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RATIS (Rapid Automatic Tyre Inflation System)

Prabhakar N Kota
Department of Electronics & Telecommunication
Modern Education Society's College of Engineering Pune, India

Pranil Sakinal
Department of Electronics & Telecommunication
Modern Education Society's College of Engineering Pune ,India

Varad Tamhankar
Department of Electronics & Telecommunication
Modern Education Society's College of Engineering Pune ,India

Rutika Sakore
Department of Electronics & Telecommunication
Modern Education Society's College of Engineering Pune ,India

Abstract*—Since the discovery of tires, amelioration is being done in tires of a vehicle regularly for its improved life and its role in increasing vehicular safety. As we all know that vehicle is the most important part of our life because it helps us in traveling miles in a few minutes. The air pressure of the tires needs to be maintained at the ideal level for better running of the vehicle and its safety purposes. So, this technique was introduced keeping in mind the fuel consumption, vehicular safety, and luxury . It maintains the required tire pressure of vehicles, increases fuel efficiency, and reduces tire wear thus increasing their life and reducing tire replacement time and cost. The significant aim of introducing this technique is to take care of ideal pressure in tires and when the pressure of tire goes below ideal value pressure gage monitors it and the tire is inflated again. This paper provides a far better understanding for researchers and new learners on the working, advantages, and limitations of the "Autonomous tire inflation system" utilized in tires of a vehicle. The project is concerned about and to develop an "autonomous tire pressure inflation system". As we are aware that by the drop of a few pressure units in a vehicle it results in the reduction in mileage, tire life, safety, and performance. This system can be placed in every automobile under any operating condition, this will not only maintain the correct tire pressure but also increase tire life, mileage and safety so we've fabricated this technique to inflate and deflate the tire automatically by using control units. This system is known as autonomous because it checks the tire pressure continuously employing a built control device and accordingly, gives alert signals to the driving force about the tire condition*

Keywords*—CTI, ATIS, Psi, PTO, GHG, Km/H, L, MPa.*

I. INTRODUCTION

According to a survey, almost 80% of the vehicles on roads are driving with under-inflated tires. Tires tend to lose air through normal driving significantly after hitting potholes, permeation & changes in seasonal temperature. They can lose one or two psi (pounds per square inch) monthly in winter and even more within the summer. One can't tell if the tires are properly inflated by observation through the naked eye. You have to use a tire pressure gauge. The underinflated tire is damaging your tire life and also has a harsh effect on gas mileage, it also significantly worsen the handling of the vehicle and is considered hazardous. When tires are not adequately inflated, they tend to wear more. According to the survey, this equates to 15 % fewer miles to drive with them for each 20 % of the tires are underinflated. Under-inflated tires also overheat more quickly than properly inflated tires, which causes more tire damage. Today the automobile sector plays an enormous role within the economics of all the countries within the world and much of the research is administered to enhance the efficiency of vehicle one of the techniques to improve the efficiency of an automobile is to inflate the tire regularly. As it is well-known, one of the most serious problems that the large motor vehicle has, whether for the transportation of passengers or cargo and especially those used for middle or long-distance travel, resides in ensuring the right performance of the tires. This means making sure that the tire is inflated and stays inflated for the right amount of pressure for the load being carried and for road condition this way one can ensure not only the preservation of the outer covering of the tires but also the correct operation of the vehicle without any risks. The importance of tire inflation pressure on vehicle stability and safety are often observed through the tire-road interface and subsequent lateral behaviour. The inflation pressure has it's considerable effects on the generated forces, moments, and steering properties of the tires. Under-inflated tires substantially prove to have greater tread wear and higher rolling resistance that affects the fuel economy and mileage. For reference, the National Highway Traffic Safety Administration (NHTSA) reported a 1.8% reduction in tire life for every 6.89 kPa (1 psi) tire pressure drop based on research with Goodyear data (NHTSA, 2000).

Also, it has been a 1.5 per cent increase in fuel consumption for each 0.2 bar of pressure in under-inflated tires. Research studies have observed that a lot of vehicle owners do not regularly check on the tire pressures of their vehicles. To address tire pressure problems, NHTSA requires onboard monitoring systems to live and display tire pressures. A variety of tire monitoring strategies are proposed to warn drivers of low tire pressures. For instance, direct pressure sensory systems typically feature transducers (e.g., tire valve stem, internal) and/or transmitters and receivers to speak and display tire inflation data. In contrast to these systems, indirect tire pressure measurement systems use types of mathematical models for estimating the pressure based on the wheel speed information provided from electronic stability control systems. For adjusting the tire pressures, Sandoni and Ringdorfer (2006) proposed an automated tire pressure measurement and inflation system. An onboard controller receives individual tire pressure, yaw, and steering sensor data, and commands dedicated pneumatic manifold valves to deliver compressed gas to every tire. An electric air compressor, with an attached accumulator, produces and stores the compressed air. The accompanying control system can evaluate the tire manufacturer's specifications, vehicle operating conditions, and roadway surface to determine the optimal inflation pressure. It should be recognized that the tire pressure controller should integrate with existing control subsystems, including electronic stability, engine/powertrain, and body controllers. To investigate the impact of tire inflation pressure on vehicle dynamics, numerical studies have been conducted for various operating conditions and driving scenarios. The CarSim™ software package has been selected given its widespread use by the automotive community, the availability of vehicle databases, and the vehicle dynamics to evaluate. This utility features tire/road interface look-up tables (one of several methods) that enable the longitudinal, lateral, and aligning moments (versus slip and slip angle) to be calculated (or measured) and then stored a priori for online retrieval.

A) Ability to supply Proper Tire Pressure

The ideal functional objective of the planning is its capability to manage the pressures of four tires of a passenger vehicle to urge the right pressure for varying road/driving conditions.

Specifically, it's desired that:

• As vehicle speed increases, tyre pressures rise
• As vehicle speed decreases, tyre pressures fall.
• As tyre pressures rise as the weight of the vehicle rises..
• As vehicle load decreases, the tire pressures decrease.

Based on more detailed research on the components necessary for the system, it has been discovered that a specialized pivot joint must be designed to support this process. This design consideration requisite additional development time that wasn't originally anticipated. Therefore, the right functional objectives are modified to account for this design requirement.

Specifically, the new objectives require that:

• Cold tire pressure is maintained by ensuring that the pivot joint shaft system doesn't fail.
• By ensuring that the rotary-joint shaft mechanism does not leak excessively, cold tyre pressure is maintained..
• Cold tire pressure is retained by ensuring that the whole system (compressor, air tubes, rotary joint, etc.) can provide a sufficient flow .

B) Importance Of Tires

Tires are a part of the backbone of a car, truck, piece of construction equipment, or bicycle. Tires add traction, braking, steering, and cargo support to vehicles while also absorbing shock and creating a smooth and cozy ride. There are o-shaped parts which will be pneumatic or solid and fit round the wheels of the vehicle to guard the wheels and increase their effect. A solid tire consists of rubber, metals, and plastic parts. Vehicle tires can affect not only the way cars are handled, but also affect the general performance and fuel economy of a vehicle. One among the foremost important things to try to do may be a regular schedule to see the atmospheric pressure in tires. Incorrect atmospheric pressure during a tire causes tire failure. Tire failure while driving can cause a crash and possibly injure the driving force and therefore the passengers.

C) Rolling Resistance

Rolling resistance is the resistance to rolling caused by the deformation of the tire in touch with the paved surface . because the tire rolls, tread enters the contact area and is deformed to evolve to the roadway. The energy required to form the deformation depends on the inflation pressure, rotating speed, and various physical properties of the tire structure, like spring force and stiffness. Tire makers sought lower rolling resistance tire constructions to enhance fuel economy in cars and particularly trucks, where rolling resistance accounts for a high amount of fuel consumptionIn comparison to a solid tyre, the pneumatic tyre has the more significant effect of greatly reducing rolling resistance. Because the interior atmospheric pressure acts in all directions, a pneumatic tyre can "absorb" bumps within the road because it rolls over them without experiencing a reaction force opposite to the direction of travel, as within the case with a solid (or foam-filled) tire. Overall, rolling resistance makes up a comparatively small percentage of the losses during a typical vehicle; it accounts for about 4% of a vehicle's energy expenditure at low speeds and about 7% at highway speeds.

D) Tread Wear

Friction between the tire and the road surface causes the tread rubber to wear away over time. The legal standards prescribe the minimum allowable tread depth for safe operation. There are several types of abnormal tread wear such as poor wheel alignment, excessive wear of the innermost or outermost rims, gravel roads, rocky terrain, and other rough terrains will cause accelerated wear. Overinflation above the sidewall maximum can cause excessive wear to the center of the tread. However, inflating up to the sidewall limit will not cause excessive wear in the center of the tread. Modern tires have steel belts built-in to prevent this. Underinflation causes excessive wear to the outer ribs. Quite often, the placard pressure is too low and most tires are underinflated as a result. Unbalanced wheels can cause uneven tire wear, as the rotation may not be perfectly circular. Tire manufacturers and car companies have mutually established standards for tread wear testing that includes measurement parameters for tread loss profile, lug count, and heel-toe wear. also known as tire wear. Tire wear rates reported in the literature range between 0.006 and 0.09 g/km per tire. The actual wear rate is, however, dependent on a range of factors such as driving style, weather, tire, and road characteristics. The wear rate is several times higher during urban driving than during motorway driving, due to increased acceleration, braking, and cornering in cities. Thus, a significant part of the worn tread rubber may be emitted in cities, even though city driving only accounts for a small part of the tire mileage.

E). Effects of Tire Pressure

Accurate air pressure in a tire helps to evenly spread the weight of a vehicle evenly across the tread pattern of tire, so the tire is highly stable. When a tire is found in under-inflated or over-inflated condition it loses stability, negatively affecting handling, cornering, and stopping. As time passes, the tire will also start to wear unevenly. Under-inflated tires show wear and tear on the outer edges of the treads present, on the other hand overinflated tires tend to show wear down at the middle of the tire's tread. With incorrect inflation pressure more tire wear and thus there is a need to change the tire quickly. The main motivation for a properly inflated tire is to distribute the vehicle load evenly across the tire footprint thereby providing good contact with the road, passenger comfort, responsive handling, and uniform tire wear. It should be remembered that it is the air pressure inside the tire that supports the weight of the vehicle. Two situations can arise with improperly inflated tires which are under-inflated and over-inflated. In the case of under-inflated tires, the tire life could be reduced considerably if the tire pressures are maintained low for long periods. Tire manufacturers Michelin and Goodyear have claimed a reduction in tire life of up to 30 % of tires operated 20 % below the recommended pressure. The tire also bends and distorts more, resulting in over-heating and increased RR. There was a test conducted in which it was even found that the vehicle was a few seconds slower around a track on under-inflated tires, with drivers reporting a detached feeling from the vehicle in the corners. For the case of over-inflation, the tire could sustain damage when riding over road surface irregularities such as potholes and bumps. Passenger comfort is also marginally compromised. Increasing the tire pressure results in a decrease in the tire-road contact area, resulting in slightly poorer traction and braking capabilities. Under-inflated tires do wear at the sides more than compared to the center as the pressure is not enough at the center of the tire to carry the load. For over-inflated tires, the wear is severe along the center due to the bulging of the tire. Proper tire pressure becomes particularly important in wet weather conditions from a safety point of view. Tread depth, tire footprint size, and tread design play a vital role in determining the hydroplaning characteristics and wet traction performance of a tire. From a series of tests conducted by Michelin, it was concluded that the tire pressure plays an important role in determining the tire's contact patch surface area, especially at increasing vehicle speeds. Tests revealed that an under-inflated tire would hydroplane at speeds lower than well-inflated tires for the same height of standing water.

II. Aim of the Project

This project aims to design a system that can inflate automobile tires autonomously and maintain tire pressure in the tire. This will help in increasing the life of the tire and also increase the performance of the automobile.

III. Problem Statement

To Design an Autonomous Tire Inflation System for Automobiles, which can intelligently monitor and operate according to the user selected mode.

IV. Proposed work

Present work includes the determination of optimum tire pressure parameters, its effects on fuel efficiency, handling and wear and tear of tires, of an automobile.
Project work includes:
A) To study the effects of varying tire pressure values on the automobile.
B) To design an Autonomous Tire Inflation System.
C) To optimise and adapt the ATIS system for various modes -
(ON-Road Mode, OFF-Road Mode).
D) Testing the designed system on simulation of various real time parameters.

V. Methodology

The methodology is the systematic steps we take to implement the idea/system in realistic scenarios.
A) We evaluate various tire inflation systems available in the market and note down their advantages and disadvantages.
B) To overcome the flaws of the evaluated systems, we design a similar system to fulfill the proposed requirements.
C) We test the designed system on a simulation with real-time parameters.
D) We compare the designed system with other similar systems.
E) We implement the design on a practical basis and produce a working model for demonstration.
F) We test the model in real-time environmental conditions.

VI. LITERATURE REVIEW

A) In their study Indrajeet Burase, et al [1],Aim of this study show that a drop in tire pressure by just a few PSI can result in the reduction of gas mileage, tire life, safety, and vehicle performance, we have developed an autonomous, self-inflating tire system that ensures that tyres are properly inflated at all times. Our design proposes and successfully implements the use of a portable compressor that will supply air to all four tires via hoses and a rotary joint fixed between the wheel spindle and wheel hub at each wheel. The rotary joints effectively allow air to be channeled to the tires without the tangling of hoses. With the recent oil price hikes and growing concern of environmental issues, this system addresses a potential improvement in gas mileage; tire wear reduction; and an increase in handling and tire performance in diverse conditions. According to Concept, about 80 percent of the cars on the roads are driving with one or more tires under inflated. Tires lose air through normal driving (especially after hitting pot holes or curbs), permeation and seasonal changes in temperature. According to Goodyear, this equates to 15 percent fewer miles you can drive on them for every 20 percent that they're under inflated. Under inflated tires also overheat more quickly than properly inflated tires, which cause more tire damage.Today automobile sector plays a big role in the economics of all the countries in the world and lots of researches have been carried out to improve the efficiency of the vehicle one the techniques to improve the efficiency of an automobile is inflate the tire regularly.This means making sure that tires are inflated and stay inflated for the right amount of pressure for the load being carried and for road condition this way one can ensure not only the preservation of outer covering of the tyres, but also the correct operation of vehicle without any risks. Fig.a. shows the faded area below indicates areas of excessive tread wear.

Bezuidenhout discusses The South African Sugar cane industry has identified central tire inflation (CTI) as a technology that could improve vehicle performance and reduce costs. Consequently it is important that transport costs should be reduced in order for the sugarcane industry to maintain profitability. Central tire inflation technology offers benefits such as improved mobility and savings in road maintenance costs, but more importantly can also reduce the two largest operational expenses on a transport vehicle namely fuel and tyres as per Oberholzer. Tire deflection is the key to understanding the use of CTI technology. Tyre deflection is defined as the change in tire section height from the freestanding height to the loaded height. The percentage deflection is the ratio of that change to the freestanding section height. At the lowered inflation pressures (increased tire deflection), the tyre's imprint or contact area is greatly increased and the load is applied over a substantially larger area.The algorithm automatically generates mask image without user interaction that contains only text regions to be painted. Proper air pressure in a tire helps to distribute the weight of a vehicle evenly across the tire's tread pattern, so the tire (and the vehicle) is at its most stable. When a tire is under-inflated or over-inflated, it loses stability, negatively affecting handling, cornering, and stopping. Eventually the tire will also start to wear unevenly. Under inflated tires tend to show wear on the outside edges of the tread as shown in fig.(b),while overinflated tires show wear down the middle of the tread. With incorrect inflation pressure more tire wear and thus there is a need to change tire quickly. The main motivation for properly inflated tire is to distribute the vehicle load evenly across the tire footprint thereby providing good contact with the road, passenger comfort, responsive handling and uniform tire wear. Tyre also bends and distorts more, resulting in over-heating and increased RR. In a test conducted by tiretrack.com it was even found that the vehicle was a few seconds slower around a track on under-inflated tyres, with drivers reporting a detached feeling from the vehicle in the corners. For the over-inflated case, the tire could sustain damage when riding over road surface irregularities such as potholes and bumps. Passenger comfort is also marginally compromised. Increasing the tire pressure results in a decrease in tyre-road contact area, resulting in slightly poorer traction and braking capabilities. This mechanism works on the principle that the compressor supplies air to the tire when the vehicle is running. The air from the compressor is supplied to the rotary joint, from where the air is supplied to the tire which is under-inflated because of the implementation of rotary joint the air is easily supplied to the tire without tangling the hoses. An automatic compact air compressor, shutdown automatically when the required tire pressure is reached. Electronic sensors are used to detect the tire pressure with the help of pressure gauge. When the pressure in the tire reduced below the required level then the sensors senses the pressure level and send feedback signal to compressor for maintaining pressure level of the air in the tire.Compressor works on the 12V battery of the vehicle and it is reciprocating in nature that's why it's easy to obtain the desired pressure level. Rotary joint is used to rotate well as to supply compressed air simultaneously when required.

B) In their study Oduro, et al [2],This study studies the relationship between tire pressure and fuel consumption of vehicles using experimental methods and mathematical models to predict vehicle fuel consumption. The model obtained was F = 0.6272- 2.5941p+3.3428p2±0.018 where F is the fuel consumed and p is the tire pressure of a vehicle, which can also be used to predict the amount of fuel consumed by other vehicles. The model was validated with its own data which showed a deviation of ±5% which is within experimental error. Using the recommended tire pressures the model reduces the fuel consumption by 17.6% thus reducing cost of fuel. From the experiment, it was observed that the relationship between the fuel consumption and the tire pressures of various vehicles is in the form of F = B2p2 - B1p+B0± e, where B0, B1, B2 and 'e' depends on other factors of the vehicle such as the age of the vehicle and the conditions under which the measurements were taken. This equation can be used to predict fuel consumptions for vehicles when their tire pressures are known. In all, it was seen from the research that any deviation in tire pressure of vehicles resulted in an additional fuel consumed by vehicles. It is recommended that there should be a massive public education or awareness about the need to keep recommended tire pressure at all times because when tire pressure falls below the recommended value, the decrease in the pressure invariably leads to an increase in fuel consumption. Tyres are part of the backbone of a car, truck, piece of construction equipment or bicycle. Tyres add traction, braking, steering and load support to vehicles while also absorbing shock and creating a smooth and comfortable ride. There are o shaped parts that can be pneumatic or solid and fit around the wheels of the vehicle to protect the wheels and add to their effect. One of the most important things to do is a regular schedule to check air pressure in tyres. Incorrect air pressure in the tire causes the tire failure. As the tirerolls, tread enters the contact area and is deformed to conform to the roadway. The energy required to make the deformation depends on the inflation pressure, rotating speed and numerous physical properties of the tirestructure, such as spring force and stiffness. The pneumatic tire also has the more important effect of Accurate air pressure in a tire helps to evenly spread the weight of a vehicle evenly across the tread pattern of tire, so the tire is highly stable. When a tire is found in under-inflated or over-inflated condition it loses stability, negatively affecting handling, cornering, and stopping. As time passes, the tire will also start to wear unevenly. Under-inflated tires show wear and tear on the outer edges of the treads present, on the other hand overinflated tires tend to show wear down at the middle of the tire's tread. With incorrect inflation pressure more tire wear and thus there is a need to change the tire quickly. The main motivation for a properly inflated tire is to distribute the vehicle load evenly across the tire footprint thereby providing good contact with the road, passenger comfort, responsive handling, and uniform tire wear. It should be remembered that it is the air pressure inside the tire that supports the weight of the vehicle. Two situations can arise with improperly inflated tires which are under-inflated and over-inflated. In the case of under-inflated tires, the tire life could be reduced considerably if the tire pressures are maintained low for long periods. Tire manufacturers Michelin and Goodyear have claimed a reduction in tire life of up to 30 % of tires operated 20 % below the recommended pressure. The tire also bends and distorts more, resulting in over-heating and increased RR. There was a test conducted in which it was even found that the vehicle was a few seconds slower around a track on under-inflated tires, with drivers reporting a detached feeling from the vehicle in the corners. For the case of over-inflation, the tire could sustain damage when riding over road surface irregularities such as potholes and bumps. Passenger comfort is also marginally compromised. Increasing the tire pressure results in a decrease in the tire-road contact area, resulting in slightly poorer traction and braking capabilities. Under-inflated tires do wear at the sides more than compared to the center as the pressure is not enough at the center of the tire to carry the load. For over-inflated tires, the wear is severe along the center due to the bulging of the tire. Proper tire pressure becomes particularly important in wet weather conditions from a safety point of view. Tread depth, tire footprint size, and tread design play a vital role in determining the hydroplaning characteristics and wet traction performance of a tire. From a series of tests conducted by Michelin, it was concluded that the tire pressure plays an important role in determining the tire's contact patch surface area, especially at increasing vehicle speeds. Tests revealed that an under-inflated tire would hydroplane at speeds lower than well-inflated tires for the same height of standing water.

vastly reducing rolling resistance compared to a solid tyre. Because the internal air pressure acts in all directions, a pneumatic tire is able to "absorb" bumps in the road as it rolls over them without experiencing a reaction force opposite to the direction of travel, as in the case with a solid (or foam-filled) tire. Friction between the tires and the road surface causes the tread rubber to wear away over time. The legal standards prescribe the minimum allowable tread depth for safe operation. Hillier (1991) suggests several types of abnormal tread wear such as poor wheel alignment, excessive wear of the innermost or outermost rims, gravel roads, rocky terrain and other rough terrain will cause accelerated wear. Over inflation above the sidewall maximum can cause excessive wear to the center of the tread.

C) In their study, Mark, et al [3], The under-inflation of pneumatic tires, a typical problem in sedans and light duty vehicles, affects the vehicle's handling characteristics. An automated tire monitoring and inflation system can ensure adequate tire pressure to better accommodate handling requirements. In this paper, the variance of longitudinal and lateral forces, plus aligning torque, have been numerically investigated for different tire inflation pressures using the STI tire model. The tire/road interface results were integrated into a comprehensive simulation to evaluate vehicle handling behavior. These results suggest that under inflated front axle tires result in understeer tendencies while rear axle under inflation creates oversteer behaviour. The importance of tire inflation pressure on vehicle stability and safety can be observed through the tire-road interface and subsequent lateral behaviour. For instance, the National Highway Traffic Safety Administration (NHTSA) reports a 1.8% reduction in tread life for every 6.89 kPa (1 psi) tire pressure drop based on Goodyear data (NHTSA, 2000). Similarly, a 1.5% increase in fuel consumption for each 0.2 bar of pressure under-inflation has been reported by Grugett et al. (1981). Studies have revealed that many owners do not regularly check the pressure in their vehicle tires. To address tire pressure problems, NHTSA requires on-board monitoring systems to measure and display tire pressures (Osajda, 2004).

A variety of tire monitoring strategies have been proposed to warn drivers of low tire pressures. An onboard controller receives individual tire pressure, yaw, and steering sensor data, and commands dedicated pneumatic manifold valves to deliver compressed air to each tire. An electric air compressor, with an attached accumulator, produces and stores the compressed air. The accompanying control system can evaluate the tire manufacturer's specifications, vehicle operating conditions, and roadway surface to determine the optimal inflation pressure. The effects of tire inflation pressure variations, as related to the recommended cold inflation pressure, for a P185/70 R13 tire have been studied. As the slip angle further increased, the under-inflated tire self-aligned more quickly. Thus, the stiffer tire self-aligns faster with higher inflation pressure in the typical 0-4º range, which contributes to the steering 'feel'. The longitudinal force look-up table was created assuming a 0.3º wheel slip angle to capture the effects of the longitudinal force vs. slip ratio with varying tire pressure. This approach was pursued since the STI model does not predict changes in the longitudinal force vs. slip ratio for zero wheel slip angles The rolling resistance and longitudinal force tire lag may also be adjusted to describe different tire inflation pressure effects. The longitudinal force due to rolling resistance is Fxrr =FRz rsurf (Rrc +RrvVx and increases due to the increased tire patch length at lower tire pressures. The two rolling resistance values Rrc and Rrv increase with decreasing tire pressure. In this study, both rolling resistance coefficients were increased by 15% of the nominal value (at 100% tire inflation) for tires that were 70% fully inflated, and were increased by 25% for tires that were 40% fully inflated. To investigate tire inflation effects on lateral handling, a sedan (150kW engine, automatic transmission, front wheel drive, rack/pinion power steering) with P185/70 R13 tires was numerically evaluated. The three load configurations were: standard (config A) with m=1,370kg, CG at (1.11m longitudinal from front axle, 0.21m above axle), passenger (config B) with m=1,624.5kg, CG at (1.18m, 0.24m), and rear with trunk load (config C) with m=1,643kg, CG at (1.49m, 0.24m). The vehicle requires more steering effort to maintain the trajectory for the under-inflated tire (Cases 2-11) per loading configurations A-C when compared to the nominal Case 1. The results consistently exhibit larger left-front (LF) and leftrear (LR) wheel slip angles, Max(αLF) and Max(αLR), since the vehicle requires larger wheel slip angles to generate the lateral force needed to complete a given lane change. The maximum vehicle slip angle, Max(β), also increased due to the vehicle's reduced directional handling capabilities when equipped with under-inflated tires. For instance, Cases 1A, 2A & 7A feature standard loading with uniform tire inflation Tdp percentages of 100%, 70% and 40%, and reflect maximum vehicle slip angles of 3.4°, 6.1°, and 15.8°. The vehicle maneuvering performance with under-inflated tires at LF/RF locations was considered in Cases 3&8. For RF/RR under-inflated tires (Cases 5&10), understeer was present but moderated due to the RR tire under-inflation, which had an oversteer influence. As the vehicle mass increased and the CG moved backward (Cases B&C), an oversteer effect occurred which decreased the maximum steering wheel angle and increased the maximum vehicle slip angle. For example, the rear loaded vehicle in Case 5C exhibited maximum steering wheel and vehicle slip angles of 82.0° and 7.9°.

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 behaviour has been investigated for various under-inflated tire cases. The front tire pressure may be decreased to offer greater understeer. A front wheel tire pressure reduction leads to larger steering wheel angles, while rear wheel tire pressure reductions produce larger vehicle slip angles (less vehicle stability and higher vehicle oversteer). 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.

D) In their study, Aneesh Rs et al [4], Driven by studies, if there is a drop in tire pressure by a few PSI can result in the reduction of gas mileage, tire life, safety, and vehicle performance. We have developed an autonomous tire inflation system that ensures the tires are properly inflated constantly. Our design proposes and successfully implements the use of a compressor which is centralized and will supply air to all four tires through hoses and a rotary joint which is fixed between the wheel spindle and wheel hub at each wheel. The rotary joints effectively allow air to the tires without tangling the hoses. With the recent oil price hikes and growing concern of environmental issues, this system addresses a potential improvement in gas mileage; tire wear and handling conditions. Most vehicle owners are unaware of the fact that their tires are not at the exact pressures because it is difficult to determine the tire pressure visually; a tire that is properly inflated to the accurate pressure looks very similar to one that is either over-inflated or under inflated. . From the perspective of the designers, however, the root cause of improperly inflated tires is due to vehicle owners not knowing appropriate tire pressures for certain conditions, trouble finding an air pump, lack of pressure calculating device, and a general lack of concern. The overall goal of our design project is to develop a system that will decrease tire wear while improving fuel economy, performance and safety of a passenger vehicle through dynamically adjustable tire pressures.

Based on more detailed research on the components necessary for the system, it was discovered that a specialized rotary joint must be designed to support this process. This system consists of a centralized compressor, rotary joint, pressure sensor, electronic control circuit, battery, wheel and a motor to run the wheel. After gathering ideas of different components needed, we will start making rough designs and after that we will draw a 3 -D model in Auto CAD. By referring to this 3D model we would buy the standard component required for the projects. After this we would start manufacturing work in the workshop. Along with this electronics part would also be done. In electronics we would have to build a controller circuit to get signal from pressure. After this, the assembly of various components would be done. Later testing will be started for getting various results. Rotary joint or a Rotary Union is a device that provides a seal between a stationary passage and a rotating part. Stationary passage may be a pipe or tubing; whereas rotating parts are a drum, spindle or a cylinder. Thus it permits the flow of the fluid in or out of the rotating part. Generally the fluids that are used with the rotary joints and rotating unions are steam, water, oil, hydraulic fluids etc. A rotary union will lock onto an input valve while rotating to meet an outlet. During this time the liquid or gas will flow into the rotary union from its source and will be seized within the device during its movement. This liquid or gas will leave the union when the valve openings meet during rotation and more liquid or gas. In this system, the compressor is connected to the wheel with the help of hoses through a rotary joint. Pressure sensor and control circuit are attached between wheel and compressor. Two limits (upper limit and lower limit i.e. 20psi and 30 psi individually) are set in the control circuit for automatic start and stop of the compressor. Compressor works on a 12V DC supply that is either a car battery or a bike or an adapter. A non-return valve is placed between pressure sensor and compressor, so that the air flow must be unidirectional from compressor to tire.

5. In their study, P.Omprakash et al [5], Every section of an automobile is getting automated except one- Tires. To inflate a tire, the driver has to go to a gas station or he has to attach a pump manually. Both these involve human labor. This project is aimed at removing such unwanted strain and save time. The system has a dedicated unit for filling air whenever required. A control unit which is a pic microcontroller is the brain of the system. When the pressure level is below the threshold value chosen by the driver, the system displays it. The

driver then may choose to refill the air automatically. A compact pump does the job. Another problem in tires is a puncture. A sudden puncture can cause the driver to lose control, culminating in an accident. The project's minor objective revolves around this. During a puncture the air pressure reduces suddenly. This reduction in pressure over a time limit is identified as a puncture. It warns the driver of a puncture and saves life. The other way of detecting a puncture is by calculating the ON time of the pump. If the pump is in ON state for a long time and there is no improvement in the pressure level it is recognized as a puncture. It also saves a lot of money by giving more longevity to the tire and better mileage. As the tire is filled with optimum air, the friction between the tire and the road is maintained properly. Henceforth, the tire is not damaged much and the fuel consumption is reduced. The project is destined to be a life and money saver. Automobiles have become an important and reliable companion of humans. The usage of the automobiles is increasing in a rapid manner. The various Automobile industry are now competing each other to win the hearts of humans. In order to do so, the companies are improving the safety systems in automobiles. The more reliable, the more successful the car becomes.

The Central Tire Inflation System is used by the military. As said the system is not a dedicated one. Air brake system and CTIS system use the air from the same provision because which a problem occurs. You cannot use both the system at the same time. Doing so may result in Accidents. Below shown is a military truck that has toppled due to the above problem.So we have to design a dedicated system only for refilling purpose. Automation and automobiles go hand in hand. Every section of an automobile is getting automated except one- Tires. To inflate a tire, the driver has to go to a gas station or he has to attach a pump manually. Both these involve human labor. This project is aimed at removing such unwanted strain and save time Another problem in tires is a puncture. A sudden puncture can cause the driver to lose control, culminating in an accident. The project's minor objective revolves around this. It warns the driver of a puncture and saves life. It also saves a lot of money by giving more longevity to the tire and better mileage. As the tire is filled with optimum air, the friction between the tire and the road is maintained properly. Henceforth, the tire is not damaged much and the fuel consumption is reduced. The project is destined to be a life and money saver. It comprises of the compact pump, hose, specially designed wheel alloy and the tire. The wheel is designed to serve the purpose of pumping and wheel rotation with minimal air leakage. The pump is fitted to the car either magnetically or screws. Magnetic fixing is to avoid the pump from falling at any cost. The pump will be fitted near the wheel, parallel to its axle. Each wheel will get a dedicated pump. The pump needs just 12v to operate. So a power supply from the car battery is more than enough for the proper functioning of the pump. The tire used may be a tube or a tubeless one, but the system remains the same.. Permanent in the sense, even during the motion of the car. It can be removed by the driver while changing a tire. The above parts comprise a single section for one wheel. So four sections totally make up the entire pumping unit.

VI.A. LITERATURE REVIEW - CASE STUDY

The prime motive of this program was to assess the economic and environmental factors of autonomous central tire inflation in B-double regional line haul applications. This trial involved in-field observations of two cement tankers operating regional line haul routes around New South Wales. The vehicles operated over an average of 12 weeks between February 2013 and May 2013. Each trial vehicle underwent a monitoring period of 6 weeks with the CTI system powered ON. This was followed by a six-week period with the CTI system powered off. To ensure that the operation of each vehicle was comparable directly before and after the intervention, data loggers were fitted to each vehicle to capture key descriptors of vehicle operation. Specifically, information was collected in relation to:

1) AVERAGE SPEED: average speed (km/h)
2) IDLE TIME: time spent at idle.
3) PTO: time spent using power-take-off.
4) STOPPING INTENSITY: number of stops taken per kilometre of travel.
5) FUEL CONSUMPTION: total fuel consumed (L).

A summary of the results for each of the trial vehicles when using automatic tire inflation is provided in Table 1. A comparison of the fuel consumption data revealed that when using a CTI system changes in fuel efficiency ranged from a 1.22% fuel use reduction in Truck 2 to a 0.84% fuel use increase in Truck 1. Despite more idling and PTO usage during the CTI era, Truck 2 presented a stronger argument in favour of CTI generating fuel savings of the two trial vehicles. The average fuel efficiency improvement was 0.19 percent. Analysis of the GHG performance mirrors the fuel trend: GHG emissions generated by the trial vehicles were, on average, 0.19% lower than before the monitoring intervention.

VII. Frame Design

We used SOLIDWORKS software to design a three-dimensional model of the Frame. This software allowed our team to visualize the design in 3-D space and reduce errors in fabrication.

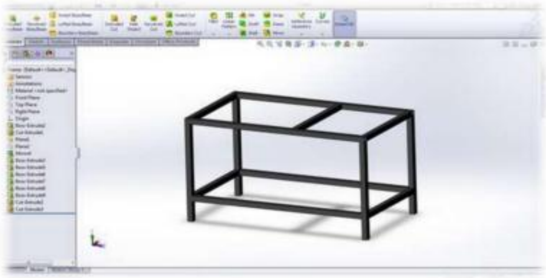

Figure 1. Frame Design.

VIII. Construction

The working of the system is as follows.

A) We connect the compressor to the battery of the car through a dc adapter to regulate the current and maintain a constant and steady supply of current to the compressor.

B) We connect the outlet of the compressor to a regulatory tank.

C) We connect the Auto cut-off valve to the outlet of the tank.

D) We then connect the tubes and the Solenoid 1 and Solenoid 2.

E) We connect the Solenoid 1 to the outlet of the Auto cut-off valve.

F) We connect one Tee Junction after the solenoid 1 and then connect solenoid 2 to the middle outlet of the junction.

G) We connect the second Tee Junction in close proximity to the rotary valve and connect the pressure sensor to the middle outlet of the Junction.

H) We connect the rotary valve to the outlet of the Tee Junction and then connect the rotary valve to the center of the wheel.

I) Then we connect the outlet of the rotary valve to the inlet of the wheel valve.

J) We then connect the Pressure sensor, Solenoid valves, and the control of the compressor to the Atmega328P controller.

IX. Working

A) When the car ignition is turned ON, the compressor is turned on. The compressor then fills up the air tank with an air pressure of 18 bar (maximum).

B) When the air tank fills up the Auto cut-off valve will automatically shut off the compressor.

C) When the pressure in the air tank falls below a certain limit the compressor will turn back on until the pressure threshold is reached.

D) After this, the Atmega 328p sends the signal to the pressure sensor to check the tire pressure.

E) The pressure sensor sends feedback to the Atmega 328p of the accurate tire pressure.

F) If the pressure is below the set limit, the Atmega 328p 1 will turn on Solenoid 1 in intervals of 0.4 seconds to regulate the airflow and volume of.

G) After every 0.4 seconds, the sensor will check the tire pressure and operate the Solenoid 1 until the pressure in the tire reached a threshold limit set by the user.

H) If the pressure in the tire at the initial condition is more than the set limit, then the pressure sensor will send feedback to the Atmega 328p.

I) Then Atmega 328p will operate the Solenoid 2 in intervals of 0.3 seconds to let some of the air out from the tire.

J) After every 0.3 seconds, the pressure sensor will report and Atmega 328p will operate the solenoid 2 until optimal pressure is maintained in the tire.

K) If the pressure sensor detects the loss of pressure is continuous, i.e. 1-2 psi
in the interval if every 15 minutes in running condition (Tubeless tire), the Atmega 328p will detect this feedback and report to check the tire for punctures or wear on the tire.

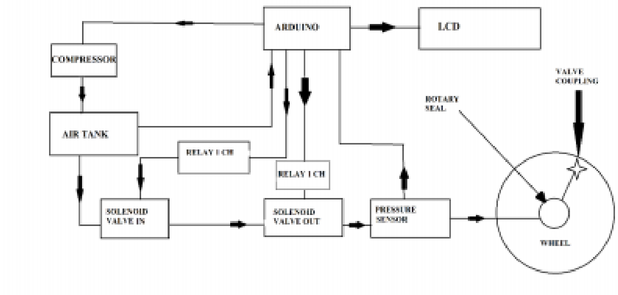

Figure 4. Block Diagram

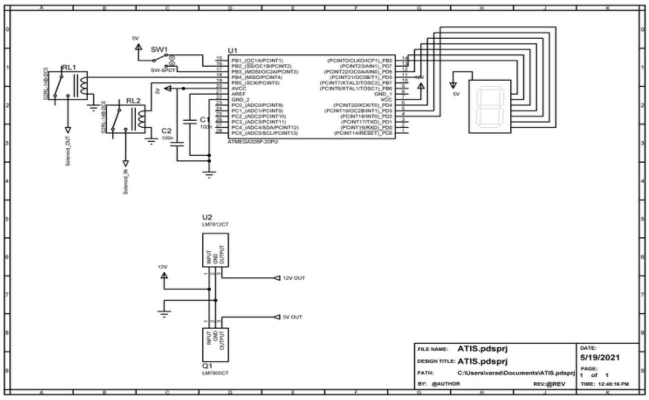

Figure 5. Circuit Diagram

X. Overview of The Work

In this project, we propose to create a Pneumatic system for indicating the tire pressure condition and inflate the tire to the optimal point to mitigate the problems due to over-inflation/underinflation. For this experiment: -

A) Install a wheel, a compressor, and an air tank on a frame structure.

B) Connect the rotary seal to the wheel.

C) We fit a solenoid valve to the compressor outlet.

D) We fit two TEE sections to the tubing, one for the pressure transducer and other for the pressure relief valve.

E) Then we connect this system through the rotary seal to the valve of the tire.

F) We program an Atmega 328p to control the solenoid valve according to the feedback given by the pressure sensor.

G) Last, we check if the system is working properly.

the hose generally consists of an inner tube, one or more layers of reinforcing braided or spiral-wound fiber, and an outer protective cover. In broad terms, hose is more rugg3.5.

X. Components Specifications

A) Tube

Polyurethane Tube. it's a sort of hollow tube which is employed to move air from the compressor to the tire and it's flexible thanks to which it can easily transport. Pneumatic tubing and hose are used to deliver pressurised air to actuators, valves, instruments, and other equipment. But there are countless types and sizes of tubing and hose on the market, so engineers should consider variety of important factors to pick the proper one for a given task. Start with construction. Tubing for air applications could also be extruded of one material or reinforced internally, typically with textile fibers, for higher strength. Pneumatic hose generally consists of an tube , one or more layers of reinforcing braided or spiral-wound fiber, and an outer protective covering . Hose is more durable than tubing in general, but it is more expensive.. The air supply and application set a baseline for the required product performance. Flow requirements help determine hose or tubing size. Hose is usually defined by ID, while tubing is usually specified by OD and wall thickness. Regardless, selecting an inner diameter that is too small restricts flow, resulting in pressure losses, inefficiency, and high fluid velocity, all of which reduce service life. overlarge a diameter, on the opposite hand, leads to above necessary weight, size and price .

Also, make sure that the goods function at or below the maximum working pressure indicated on the label. Manufacturers generally rate tubing by measuring the burst pressure at 75° F, then divide it by an appropriate factor of safety (typically 3:1 or 4:1) to work out the utmost working pressure. Manufacturers deliver a wide range of polymer formulations to meet specific requirements. Typical tubing materials utilized in pneumatic applications include: Polyurethane tubing is robust , flexible, kink and abrasion resistant, and it withstands contact with fuels and oils. It's commonly utilized in pneumatic actuation and logic systems, robotics and vacuum equipment, and during a sort of semiconductor manufacturing, medical and laboratory applications.

B) Rotary Seal - ¼" Rotary Seal.

A rotary union or swivel joint may be a mechanism wont to transfer fluid (under pressure or vacuum) from a stationary inlet to a rotating outlet, preserving and isolating the fluid connection[9]. Also mentioned as rotary joints, rotary couplings, fluid swivels, or swivel joints; rotary unions are engineered to endure an outsized range of temperature and pressure for a spread of conditions and environments. In addition, rotary unions may integrate multiple independent flow connections (passages) and handle differing types of media simultaneously. Rotary unions typically function by connecting to input and securing onto another mechanism by allowing a moving connection to be preserved. Rotary unions are utilized in a variety of rotary applications from compact unions for the semiconductor industry to large, rugged-duty fluid swivels for industrial variety of applications. Additionally, materials, sealing technology, and bearing types are often incorporated.

Figure 6. Rotary Seal.

C) Wheel

It is a circular component which must rotate on an axle bearing. Tires are fixed on wheels that have integral rims on the outer edges which hold the tire. Automotive wheels are specially made up of pressed and welded steel, or else a mixture of lightweight metal alloys, like aluminum or else magnesium. These kinds of alloy wheels can be either cast or else forged. The fixed tire and wheel together are then attached to the hub of the vehicle. A fancy hubcap and trim ring can be put over the wheel. R13/R14.
Size.

Figure 7. Wheel R14.

D) Pressure Sensor

Pressure is defined because of the applied force by a liquid or gas on a surface and it's usually measured in units of force per unit of area. Some common units are Pascal (Pa), Bar (bar) and N/mm2 or psi (pounds per square inch). A sensor could also be a tool that measures a physical quantity and translates it to a symbol . The quantity is often as an example temperature, length, force, or – in fact – pressure. The signal is in most cases electrical but also can be optical. Therefore, a pressure sensor is an instrument consisting of a pressure-sensitive element to figure out the actual pressure applied to the sensor (using different working principles) and a couple of components used to convert this data into an output signal. There is a spread of various technologies used within pressure sensors to supply accurate results. The following section will highlight some of these. Capacitive pressure sensors use a pressure cavity and diaphragm to generate variable capacitor. The diaphragm is contorted when pressure is applied and capacitance decreases accordingly. This change incapacity is often measured electrically and is then set in reference to the applied pressure. These sensors are generally limited to low pressures of around 40 bar. There is a variety of properties that will not to classify pressure sensors, including the pressure range they measure, the temperature ranges of operation, or the sort of pressure they measure.

• Absolute pressure sensors tend to measure the pressure in accordance to a reference chamber (nearly vacuum).

• Gauge pressure sensors – or relative pressure sensors – are wont to measure the pressure relative to the currently present air pressure.

• Sealed gauge pressure sensors are like gauge pressure sensors, but they measure pressure relative to a hard and fast pressure instead of to the present air pressure.

• Differential pressure sensors output the difference between two pressures and are generally used to measure pressure drops, fluid levels, and flow rates.

Generic G1/4 Pressure Transducer Sensor 0-1.0MPa.

This is used to measure the tire pressure and send a signal to the Atmega 328p.

Figure 8. Pressure Transducer.

E) Air Tank

Any compressed gas system needs an air receiver tank, which is an essential component. Manufacturers have a plethora of options. When there are large demand swings or spikes, a receiver tank is typically sized at 2 gal/scfm and increased to 4-10 gal/scfm of flow. If a compressor is rated at 25 scfm at 100 psig, the receiver tank should be at least 50 gallons and up to 250 gallons if there are major surges. olymer formulations tailored to particular requirements In a compressed gas system, a receiver tank provides the subsequent benefits:

• The receiver tank acts as a reservoir of compressed gas for peak demands. • The receiver tank will help remove water from the system by allowing the air an opportunity to chill .

• Pulsation inside the system triggered by a reciprocating compressor or a cyclic mechanism downstream is reduced by the receiver tank.

Typically, a receiver tank is sized at 2 gal/scfm and increased to Just like a water reservoir compensates for peak demand and helps balance the availability of the compressor with the demand of the system, an air receiver tank compensates for peak demand and helps balance the availability of the compressor with the demand of the system. Receiver tanks are mandated by law to have a pre-installed pre-installed pre-installed pre-installed. The safety valve should be set to 10% above the working pressure of the system.It is also important to put in either a manual or automatic drain on the receiver tank to get rid of water from the system

Specification- 9-10 Liters.

Figure 9. Air Tank.

F) Solenoid Valve

A solenoid valve is a valve that is electrically activated, mainly used to control the flow or the direction of air or the liquid in fluid power systems. Solenoid valves are highly used in both the pneumatic as well as the hydraulic fluid power systems, and many times in poppet or else spool configurations. The valve's spool is joined to a ferrous metal plunger, which is mainly spring centered. The plunger slides within a core tube of non-ferrous metal, which itself is surrounded by a coil of electrical winding. The coil can be in any range of voltage from 12-48 V dc to 110-220 V ac. When power is passed through the coil, a magnetic field is generated that will push or pull the plunger, shifting the valve. The most common solenoid valves are of two-way as well as two-position poppet valves, which easily open and close to allow flow when that coil is energized. They are obtained as normally-open and normally-closed types, that means normally-flowing and normally-blocked.

Usually open in fluid power is completely opposite of normally-open in the electronics, that means either the switch or the contact is open and is not flowing electrons.

Three-way with two position poppet valves are common too, allowing fluid to be flowing from one channel to a different one . Two 3/2 valves in parallel are often wont to control and cylinder bidirectionally. Although construction varies depending on the utilization , this sort of valve is often used for either pneumatic or hydraulics. Spool solenoid valves contain a machined spool which will slide within a machined valve body. Both ends of the spool may have a plunger joined, allowing the solenoid valve to be drawn in any one direction, allowing three positional envelopes. The 4/3 hydraulic solenoid valve is one of the foremost famous, allowing both directional control of a cylinder during a single valve body. The “ways' ' of a solenoid valve ask what percentage ports it contains, and therefore the “positions” of a solenoid valve ask what percentage states it can operate within. A three position valve requires a spring centered neutral state alongside two actuated positions. Pneumatic valves are also there as valves with five ports, that allow a 5/3 solenoid valve to handle the cylinder applications. Ways of a pneumatic valve have exhaust ports, which there are normally two.

Solenoid valves for either hydraulic or pneumatic applications are available as manifold-mounted modular units, like the pneumatic or hydraulic ISO valves. These valves contain standard mounting and porting patterns, allowing valves from any manufacturer to be installed upon an equivalent manifold. Many times, these valves are very cheap, and easily available “off-the-shelf”. The coils of a solenoid valve are often had with DIN connectors, lead wires, Deutsch connectors or the other popular sort of electrical connection utilized in fluid power and automation. Solenoid valves often have removable coils, allowing quick and straightforward replacement after they fail. Coils even have a good range of application and purpose. Some are intended for the economic environment, where atmospheric conditions are consistent. Mobile environments are far more demanding, and need coils which will both handle heat ranges and exposure to road film and salt.

Figure 10. Solenoid Valve.

G) Pressure Relief Valve

A pressure safety valve , sometimes called a safety valve , is one that's wont to control or put a limit on the pressure within any given system to stop preventing it from accumulating and causing equipment damage or posing more severe risks. The valves allow media to be due an auxiliary passage and out of the system once a particular pressure is reached, whether it's a maximum or minimum level. To secure the device, the valve will then open to relieve the strain. The valve is closed until the pressure has returned to normal.

The two forms of pressure relief valves are as follows:

• Pilot operated pressure relief valves – These valves are operated by hand and are opened often through the utilization of a wheel, crank, or similar device. When the operator sees a gauge or other readout in the device that indicates the pressure is too high, they will frequently open the valve. They release the pressure by opening the valve and then closing it by hand.

• Directly controlled pressure relief valves – These valves use a spring mechanism to open when pressure reaches an intolerable level. They can be managed using a remote, a computer programme, a control panel, or a variety of other methods. When the pressure is released, the valves are often programmed to close automatically.

Other types of pressure relief valves include:

• When the relieving pressure is low, these valves use the static pressure of a gas to relieve the device and shut to air pressure.

• Pressure safety valve – the most difference between these and a pressure relief valve is that they are operated with a manual lever to activate the valve just in case of emergencies.

•Safety valves are widely used in the gas industry and work under the same concept as normal pressure relief valves. They can be operated with maximum lift or snap action.

• Vacuum pressure safety valve – When the pressure is minimum, negative, and similar to atmospheric pressure, this is a direct relief valve that often uses the static pressure of a gas.

Pressure relief valves are used in a variety of applications where pressure levels are important for smooth operations, including oil and gas, petrochemical, and power generation with steam, air, gas, or liquid. They're also used of multi-phase applications in refining and chemical manufacturing. The key benefit of a pressure

relief valve is that it prevents the device from malfunctioning when the pressure is turned off. They're also used in refining and chemical processing systems in multi-phase applications. A pressure relief valve's main benefit is that it prevents the device from malfunctioning when the pressure is released.
Approximate cost – 380 Rs

Figure 11. Pressure Relief Valve.

H) ATmega 328p

Atmega 328p is an open-source platform used for building electronics projects. We use Atmega 328p to control the compressor and the solenoid valve in the system to regulate the pressure. We use ATmega 328p in this system.

Figure 12. ATmega328P.

I) Compressor

An air compressor is an actuator that converts power, for example, electric motor, diesel or gasoline engine, etc. into potential energy stored as the pressurized air (i.e., compressed air). A compressor forces a lot of air into a tank, increasing the pressure. When tank pressure reaches its upper limit the air compressor turns off. The compressed gas, then, is held within the tank until called into use. When tank pressure reaches its lower limit, the compressor activates again and re-pressurizes the tank. Pressure of the compressor used: - 115psi-200psi.

Figure 13. Air Compressor.

J) Check Valve.

Check valves are one of the most confused types of valves ever devised. As fluid inside the line reverses direction, a check valve makes flow in one direction but automatically prevents backflow (reverse flow).

They're one of the few self-operated valves that don't need help to open and close. They continue to function even if the plant facility loses air, electricity, or the human being who could manually cycle them.
Check valves are found everywhere, including the home. If you've got a suction pump within the basement, a check valve is perhaps within the discharge line of the pump. Outside of the home, they're used in almost every industry that uses a pump. Check valves are used for a variety of media, including liquids, air, other gases, steam, condensate, and, in some cases, fines or slurries. Pump and compressor discharge, header lines, vacuum breakers, steam lines, condensate lines, chemical feed pumps, cooling towers, loading racks, nitrogen purge lines, boilers, HVAC systems, utilities, pressure pumps, sump pumps, wash-down stations, and injection lines are only a few examples of applications. Check valves are flow-sensitive, meaning they open and close based on the flow of the line fluid. The internal disc causes the valve to open by allowing flow forward. The disc begins to close the valve as forward flow decreases or reverses, depending on the planning.
Internal sealing of the check valve disc and seat relies on fluid back pressure as against the mechanical force used for on/off valves. As a result, permissible seat leakage rates for check valves are higher than for on/off valves. Elastomers, such as Buna-N and Viton, provide bubble-tight shutoff while metal sealing surfaces allow some leakage (zero leakage). As a result, elastomers should be considered for air/gas media and low-pressure sealing where chemical compatibility exists.

Figure 14. Check Valve

XI. FUTURE SCOPE

This ATIS (Autonomous Tire Inflation System) has various applications in many industries such as:
1. Military Vehicles (Armored truck and All-Terrain Vehicles)
2. All-Terrain Rovers
3. Robotics
4. AI-based Autonomous Vehicles
5. Construction and Mining Vehicles.

Such types of application in the real world will be possible and make modern vehicles more safe and secure.
The system we propose features a compressor that automatically adjusts the pressure in each tire while the vehicle is operational to catch up on leaks and slow leak punctures. The driver is going to be ready to adjust the pressure counting on the specified driving mode: comfort, sporty, all-terrain, or over-obstacle. There are two other systems that are oriented toward the consumer market: the Entire system and the Cycloid Air Pump system. The complete self-inflating system uses a valve that sucks in the air from the atmosphere. It then pumps the air into the under-inflated tire employing a peristaltic-pump action. The goal is to constantly maintain a selected pressure.

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