

# Use of Extra Tire to Provide Stability to the Vehicle in Emergency

**Dr. Pranil Vijay Sawalakhe**

*Department of Mechanical Engineering, Faculty of Engineering and Technology,*

*JAIN (Deemed-to-be University), Karnataka – 562112*

*Email Id: vs.pranil@jainuniversity.ac.in*

## **Abstract**

*As the vehicle travels over the road there are lot of obstructions or sharp objects are encountered by the tires due to which the tire of the vehicle gets damaged or punctured. Due to which there is production of sudden jerk on the vehicle which can make the vehicle unstable and the driver may lose control over the vehicle and accident may happen. So to maintain the stability of the vehicle there is need for the immediate use of some extra tire to provide stability to the vehicle. In this research paper the technique of extra tire technique has been proposed. The tire provided can rotate in any direction to meet the directional movement need of the vehicle for the immediate cause. The tire provided is actuated with the use of the hydraulic telescope. This hydraulic telescope is actuated either by the driver by pressing the button for the specific tire or it can be made automatic using the Tire Pressure Monitoring System (TPMS) sensor. This technique will be very useful to tackle the emergency situations arising due to sudden damage or puncture of the tubeless or with tube tires because sudden damage to the moving tire causes the instability and this instability becomes more if the vehicle is moving at a high stability which may otherwise cause a major damage to the occupants and vehicle.*

**Keywords:** *Obstruction, occupant, Puncture, Tire, TPMS, Tubeless, Unstable, Vehicle.*

## **I. INTRODUCTION**

Extra/spare tire is generally provided with the 4 wheelers by the company selling the car. It serves the purpose for changing the tire in use if there is any problem of puncture or damage to the tire in use. To change the tire special tool kit is also provided which contains the jack, handle for the jack, wrench. It requires an effort by a person to firstly park the vehicle on a leveled surface with the hand brake applied and then opening the wheel cover, then opening the nuts to loosen the tire and then fitting the extra tire on the hub and putting back the wheel cover and mounting or placing the used or damaged or punctured tire in a proper place where extra tire was placed. This takes a lot of time [1]. Now in emergency situations what happens is that whenever a tire gets puncture or damaged due to any of the uncertain reasons there is immediate jerk on the vehicle which unstable

the vehicle and driver may lose control over the vehicle and thus ultimately may lead to accident of the vehicle and after math results may be dangerous that are unexpected. The more the speed of the vehicle the more will be the jerk and higher chances of losing control over the vehicle. So, to prevent this situation there is need of providing immediate stability to the vehicle so that the vehicle can be taken under control in case such a situation arises. This can be done only with the use of providing some running support or object on the same side so that the jerk can be prevented and the vehicle keep on moving with the same speed while maintaining the proper running direction of the vehicle. So, providing an emergency tire on the same side and close to the damaged or punctured tire can be a solution to the problem. The research on this technique has been done in this research paper with the use some other supporting apparatus like shocker, mechanical spring and the telescope, all-round rotating tire and a column.

#### **A. TPMS:-**

It is used to continuously monitoring the pressure of the tires like whether the tire is underinflated or the tire is creating problem in the driving conditions. It is indicated on the dashboard as yellow symbol which illuminated on the dashboard's instrument panel in the form of a tire cross section with an exclamatory sign. This is necessary because in the past it has been observed that a lot of accidents occurs due to the low pressure of the tires. Thus with the use of TPMS the tire pressure can be maintained and thus accidents can be avoided. There are two types of TPMS: Indirect and Direct TPMS [2].

#### **B. Indirect TPMS:-**

It depends on the wheel speed sensors which are also use in the ABS. Wheel speed sensors measures the rate of revolution of each wheel then each wheel speed is matched or compared with the speed of the other wheels and this is further compared with vehicular speed. Thus on the rate of the revolutions made by each wheel the relative size of a tire can be determined but when a wheel makes more revolutions than the desired it means a tire is underinflated because a small objects makes more revolutions in the same time as the large round object makes and this alert is sent to the driver that the tire is underinflated [3]. Thus an indirect tire pressure monitoring system measures the pressure of the tire in an indirect manner which is different from the gauge measurement. Instead it simply monitors the rotation rate of the tires and interprets the condition of the tire and signals the system to actuate the indicator whenever there is some mismatch with the desired rotation rate than the actual rate. Following are the advantages of the indirect TPMS.

1. Less expensive as compared to the direct TPMS.
2. Less programming is required as compared to the direct TPMS.
3. Maintenance required is very less than the direct one.

#### **C. Cons of Indirect TPMS:-**

1. Gives inaccurate readings if the size of the tire changes than the standard one.
2. Not reliable in case of worn out tires
3. Reset is required after the inflation of the tires
4. Reset is required after the rotation of the tires.

#### **D. Direct TPMS:-**

It uses the pressure sensors which measures the pressure of each tire specifically. These sensors can also provide the temperature reading of the tires. This direct pressure monitoring system. It sends all the data wirelessly. Each sensor is different from the other sensor with unique sensor number. To choose a TPMS for a vehicle requires an expertise and knowledgeable technician. Following are the advantages of the direct TPMS.

1. Provides actual measurement of the pressure.
2. Readings not affected with the change in size or rotation of the tires
3. Batteries provided for the sensor inside the tire can last for almost a decade
4. This can also be used in vehicle's spare tire.

#### **E. Cons:-**

1. It is costlier than the indirect one
2. Although simple resynchronization is required after rotation of the tires but that also requires some costly tools
3. In case of any problem to the battery the whole sensor should be changed
4. Sensors may get damaged during the mounting or demounting of the tires.

Although both the above discussed systems may differ in their methodologies but ultimately both the systems provide the same results in the end that is the pressure measurements for the tires. It should not be considered as the replacement for the manual air pressure checks but an another object in the vehicle for the maintenance of the tires.

The Arduino UNO is the best board to start with the electronics and coding/programming. The UNO is the very much in demand and documented board of the whole Arduino family. Arduino Uno is a microcontroller board based on the ATmega328P [4]. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 are analog inputs, a 16 MHz ceramic resonator (CSTCE16M0V53-R0), one USB connection, one power jack, one ICSP header and one reset button. It also contains everything required to support the microcontroller; by simply connecting it with a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. You can tinker with your Uno without worrying too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again. "Uno" means one in the Italian and was chosen to mark the release of Arduino Software –IDE b 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino. The Uno board

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is the first one in the series of USB Arduino boards and the reference model for the Arduino platform, for an extensive list of the current, past and the outdated boards [5].

## II. LITERATURE REVIEW

Parth M. Patel, Parth S. Patel, Vaibhav H. Shah, Suril R. Shah in their research paper proposed an automatic jack for the vehicle. In case of changing the tire there is need to raise the car and for that a jack is used which lifts up the car to a height so that with the help of wrench the screws can be loosened and the tire can be easily changed [6]. So this technique will save the time and effort required to use the jack and founding the suitable place on the vehicle to use the jack. Just by pressing a button the jack will lift off the vehicle. This technique can be combined with this research paper technique to make the vehicle occupants to feel more easy and comfort in case of experiencing the tough situations of puncturing or damage to the tire of the vehicle. Qingzhang Chen, Youhua Liu, and Xuezhi Li in their research paper proposed a different technique for providing the stability to the vehicle as proposed in this current research paper [7]. In their research they proposed for using the emergency braking to slow down the vehicle or stop the vehicle when this system will receive signal for tire blowout. As the tire blowout immediately provides a blow or heavy jerk to the vehicle due to the release of the air there may be accident of vehicle that can lead to the loss of the lives or the damage to the vehicle. But the technique proposed in this current research paper is an advancement in this current existing technique because using emergency braking or slowing a vehicle can be dangerous sometimes on the highways as all the following vehicles may smash with the leading vehicle. So, using an extra tire is more fruitful and also to maintain the same the same speed for some time until the vehicle can be moved to a safe side.

## III. METHODOLOGY

An extra tire is provided on each side of the four tires to serve the purpose of each tire in case of emergency. This tire cannot be used all the time or for a long journey but just to serve the emergency situation and providing the stability to the vehicle. This tire is provided on the chassis of the vehicle and in total 4 tires are provided. Each tire is provided with a telescope, shocker and an all-round moving tire attached with a column, and a spring[8]. Telescope is provided to move the column or open the column to touch the tire to the ground in case of emergency. Shocker is provided to absorb the jerks produced on the column and spring is provided to absorb the jerks produced in the telescope. The telescope is actuated with the use of the hydraulic pressure using hydraulic fluid from a sump. This actuation of the telescope is done either by the driver who observed the danger of the instability of the vehicle or it can be made automatic with the use of the signal of the TPMS. TPMS continuously monitors the pressure of the tire. This signal is sent to the microprocessor Arduino Uno and Arduino Uno further controls the telescope open and closing to actuate the emergency tire. In case of emergency the pressure of the tire will get reduced below a predefined value which provide the instability to the vehicle and the emergency tire will get open automatically and the vehicle can be made to land on the safe side and then this emergency

tire can be lifted off by pressing the button to the pressure of the telescope to retract the tire back to its folded position. The dimensions of the open column and the emergency tire are calculated with the corresponding size of the tire used in the vehicle in its inflated size. Figure 1 illustrate the various link of actuating the emergency tire Telescope, Spring, Column actuated by the telescope, Shocker to absorb the jerks on the emergency tire and the tire. Figure 2 illustrate shows the vehicle mounted with the emergency tire on the front right side of the vehicle.

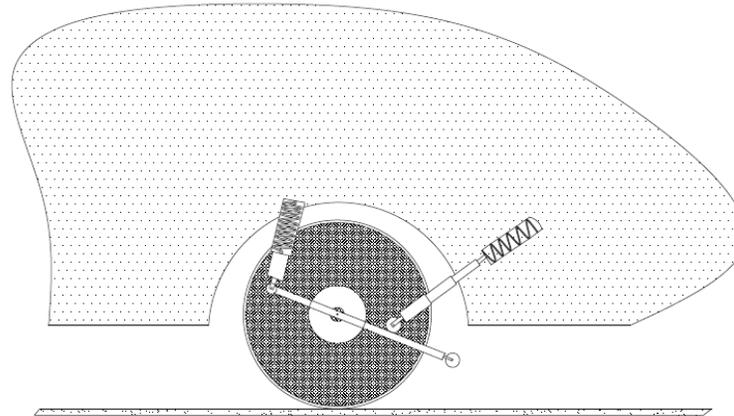


Fig. 1 Shows the various link of actuating the emergency tire Telescope, Spring, Column actuated by the telescope, Shocker to absorb the jerks on the emergency tire and the tire.

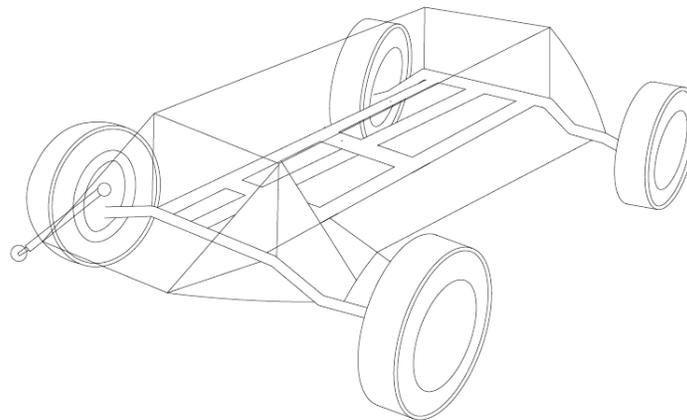


Fig. 2 Shows the vehicle mounted with the emergency tire on the front right side of the vehicle.

#### IV. RESULTS & DISCUSSION

Using this extra emergency tire will provide stability to the vehicle and it will help the driver to maintain the control over the vehicle and thus it will prevent the vehicle from accident saving the lives of the occupants. This tire can rotate in any direction so it will provide all direction movement in case of steering of the vehicle also. This tire cannot be used as the other tires because this tire is not made for the running for long distance. These tires are just to assist for the emergency situation to prevent the accident and to take the car to the safe side so that the damaged tire can be changed

with same type of extra actual size tire. This emergency tire is small in size as compared to the tire mounted on the hub.

## V. CONCLUSION

This technique can be implemented in various vehicles depending upon the requirement. Further this can be modified by using the tire not only in case of damage to the tire but also in case of tilting of the vehicle for which the extra column length, better use of telescope and the shockers and the better design of the tire. It will help in maintaining stability to the small as well as the heavy vehicles. It is like emergency landing of the vehicle on the safe side. This will help to reduce a great of number of accidents happening on the roads due to the instability of the tire which mainly occurs due to the sudden burst of the tire in summer season mainly or due to heat up of the tire, due to wear up of the tire or it can be said using the tire after the permissible lifetime of the tire or due to any cause of damage occurring to the tires.

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