

# MODIFICATION AND AUTOMATION OF TYRE INFLATION AND DEFLATION SYSTEM

V.P. Neve<sup>#1</sup>, Sarthak M. Shukrey<sup>#2</sup>, Mayuresh M. Wamorkar<sup>#3</sup>, Badal G. Singh<sup>#4</sup>, Niketan S. Kendre<sup>#5</sup>

<sup>#1</sup> Assistant Professor, Mechanical Engineering, Konkan Gyanpeeth College of Engineering, Karjat, Maharashtra, India

<sup>#2,3,4,5</sup> UG Student, Mechanical Engineering, Konkan Gyanpeeth College of Engineering, Karjat, Maharashtra, India

## ABSTRACT

We all know that tyre is an important component of every vehicle. Over the period of time amelioration of tyres has been taking place to increase the life of them. Improved tyre life is important to safety of vehicle and driver as well. Therefore, to increase the tyre life, maintaining proper or optimum tyre pressure is very important. So, the aim of our project is to build such system which can monitor and at the same time automatically increase or decrease the tyre pressure according to drivers will. The purpose of our project is to maintain optimum tyre pressure and when pressure gets reduced below the minimum set pressure then pressure sensor will detect it and send a signal to controller unit and tyre will get inflated again via compressor unit. This paper also gives idea about advantages and disadvantages of this system.

**Keywords**— Tyre life, optimum pressure, pressure sensor, controller unit, compressor etc.

## 1. INTRODUCTION

As we know that, tyre is a protective covering around the rim of a wheel that supports the vehicle and increases traction as well. Tyres also increases vehicles performance by absorbing shock. [1]

“The modified tyre inflation and deflation system” is a mechanical system which can be installed in a vehicle that enables vehicles operator to adjust the inflation pressure of individual tyre while vehicle is in motion. [7]

The basic purpose of this system is to:

- A) DETECT: To detect drop in tyre pressure.
- B) NOTIFY: to signal the driver through LCD board about tyre condition.
- C) INFLATE/DEFLATE: There has to be a solenoid valve which allows the air to pass given by compressor unit.

According to a recent study, 75% of automobile on road are driving with underinflation condition. Tires lose their pressure through seasonal change in temperature [2]. They can lose 2-3 psi each month. Underinflation decreases fuel efficiency and increases rolling resistance. When tires are underinflated the contact patch area increases because of which wear and tear of them increases. Underinflated tyres get heated up exponentially. As shown in fig. below faded area indicates excessive wear.

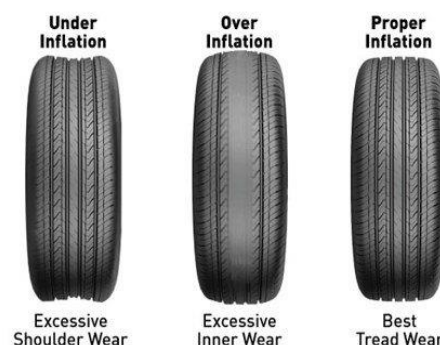
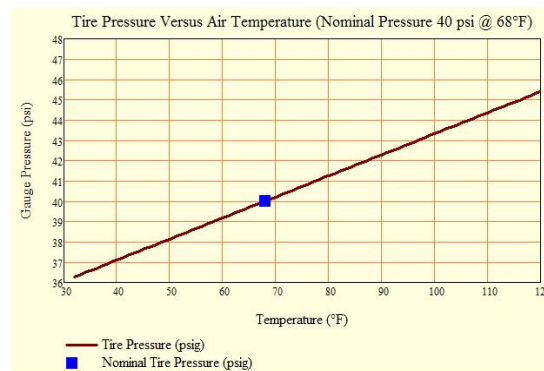


Fig.1 above fig. depicts different states of tyres.

According to Weissler of Popular Mechanics, 1 psi pressure decreases substantially corresponding to 10° F drop in temperature. When tyre is under inflated, the work done by engine increases thus requirement of fuel increases. The aim of infixing is to improve handling and it to improve ease of maneuvering and reduce probability of accident. Due to automation there is no need of human intervention thus reducing time and cost.



**Fig 2. Above fig. depicts graph of Temperature v/s Pressure**

Improperly inflated tyre is a common problem in passenger vehicles. In fact, 80% of vehicles on the road have at least one underinflated tyre and 36% of passenger cars have at least one tyre that is 20% or more underinflated [6]. According to Rubber Manufacturing Association (RMA) survey, 80% of people are unaware of how to check their tyre pressures. Thus, from the viewpoint of passenger vehicles owner, they're losing their money due to increased tyre wear and decreased fuel economy. According to NHTSA Tyre pressure monitoring system is now mandatory in all vehicles whose weight is less than 10,000 pounds or less [8]. Therefore, a solution needs to be found out for this problem. Thus, a combination of the user and expert viewpoints will be used to make decisions in the design of system.

## 2. LITERATURE REVIEW

Literature Review is implemented to carry out to acquire knowledge and skills needed to complete this project. The main sources that led us built this system are previous projects and various thesis related to this project. And other source is Internet wherein we referred various international journals. Thus, by referring to previous project, we can figure out the disadvantages in their project or what we can modify in their system.

Information about various reference papers or previously implemented project have been used as a reference which is as discussed below:

In [1] we get information and definition of tyre. It is a ring-shaped covering that fits around a wheel's rim, protect it and gives better vehicle performance. It acts as a cushion to absorb the shock and provide tractional control for vehicle.

In [2] Sagar Adakmol and team conclude that roads are most important factor for transportation and cars are integral part of it. But, condition of roads is poor nowadays so when car tyres run through pot hole it losses air. Car tyre also losses air due to temperature or seasonal change.

In [3] Aniket Bade and team concluded that, tyre is main component for vehicle handling and safety. Over inflated and under inflated tyre causes bad handling, high fuel economy, less life of tyre and low safety.

In [4] Inderjeet Singh and team conclude that to maintain the uniform tyre pressure of an automobile this system is used. Moreover, maintaining proper pressure fuel efficiency of vehicle increases and overall safety also increases and overall safety also increase.

In [5] According to A. V. Wadmore and team, to aware driver for low tyre pressure a number of tyre monitoring methods have been developed. Properly inflated tyre can give almost 9 more months than its calculates life span. It can save fuel up to 10% and can increase breaking efficiency by 20%.

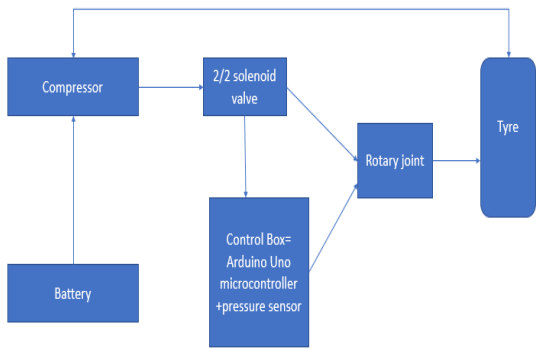
In [6] Harshal Junankar and team conclude that, threads on tyre wears with high rate when tyres are under inflated. That means for every 20% of their life they are not properly inflated you get 15% less miles than tyre's calculated life. As the contact area of tyre increases they overheats quickly causing more damage. To maintain the optimal pressure in tyre while running, the onboard air inflation system is used. For military vehicles this system is very useful as these vehicles have to go to remote places where no system is available to maintain the proper tyre pressure.

In [7] Shreyansh K. Purwar has concluded that, since discovery of tyres, many researches have done on tyres to improve its life and its role in vehicular safety. Proper air pressure must be maintained for smooth running of vehicle and for safety purposes This system was first introduced in American DUKW amphibious trucks in 1942. But now commonly used in Russian military trucks. Tyres are the most important part in trucking industry as they are the second highest costly part. According to AAA (American Automobile Association) fuel efficiency of vehicle is reduced by 10% when tyre pressure is below 2psi than its ideal pressure.

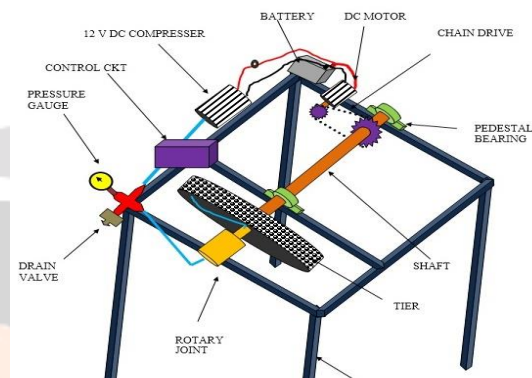
In [8] NHTSA, in their federal rules, concluded that TPMS system is mandatory and should be installed in every vehicle to warn the driver regarding the drop in tyre pressure.

**3. WORKING PRINCIPLE**

In the process of modified and automated tyre inflation and deflation system, the compressed air is provided by a compressor. The pre-programmed sensor is fitted in the pipe structure through which tyre pressure can be determined. The information given by the sensor is fed to Arduino Uno microcontroller which sends signals the compressor to supply compressed air to the tyres. The pressure so supplied is difference of actual tyre pressure and required tyre pressure. Now, compressed air is supplied to the rotary joint which is one of the most critical component of the system. The compressed air after leaving rotary joint passes through flexible rubber housing and then to tyres. Two pedestal bearings are used to support the axle of assembly. Bearings are fixed to the rigid supports via nuts and bolts. The axle is to rotate on which wheel or rim is mounted on one end.



**Fig 3. Flowchart of system**



**Fig4. Constructional Diagram**

One end of the coupler is connected to axle and another end is connected to the rotary joint. Compressor works on 12V battery of the vehicle and it is reciprocating type that’s why it is easy to obtain required pressure level. Rotary joint is used to supply compressed air continuously whenever its required.

**2.1 Components:**

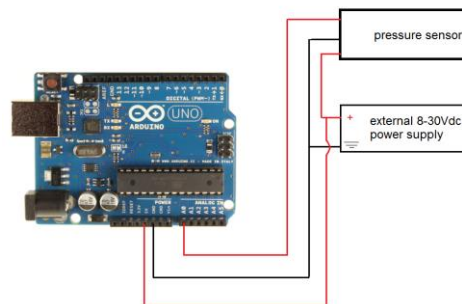
- a. **Pressure sensor:** One of the most important task is to detect actual tyre pressure and to find out how much is required to supply to the tyres. The minimum optimum and maximum optimum pressures are already pre-programmed with the help of Arduino controller. Equivalent reading will be showed to the driver with the help of LCD screen. Pressure sensor will monitor the tyre pressure and will send to Arduino Uno. We are using pressure sensor of SKU series (SKU 237545)

**Specifications of pressure sensor:**

- Working voltage: DC 5.0 V ;
- Working current <=10 mA;
- working pressure range = 0 to 1.2 MPa;
- Bursting pressure: 3 MPa;
- Working Temp range: 0-85 °C;
- Measuring error: ± 1.5% FSO.

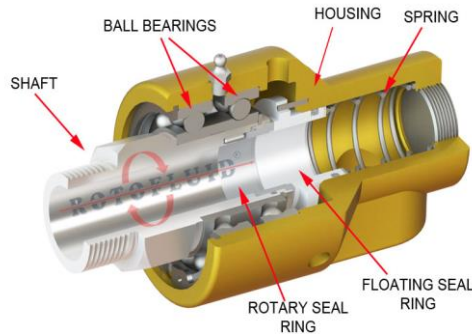


**Fig4. Pressure Sensor**



**Fig5. Arduino Uno interfaced with pressure sensor**

- b. Rotary union/joint:** The most critical component of system is Rotary Joint/Union. Rotary union is a kind of union that allows for rotation of the united parts. It is thus a device that provides a seal between stationary supply passage and rotating part (here, a tyre) to permit air into the tyre. This joint has one half stationary and another half spinning with the spindle.



**Fig 6. Rotary Union**

- c. Air Delivery system:** It consists of 2 by 2 solenoid valve for inflation and deflation as well. It also comprises of piping system for the flow of compressed air. After, passing through rotary joint it encounters rubber hose viz flexible. Flexible hose rotates along with tyre



**Fig.7. 2 by 2 solenoid valve**

- d. Compressor:** A compressor is the one which provides the compressed air to the tyres. It's a 12V electric air compressor which is powered by car cigarette lighter. It is very compact and portable. This compressor has a pressure gauge attached to it that reads pressure in lb/in and kg/cm. The maximum pressure that can be delivered is 300 psi (as written in the product description). The proper placement or positioning of compressor is important



**Fig8. 12V Compressor**

- e. Car battery:** An automotive battery is a type of rechargeable battery that supplies electric energy to automobile. Usually this refers to an SLI battery (starting, lighting, ignition) to power the starter motor, the lights, and the ignition system of a vehicles engine Modern SLI batteries are of lead-acid type and provide volts of direct current, generally 12V.
- f. Pedestal bearings:** A pillow block usually refers to a housing with an included anti-friction bearing. A pillow block refers to any mounted bearing wherein the mounted shaft as in a parallel plane to the mounting surface and perpendicular to the center line of the mounting holes as contrasted with various types of flange blocks. A



pillow may contain a bearing with various types of rolling element., E.g. Ball, roller, cylindrical, tapered, needle type etc.

#### 4. CONCLUSIONS

The main benefit of this advancement in technology is that the vehicle owner can change the tyre pressure according to his own will. Despite of its high initial investment in this technology, the vehicle's owner will experience reduction in tyre wear and increase in fuel economy. Also, the vehicles safety will exponentially increase because of this modification and advancement in technology. There is no human intervention since it is automatic because of programming.

It has many benefits in transportation industry as well. These benefits include, improved vehicle mobility due to the increase in traction when tyre pressures are lowered, improved ride quality and cargo safety due to the reduction in vehicle vibrations when the correct tyre pressure is used for a particular road condition, reduced road maintenance because sediment production is limited and lowered road construction costs, increased fuel efficiency and a considerable increase in the tyre life of vehicles.

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#### REFERENCES

- [1] V. Jeeva Bharathi, D Johny, G.K. Abilan, K. Karthik, M. Mohanraj, Design and Fabrication of Automatic tyre Inflation System. International Journal of Advance Research and Innovative Ideas in Education. Vol. 02 Issue 03. (2016)
- [2] Sagar Adakmol, Tushar Shende, Dikshit Poriya, Sanjot Fotedar, Prof. S.P. Shinde, Central Tyre Air Inflation System, International Journal for Scientific Research and Development, Vol. 04, Issue 03. (2016)
- [3] Aniket Bade, Vijay A. Khade, Mukesh Dangwal, Sunil Hatkadke, Prof. Sagar Patil, Online Tyre Inflation System, International Journal of Engineering Science and Computing, Vol. 07, Issue 06. (2017)
- [4] Inderjeet Singh, Bhupendra Pratap Singh, Hari Shankar Sahu, Raunak Chauhan, Novel Kumar Sahu, To Study on Implementation of Tyre Inflation System for Automotive Vehicles, International Journal of Innovative Research in Science Engineering and Technology Vol. 05, Issue 04.
- [5] A. V. Wadmore, P. S. Pandure, Automatic Tire Pressure Controlling and Self Inflation System: A Review, IOSR Journal of Mechanical and Civil Engineering e-ISSN: 2278-1684, p-ISSN: 2320-334, PP. 01-05.
- [6] Harshal Junankar, Vishnusagar Bihare, Nishant Giradkar, Chetal Gupta, Automatic Tyre Inflation System, International Journal for Scientific Research and Development, Vol. 03, Issue 01. (2015)
- [7] Shreyansh Kumar Purwar, Automatic Tyre Inflation System, International Research Journal of Engineering and Technology, Vol. 04, Issue 04.
- [8] NHTSA, Federal Motor Vehicle Safety Standards [online] Available <http://www.nhtsa.dot.gov/cars/rules>
- [9] "Tire Maintenance and Safety." The Rubber Manufacturers Association.
- [10] Design of machine elements by V.B. Bhandari.