MEASUREMENT OF AIR PRESSUREON AUTOMOBILE

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ABSTRACT

Speed limit of a vehicle is decided depending upon the condition of road, traffic, government regulation and other real world constrains, one of them being the air pressure on the vehicle when it is moving on the road. Technically speaking it depends upon the drag coefficient of the vehicle being determined on the design of the car. Instead of using the traditional CAD design and testing tools or the numerical based approach here the below given system employes the technique being solely used for race car design testing or the Aeroplane test. This project employes a no of sensors to gather the data and LABview tool to analyse that and show the pressure on various zones of the vehicle.

***Keywords*: Labview, testing, Air pressure, vehicle Design, Drag coefficient**

I. INTRODUCTION

Everyone today is in hurry to reach his destination as swift as possible, their delivery being made as soon as possible. Fuel is also an important factor to be considered which depends on the drag coefficient of the subject under study. Drag coefficient as per Wikipedia is a dimensionless quantity which is used to measure the resistance offered by an automobile travelling at high speed. It is because of two things one because of skin called as skin friction drag and second because of shape called as to be form drag. Mathematically

$$Cd = \frac{2F}{\rho v^2}$$

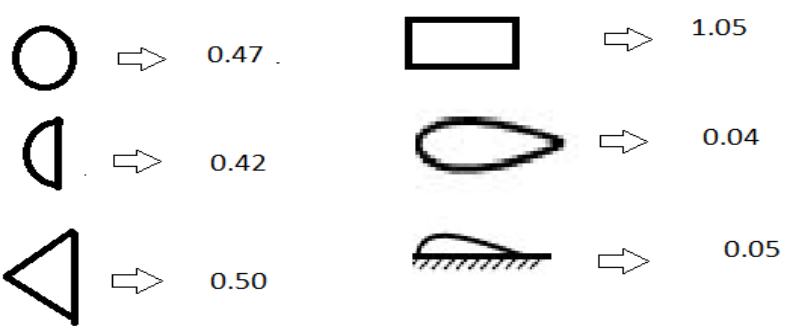
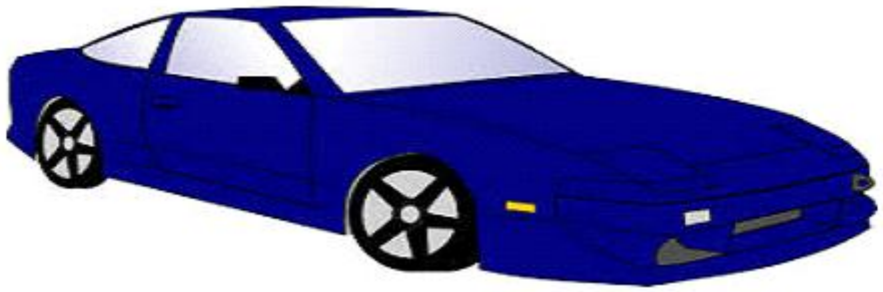


Fig.1 Typical Values of Drag Coefficient of Various Shapes

Typical car designs are as depicted in the images below

Angular A and angular Cpillar



Curved A and curved C pillar

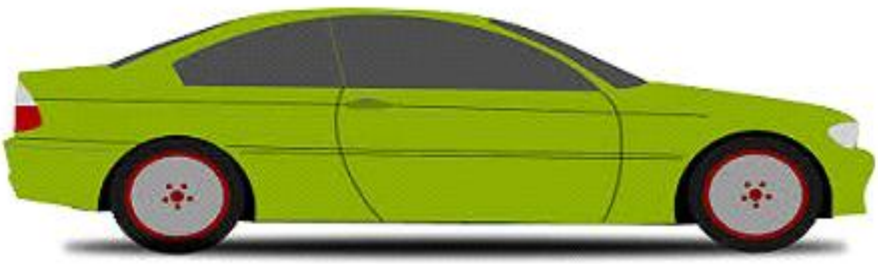


Fig. 2 Typical Car Designs

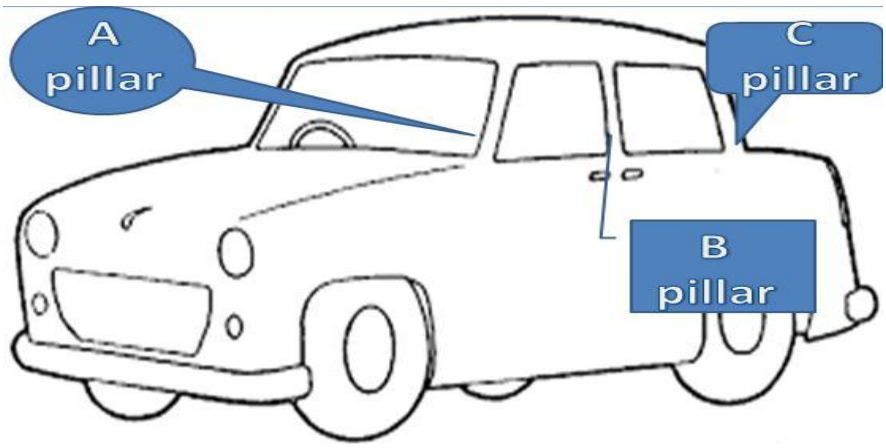


Fig. 3 Car Depicting Body Pillar of the Car

When air hits the automobile from the front end it has two effects one is reduced speed, causing discomfort in driving and higher fuel consumption, the other being lower grip of the vehicle on road as tries to lift it against gravity. For a heavy automobile such as truck the later problem is seldom observed but for light commercial vehicle and personal cars it a major issue of concern. Also at the time of car turning at curved roads and flyovers the air tries to drag the unstable vehicle to the edge and causing catastrophic situations. Hence all these constraints must be kept in mind while vehicle design.

Along with all these necessities there are some more such as safety of the passengers, look of the vehicle (attraction is a major force in case of personal automobile sales) and last but never the least is the cost of the subject the more time and money is spend in testing the costlier the vehicle get. To achieve this entire goal this paper discusses various tools and techniques a few of which worth mentioning are numerical based approach and CAD based analysis

1. Numerical based Approach

It uses the power of mathematics to check for the automobile design testing. The subject under consideration of our work is a Car model.

Any car design typically can be divided on the bases of pillar into three. A, B, C pillars which are as depicted into the picture just before.

A pillar and C pillar are the aerodynamically most important part of the car that causes the car to be unstable, reduced speed and lesser secure. In this approach without making the actual model everything is drawn on paper and is evaluated by making a lot of assumptions.

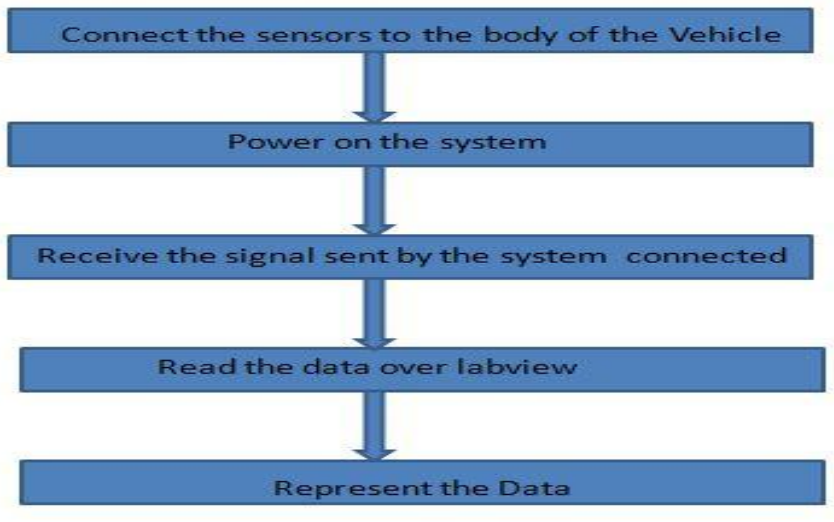
2. Computer based Design tools (CAD)

CAD tools have made our life simple by doing various calculations in background and making the response faster, reliable and represent able format. For these tools there is complex algorithm to show the outputs for the design being generated in a particular environment loaded with all design constraints for making it to appear as to be realtime.

But the problem with all these approaches is that they are all based on certain assumption and approximation. No matter how close to the real life they try to get the always lends up in a few or more assumption or costly setups.

II. METHODOLOGY/ ALGORITHM

This system is very generic in usage and is capable to be used for any vehicle under test as per the following algorithm



First connect the hardware being discussed shortly ontothe surface of the vehicle. The system is then turned on and the data is now being transmitted by various sensors one by one on time sharing basis. The data being received is saved into a file format acceptable to the labview i.e. labview compatible. The data is then being represented using GUI feature of LABview.

III. CIRCUIT DIAGRAM

The circuit of the subject can be divided into two parts transmitter and receiver circuit. The transmitter is located at the vehicle site and the receiver being at a remote place.

Fig. 5 MPL 500

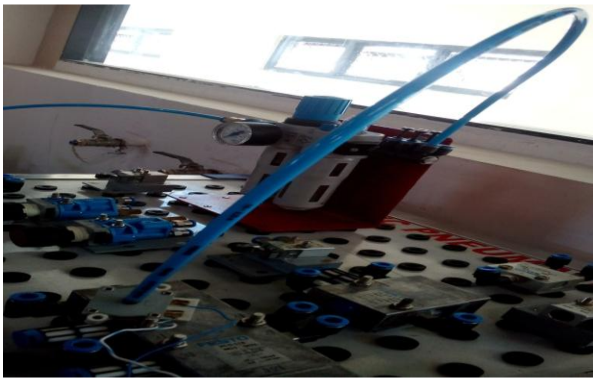


Fig. 6 Sensor Calibration

3.1 Transmitter Circuit

The system under the consideration is to be placed at a far place from the place where it is to be analysed so we have taken a device for remote space called as zigbee configured as to be router. To take the sensor data from the body of the automobile we have take a series of sensors from various manufacturers like MPL 502, MPL 500, BMP180

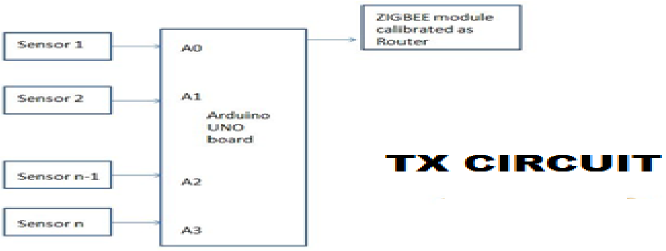


Fig. 4 Transmitter from Vehicle

An Arduino board is used to collect the analog data from these sensors and then send them one by one on TDM basis. Since the project uses a single zigbee transmitter module the TDM process for signal transmission and reception is used. Arduino UNO board is in built with a 4 channel 10 bit ADC so as to convert the data to digital format and then modulate the signal as per proper format. This system ported an RTOS on to the board so as to make the transmission to be very effective and to synchronize signal as per correct order

3.2 Receiver

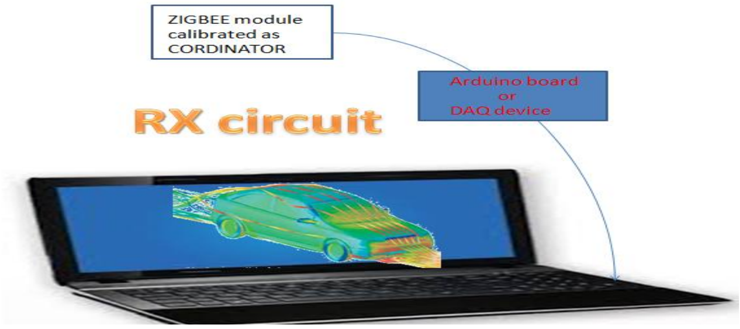


Fig. 5 Receiver of the Sensor Data at Distant Place

The signals that are sent from the TX circuit are received by the zigbee module configured as coordinator and the data is received serially.

This system is programmed to use an Arduino board as an interface b/w the LABview software installed in our system and the zigbee. After getting the data over LABview, data is manipulated and is displayed as some GUI.

IV. TOOL USED

The tool used for creating the module is LabVIEW by National Instrumentation [9] which is acronym for Laboratory Virtual Instrument Engineering Workbench. It is a visual programming tool for creating program. It is a very powerful and generic programming language which creates VI i.e. virtual instrument and can be called in other VI as sub VI for ease of programming.

Also the system uses XCTU for configuring the zigbee modules provided by xbee ltd. Arduino IDE is used to programme the Arduino UNO board.

V. RESULTS

The system was tested for two car designs and the various values of the sensor output are collected. A source with unknown levels of the wind pressure was taken and air was blown from the front end of the design. The sensors were pre calibrated using FRL system (a system capable of flowing air at non pressure ranging from 0 to 20 bars) and the typical sensor values were already recorded in a lookup table format and when unknown pressure was blown these values were matched and displayed. We have used 3 levels of air pressure on each design having 3 sensors over the subject under test. The results obtained are as

Table 1 Showing Pressures at Angular A and Curved C pillar Car (angle of A is 35*)

Pressure level	Pressure observed at in Bar		
	Sensor 1	Sensor 2	Sensor 3
1	1.5	1.3	1.01
2	1.7	1.4	1.01
3	1.9	1.5	1

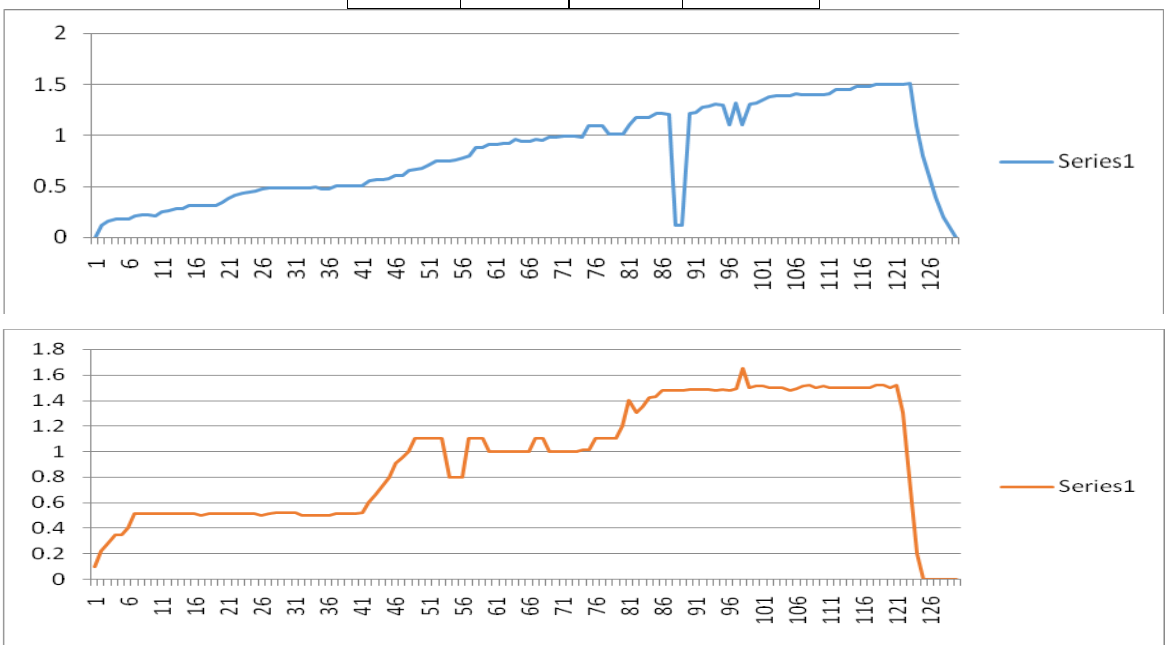


Fig. 6 Sensor Value Plotted as Graphs

VI. CONCLUSIONS

Of various design of car that have been tried out results shows that angular A and curved C pillar design is best suited for the high speed application as they provide better stability and a reduced value of drag coefficient along with more comfort. As previously talked about, these various configurations causes the air flow dynamics misbalance as per the laws of physics under the car and opposite to the direction of it making it difficult to drive and less fuel economic. For an effective car design we must make the body streamlined as it makes the pressure of wind to be distributed in a balanced manner and avoiding it to get dislodge from the road.

An alert system can also be designed on this project so as to give warning to the driver if he is driving in improper manner or in hazardous conditions as to avoid loss of property and human life.

VII. SCOPE OF WORK

Since this project is only for college project here only 3 sensors have been incorporated but if provided with proper funding and professional excellence system which is having an array of sensors to read the data over various parts of the vehicle can be developed. These could be used to generate a point to point mapping of all the points of a car at their respective pressure levels. This is a very generic design circuit capable of implementation at various environments and for any designs.

This project as is clearly depicted is free from any errors because of assumption and is cost effective as the sensors and other hardware requirement are cheap in cost. This system can also be used to decide the speed limits of an automobile and at various road conditions.

VIII. ACKNOWLEDGMENT

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