The Modification of Smart Rubber Tire Structure

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Abstract

In this study, two layers of steel conductors were shaped and designed as network and overlapping with each other figure (2). Then putting polymer material (non-conductor) (2mm) between these two layers as tire structure consists of seven layers. This project analyzes the implementation of a smart tire with data showing capability in cars and other wheeled vehicles at a systems engineering level. The work has shown that the system can identify any conductor materials were penetrated or punctured the tire structure figure (1). As a result, conductor materials have significant influence which the tire damage can be identified 99% table (1). However, polymer and glass were non-significantly been shown whilst they were penetrating or puncturing the tire layers and the percentage of identification for polymer and glasses was 10%. In the further research the Sensor node packages which lie within the tire is necessary to show any other material such polymer and glasses while penetrating or puncturing place.

Keywords; **conductor materials; smart tire; Sensor node packages; puncturing.**

I. INTRODUCTION

Many active safety features exist in cars and other vehicles, but many improvements are possible. However, any system is limited by the amount of information that is available to it. Ultimately, to become safer, additional information beyond what can be provided by current sensors is necessary [1]. Showing light alert in the car dash board and other values directly from the tire of a vehicle can provide some of this additional information. By taking data near the contact patch between the tire and the road during penetrating the tire by any metal shapes such as nail and screw. This idea become acceptable in the near future; this project would improve car safety, and reduce car potential accident. In addition, Pneumatic tires are manufactured in 450 tire factories approximately; over one billion tires are manufactured yearly, making the tire industry a major consumer of natural rubber. It is estimated that by 2015, 1.72 billion tires are expected to be sold globally. Tire invention starts with bulk raw materials such as rubber, carbon black, and chemicals and produces numerous specialized components that are assembled and cured. Many kinds of rubber are used, the most common being styrene-butadiene copolymer [2].

According to National Highway Traffic Safety Administration has been estimated that 200,000 accidents occur as a result of under-flatted tires [3]. Also there are inventions and modifications have been investigated previously “The transponder is located within the tire structure and is capable of transmitting an identifying digital signal in response to interrogation by an R/F electric field emanating from outside the tire” [4]. In addition, there is a great attempt such as “between the tread of the tire and road there are distributors and interfacial
Pressure and horizontal streets that affect the important operating properties of the pneumatic tire [6].
“it’s a key to know that Combining FEA with optimization techniques, the tire design procedure is drastically changed in side wall shape, tire crown shape, pitch variation, tire pattern” [7]. According to agency data, 3% of tires in the system are rated with the highest (wet) traction grade and provides a rating for treadwear that indicates a tire's wear rate relative to a control tire. The control tire is assigned a grade of 100, and the higher the assigned grade the longer the projected tread life [8].

Therefore, there are many researches and works have been conducted previously to find out sustainable materials and optimal solution to better and safer progress tire industries however, safety is the key and has a significance impaction from both friendly and environmentally safe tire construction and economic perspective.

Final attempt regarding to effect of tire dealing with environment has been searched that there have been no data available for carcinogenic dibenzopyrene isomers in automobile tires. Furthermore, these findings show that automobile tires may be a potential previously unknown source of carcinogenic dibenzopyrenes to the environment [9].

II. PROJECT STATEMENT

Although tire manufactures and mechanics in that area developed tire pressure monitor system (TPMS) however, their studies might not identify the reason behind tire fault therefore; this project analyzes the implementation of a smart tire with data showing capability in cars and other wheeled vehicles at a system engineering level.

III. Aim of the Project

This modification provides additional safety and car reduction accident due to tire damage. Also this project let the driver and mechanic know about penetrating tire by any metals and conductors. This strategy leads reduce time to find crossing place and provide a better and more intelligence system for car tire

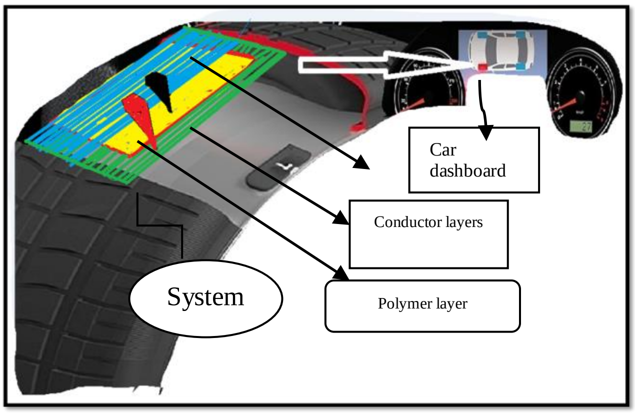


Figure 1. Visual Structure shows the Penetrated tire

IV. Methodology

This work was conducted at automobile workshop - manufacturing department - faculty of engineering - Koya University. Figure (2) show two layers of steel conductors shaped as network and overlapping above each other. Then covering the net (steel) with polymer material (non-conductor) (2mm) between these two layers as tire structure consists of seven layers and most of the tires have two steel belt layers and covered by polymers. Accordingly these two layers connected to an open circuit of electricity therefore, during any metal or conductor materials such as screw and nail penetrate the thickness of the tire was closed the circuit of the electricity and that action was shown the light or ringing as well as identify that the tire has been penetrating. It has been showing in car dashboard and the tests and attempts have been checked for many times and have shown the same result as expected. However, for the non-conductors materials (glass and polymer) were different and their results did not demonstrate same situation table (1). It's crucial to mention that the tire layers was made at automobile workshop – manufacturing department – faculty of engineering Koya University however, searching still under way to find out the best optimal tire manufacture to create and add this modification. Here are the tools and devices used in the test:

1- Conductor layers (net shaped)

2- Non-conductor Polymer layer and used tire

3- Electrical circuit (Control system)

4- Wireless Doorbell (communicate device and connecting with receiver)

5- Screw, nail and glass for puncturing operation.

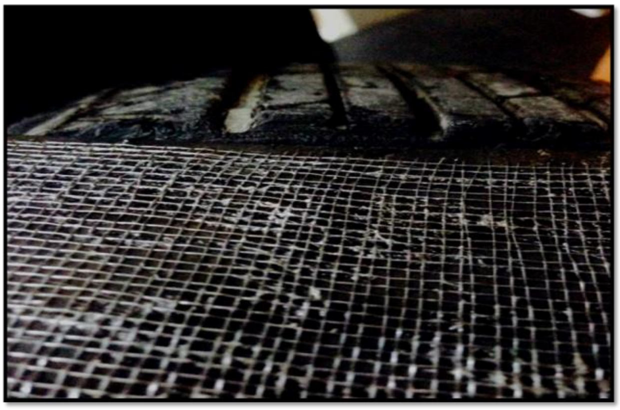


Figure 2. Tire Steel Layers Modification

Figure 3. It can be seen nail Penetrated the tire layers

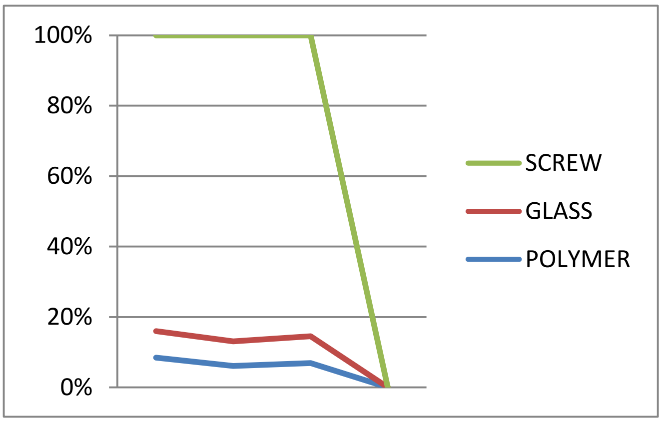
V. Results and Discussion

To show the effect of modified tire structure which plays important role to identify reasons behind tire damage as the graph (1) shows the conductor materials such as screw increasingly show it.

For the current work the result is summarized in Graph (1) as well as table (1), it can be seen that the maximum identification significantly affected while the tires have been penetrated with (screw).On the other hand, the graph (1) and table (1) also show non-conductors for example, (polymer and glass) non significantly affected by the modification that has been done this techniques leads to supply smart improvement tire structure which is only read or show the conductor materials. In some cases the net also could read and identify the polymer and glass due to overlap the net by the pressure and areas compressed.

TABLE I. IDENTFICATION OF CONDUCTOR AND NON CONDUCTOR

	POLYMER	GLASS	SCREW
attempt 1	10	9	98
attempt 2	7	8	100
attempt 3	8	9	99



Graph (1) shows the conductor material (screw) compare to others

Figure 4. Tire modification and data reciver

VI. CONCLUSION

1- Preliminary work on the Smart tire system shows that the system is quite complicated because of its diverse innovation in tire manufacturing.

2- The work has shown that that the system can identify any conductor materials.

3-For improvement of this development in tire, further actions and designs are necessary. Moreover, providing and generating electrical power from tire accessories or from itself.

4- In terms of economic effectiveness that has been evaluated there was approximately six USD can be added to regularize this modification to current tire.

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