tyre pressure monitoring. Our study revealed several security and privacy concern. [9] We also found out that current implementations do not appear to follow basic security practices. Messages are not authenticated and the vehicle ECU does not appear to use input validation. We were able to inject spoofed messages and illuminate the low tyre pressure warning lights on a car travelling at high way speeds for another nearby car, and managed to disable the TPMS ECU by leveraging packet spoofing to repeatedly turn on and of warning lights. TPMS can provide guidance towards designing more secure in-car wireless network. [14]

**[15] D. Madhusudana, C.Nagarajan, Dept. Of Mechanical Engineering K.S.R.M.College Of Engg, Kadapa, Andhra Pradesh. 516003** The effect of tyre over loaded and inflation pressure on the rolling loss and rolling resistance on fuel consumption of automobile car tyre in analyzed by applying the loads of car weight and also with the person's weight. The effect of tyre over load an inflation pressure on the rolling loss and fuel consumption is analyzed.[16]The rolling loss will be more for overloading then the specified load and the fuel consumption will also be more increasing tyre pressure in convenient and inexpensive method of partially or fully compensating for rolling resistance increase. Some fuel saving might be accomplished by this method.[12]

### III. Conclusion

We applied all these techniques to reduce the process time and human efforts of the conventional manual air filling system. The system helps to reduce cost and friction between surface of tyre and road so that will reduce the wastage of tyre material. As a result, it will increase the life of tyre .After fabrication of automatic tyre inflation system, the result obtained that if the system utilization will be executed in proper by taking and concerning all the relevant according to the project demand the process time , cost and human effort can be reduce in a great manner .

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