

Fig 10. (a) Isometric view

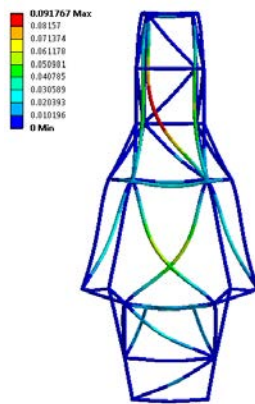


Fig10. (a) Top View

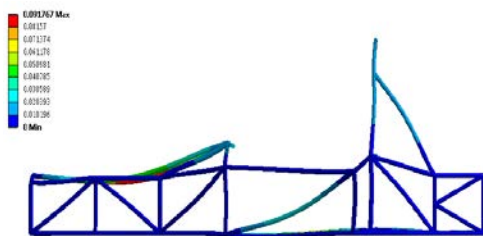


Fig 10. (c) Side View

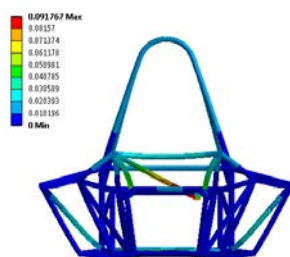


Fig 10. (d) Front View

tural frame of chassis is first designed on solid works software and also structural Analysis are used. After designing this structural chassis, it is tested and analyzed for different fatigue, static and dynamic loads which is done on ANSYS Software to obtain proper chassis design with minimum deflection for failure. For fabrication of chassis selection of material is also an important criterion due to fact of sustaining loads and forces, and resist any deformation. Any deflection or deformation may be averted by the use of structural support which may provide rigidity and stiffness to the chassis and also may help in terms of reliability and endurance strength. The overall need is to create a light, stiff, rigid and safe chassis to fulfill its given purpose.

## 7 Acknowledgment

The authors wish to thank prof Mohd. Raees who helped us in the research for the analysis of the chassis, along with publishing of this paper. Also, we would like to thank the SAE SUPRA for providing us the platform to do such kind of research work.

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## 6 CONCLUSION

A chassis consists of an internal vehicle frame that supports an artificial object in its construction and use, can also provide protection for some internal parts. In this work Struc-

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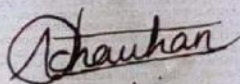
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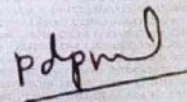
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# CFD analysis of solar air heater having absorber plate roughened with compound turbulators

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**Abstract**—In the present work the thermo hydraulic performance of solar air heater having absorber plate roughened with compound turbulators is analyzed using Computational Fluid Dynamics (CFD). The effect of absorber plate geometry on heat transfer and friction factor is studied by varying the relative roughness height ( $e/D_H$ ) from 0.025 to 0.040 (4 values) and relative roughness pitch ( $P/e$ ) from 8 to 15 (4 values). Range of Reynolds number selected for numerical simulation is 3000 to 18,000 (6 values). Different turbulent models have been used for the analysis of solar air heater and their results are compared with the experimental data available in the literature. The results obtained using K- $\epsilon$  Standard model have been found in good agreement with the experimental results and hence this model is used to predict the heat transfer and friction factor in the roughened duct for various geometries of an absorber plate. The thermo hydraulic performance parameter (THPP) is also evaluated for each plate to predict the overall performance and also for selecting the best geometry for the range of parameter investigated.

**IndexTerms**—Solar Air Heater, Heat Transfer, Friction Factor, Compound Turbulators, Thermo Hydraulic Performance Parameters (THPP).

## I. INTRODUCTION

The demand of the energy is increasing day by day on the other hand the fossil fuels are depleting continuously and rapidly. This leads to the continuous increase in demand supply energy gap. In order to fulfill this huge energy gap, lots of research is going on all around the world to utilize the renewable sources of energy properly and efficiently. Among all the renewable sources of energy Solar energy is available in plenty as compared to other renewable sources of energy like wind energy, tidal energy, ocean energy, wave energy, geothermal energy etc. This solar energy can be properly utilized by converting it first into thermal energy using solar collectors and then using this energy in various applications.

Among the various solar collector systems solar air heater is the simplest and cheapest way to convert the solar energy into thermal energy. It has various advantages like compact and less complicated system, it can be design using cheaper and lesser material as compared to solar water heater and best part is air ass working fluid which is non-toxic, freely available, corrosion free, its leakage doesn't harm the environment etc. It has variety of applications like space heating for residential and commercial applications, drying of laundry, agricultural crops (i.e. tea, corn, and coffee) and other drying applications, seasoning of wood etc. But poor thermal conductivity of air leads to lesser heat transfer coefficient between absorber plate and air which leads to poor performance of solar air heater. In order to enhance this performance, a passive technique of introducing artificial roughness in absorber plate is the most common technique trending nowadays. Use of artificial roughness creates turbulence inside the duct which effectively increases the heat transfer rate and on the contrary it also increases the friction factor which leads to high pumping power. So to avoid higher requirement of pumping power turbulence must be created only near to absorber plate (i.e. in laminar sub layer zone only).

Lots of research has been carried out by various investigators experimentally as well as numerically in order to predict the performance of solar air heater with artificial roughness on absorber plate. Summary of various numerical and theoretical studies has been discussed in the review papers [1-4]. The number of numerical studies reported is quite less compared to the number of experimental studies. Bhagoria et al. [5] have performed experimental investigation of solar air heater with wedge shaped roughness element. By varying the rib height, pitch and wedge angle 20 different absorber plate geometries have obtained and analysed in order to optimize these parameters. Correlations for Nusselt number and friction factor has also been developed by them. The maximum enhancement of heat transfer is occurred corresponding to wedge angle ( $\Phi$ ) =  $10^\circ$ . Chaube et al. [6] numerically investigated heat transfer and flow characteristics for a duct having roughness element in the form of transverse rectangular ribs. They have carried out numerical analysis using SST k- $\omega$  model which are in good agreement with the experimental results. The analysis reveals that maximum local heat transfer coefficient occurs at the point of reattachment. Aharwal et al. [7] have performed experimental investigation on repeated inclined square cross sectioned ribs with gap. The angle of attack ( $\alpha$ ) has been kept constant =  $60^\circ$  for the study and the variation in performance with relative gap width ( $g/e$ ) and relative gap position ( $d/W$ ) is analysed. The THPP is found to be the maximum for the relative gap width of 1.0 and the relative gap position of 0.25. Saini and Saini [8] have carried out experimental investigation on solar air heater with artificial roughness in the form of arc shaped wires. They have studied the effect of variation of relative roughness height and relative arc angle ( $\alpha/90$ ) on performance of solar air heater. Using the experimental results the correlations for Nusselt number and friction factor has also been developed which gives good agreement between predicted and experimental values. Kumar et al. [9] have carried out experimental

# Virtual mouse using sixth sense technology

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**Abstract**--Since, people nowadays are highly dependent on the technologies and so do the interaction between computer and humans are increasing tremendously. The more the interaction between us becomes physical the less tedious it become. A person in an i.t firm who has to sit in front of the computer all day long, it's like a boon for them. Since, they can use the gesture for their feasible interaction. In this paper we have proposed the idea of virtual mouse using sixth sense technology since it uses gestures for its interaction making it highly responsive in real time.

**Keywords**—Virtual Mouse; Color Markers; Images;

## I. INTRODUCTION

In today's world it is impossible to remain inseparable from digital device interface. In this technological environment many technologies are developing day by day. One of those technical concepts is human–device interface. In wired mouse, the main disadvantage is it is not portable and it must be plugged into the power outlets in order to function. These hard-wired requirements can make arranging personnel, furniture and equipment difficult. Employees are restricted interaction in their work location while using wired office products. Even in case of wireless mouse you need a surface to use your mouse and you cannot move beyond certain limits as we know the distance limit of wireless mouse is maximum 50 feet. Where by using virtual mouse you can do all the functions without having interaction with any of physical devices. We have explored low cost but high performance hand gesture controlled virtual mouse.

In this project we have been using color tapes for object recognition. Left and the right click events of the mouse have been achieved by detecting the distance between thumb and index finger, thumb and middle finger respectively. Humans communicate mainly by vision and sound, therefore, a man-machine interface would be more intuitive if it made greater use of vision and audio recognition.

Another advantage is that the user not only can communicate from a distance, but need have no physical contact with the computer. In this project will be using next generation features i.e.Detection of the pointer using the defined color information for controlling computer functions Dial pad control (Can dial number and can make a call and talk), Mouse movement control with clicks, Capture of image, Power point slide control. These features can be implemented using image processing.

## II. COMPONENTS

### A. Webcam

It is an important device used in working of virtual mouse. It is used to capture the images of the gestures which are further processed and used as commands by the system. Sensitivity of the mouse totally depend on the resolution of the camera. Hence the resolution of the camera should be good enough to guarantee enhanced user experience<sup>[4]</sup>.

### B. Color Markers

Color makers are primary requirement of user. Different color markers are used for different commands. We stick these color markers around our different fingers. Due to the clear distinction of the colors it will be faster and easier for the algorithm to process<sup>[4]</sup>.

### C. GSM Module

GSM module is used to call or send messages to the number of the person fetched in the code using at command. The user can organise this features also using the gestures.

## III. TOOLS USED

### A. Image Acquisition toolbox

The Image Acquisition Toolbox is a set of functions that enhance the graphics capability of the MATLAB. The toolbox supports a large no. of image acquisition operations. This tool enables us to connect with variety of scientific cameras to MATLAB. Basically all we can do with the image acquisition toolbox is, we can acquire the images and videos.

### B. Image processing Toolbox

It provides set of standard algorithms and functions for image processing, analysis, visualization, and algorithm development. You can perform image improvement, image de-blurring, noise pruning, image division, geometric conversion, and image registration. Image Processing Toolbox supports a various set of image types, including binary images, fluoroscopic image, Gray-scale images, Indexed images, RGB images. Using visualization functions we can understand an image, calculate region of pixels, adjust the contrast, and create contours or histograms and make changes according to our interest field. With the help of toolbox algorithms you can repair degraded images, study shapes and textures, and adjust color balance.

C. GUI Builder:

A graphical user interface (GUI) is also known as a graphical designer display in one or more windows containing components that enable a user to perform collaborative tasks. The user of the GUI does need to create a script or type commands at the command line to perform certain tasks. GUI components include menus, toolbars, push buttons, radio buttons, list boxes, sliders, static elements, axes etc. By using MATLAB GUI tools can also perform any type of computation, read and write data files, communicate with other GUIs, and display data as tables or as plots.

IV. PROPOSED SYSTEM

This paper collects all the drawbacks of the previous system and tries to integrate the solution for them. The proposed system enables the user to interact with the computer and computer applications with the help of gestures. Thus providing them convenience by extending the feature of calling and messaging using GSM modem. The flow of work of the system proposed by us is as follow

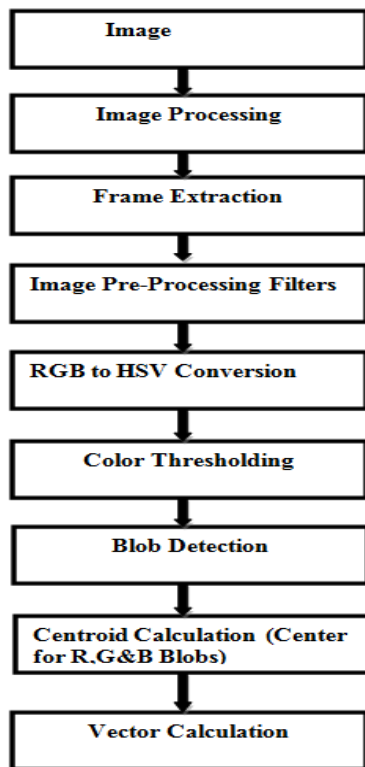


Fig: 1work flow diagram

A. Image

Image is a replica of object or a scene which one can see. It is a 2D light intensity function  $f(x, y)$ , where  $x$  and  $y$  denotes spatial co-ordinates. And that value of function at any point  $(x, y)$  is proportional to the brightness of the image at that point.

B. Image Processing

In image processing it takes image as a input. In image processing we are using web cam as a input device. Web cam is a hardware device which is used to capture the video.

1. Image acquisition: in image acquisition, digitizer will convert the signals derived from the web cam into an array of numbers (digital form).
2. Image preprocessing: preprocessing is done to improve the image. It will deals with technique of removing noise and improving contrast of color of image.

C. Frame Extraction

As yellow and red colour is detected, further step is to extract the single frame. One should take care about processing speed of each image, as every camera has number of frames per seconds. In this step we are going to extract the key frame out of the series of frame which we have got from the video taken by the web cam using win video software.

D. Image Preprocessing Filter

Here the aim of preprocessing is an improvement of image data that suppressed the unwanted distortion or enhances the quality of the image. Basically, nearby pixels subjected to one object in real images have the similar brightness value, thus displaced pixels can be reimpose as total value of nearby pixels.

E. RGB to HSV Conversion

In RGB color space, the colors are defined in the amount of red, green and blue whereas, In HSV color space, the colors are defined in the amount of hue, saturation and value. The digital camera is used to capture the RGB values. The camera converts this RGB values into HSV values after reading it. The HSV values are then used in the code to find the location of object or say color.

The  $R, G, B$  values are divided by 255 to change the range from 0...255 to 0...1

$$R' = R/255$$

$$G' = G/255$$

$$B' = B/255$$

$$C_{max} = \max(R', G', B')$$

$$C_{min} = \min(R', G', B')$$

$$\Delta = C_{max} - C_{min}$$

Hue calculation

$$H = \begin{cases} 0^\circ & \Delta = 0 \\ 60^\circ \times \left( \frac{G' - B'}{\Delta} \text{mod} 6 \right) & , C_{max} = R' \\ 60^\circ \times \left( \frac{B' - R'}{\Delta} + 2 \right) & , C_{max} = G' \\ 60^\circ \times \left( \frac{R' - G'}{\Delta} + 4 \right) & , C_{max} = B' \end{cases}$$

Saturation calculation

$$S = \begin{cases} 0 & , C_{max} = 0 \\ \frac{\Delta}{C_{max}} & , C_{max} \neq 0 \end{cases}$$

Value calculation:  
 $V = Cmax$

**F. Thresholding**

It is a special case of segmentation where  $r=r_2=T$  and the output image becomes binary. It is simple and effective way of partitioning the image into foreground from the background. According to prescribed threshold value  $T$ , each grey level that is less than equal to  $T$  is changed to zero and each grey level greater than  $T$  is changed to  $L-1$ . Thresholding is useful when one wants to separate bright objects interest from a darker background or vice versa<sup>[3]</sup>. If the original image is denoted by  $F_1(x, y)$  and the new image i.e. threshold image by  $F_2(x, y)$  then,

$$F_2(x, y) = \begin{cases} 0 & \text{if } F_1(x, y) \leq T \\ L-1 & \text{if } F_1(x, y) > T \end{cases}$$

Where  $L$  is the number of grey levels<sup>[3]</sup>.

**G. Blob Detection:**

Its aim is to differentiate region in a digital image which differ to each other on the basis of brightness, properties and color when compared to the remaining surrounding. It can be said that in a image, blob is region in which some properties are constant or approximately constant.

The process is as follow, Filter with Gaussian at different scales, in this there is repeated filtering with the same Gaussian. Then the filtered image at one scale is subtracted with the filtered image at previous scale. Find out the local extreme, this pixel is bigger/smaller than the eight neighbor pixels. The characteristic scale of a blob is the scale that produces peak of Laplacian response in the blob center.

$$L = \sigma^2 (G(x, y, \sigma) + G(x, y, \sigma)) - xx \ yy \ x \ y \ x \ y \ D \ G$$

(k(Laplacian))

$DoG = x, y, k\sigma) - G(x, y, \sigma)$ , difference of Gaussian.

For efficient implementation, their difference is considered<sup>[1]</sup>.

**H. Centroid calculation:**

Thus, we calculate the centroid of the largest blob detected. After the centroid of the blob is calculated, the Centroid is treated as the pointer of the mouse. After that the mouse acts as a robot. Then we can operate the system with the help of the gestures.

To calculate the centroid of the blob<sup>[2]</sup>, the formula is

$$x = \frac{1}{n} \cdot \sum_{k=1}^n x_k$$

$$y = \frac{1}{n} \cdot \sum_{k=1}^n y_k$$

**I. Vector calculation:**

Vector calculation basically means the coordinates of last few locations that give us information about patterns. On calculation of vectors proper actions or events can be executed or performed.

**V. FUTURE SCOPE**

While the system works fairly well for the simple pointing and pinching gestures, there is still room for improvement. Currently the system assumes a static background, but it would be desirable to use this hand tracking system in an augmented reality setting where a user, wearing a head-mount display, could interact with virtual 3D objects in the real-world. In other words, the cameras would be attached to the head-mount display and viewpoint could thus be controlled by natural head motions, resulting in a changing background scene.

If the skin pixel detector could be made more robust, it would be possible to completely discard the background subtraction phase and use the current system in such an augmented reality setting. However, a more sophisticated hand segmentation system would still be required in order to differentiate between other objects with skin-colored pixels, such as faces.

**A. Future Enhancements:**

1. To get rid of color markers.
2. It should allow us to touch the table as multi touch user interface.
3. Implementing this technology in various fields such as education, gaming, etc.
4. To have 3D gesture tracking.
5. For disabled people, the sixth sense should work as fifth sense.

**VI. CONCLUSION**

This project presented a vision-based hand tracking system with the help of markers and can operate in real-time on a commodity pc with low-cost cameras. Specifically, the system can track the tip positions of index finger and the middle finger, assuming that a calibrated pair of cameras is viewing the hands from above with the palms facing downward.

The motivation for this hand tracker was a desktop-based Pranav Mistry's sixth sense technology in which a user can physically interact with the computer applications in real-time using natural hand motions. The algorithmic details for the hand tracker were presented, followed by a discussion of the performance and accuracy of the system, as well as a discussion of how the system could be improved in the future.

## VII. ACKNOWLEDGMENT

Any successful Endeavour requires an opportunity, an opening and proper direction. Such an opportunity was provided to us by THEEM COLLEGE OF ENGINEERING. We are really grateful to Dr. N.K.Rana (Principal) that he accepted our project. The environment and resources made available enable us to put in the best efforts and to complete our project in time. We would like to thank our Head of Department Prof. Harshal Patil for giving us time in his busy schedule. He also provided us with most congenial and conducive environment and his unrelenting support.

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# Blister Testing in MATLAB

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## ABSTRACT

Medicines have helped to make our lives easy. Drug industry is developing industry in terms of production as well as consumption. Medication has become very important in everyone's life as we are affected by so many diseases. But these medicines might be defected, tablets may be broken, there may be missing tablet in a strip and consumption of these drugs might be dangerous. This project shows a method in digital image processing technique to find the defects in tablets. In this project we use mathematical manipulation, to detect the defected tablet packet.

**Keywords:-** Micro-controller, servo motor, dc motor, conveyer belt, web cam, spdt relay, robotic arm, Image Processing.

## I. INTRODUCTION

Digital image processing techniques and algorithms are applied on images in order to remove error. In this paper, we use digital image processing technique to detect the broken tablet. Such tablets are harmful to consume and may have many side effects. The inspection process is effective to detect the defects in tablets. Mathematical manipulation is used to detect the defect. This is done in Matlab10. First Image is taken and is converted into gray and then to binary and then noise is removed. Morphology operation is used to remove the noise. Morphology operation is applied on binary images therefore for this image is first converted into gray.

This technique will find the defect in those tablets which are circular in shape.



Artificial intelligence:

The collective attribute of computer, robot or other device capable of performing functions such as learning, decision making or other human behaviours.

### Automation:

It can be defined as the machine is designed to carry out or do variety of operation.

Identify and remove:

It can be defined as robotic arm to remove the product once the fault is identified.

## II. Methods of detecting Irregularities in the Blister

### 1. Image enhancement

This refers to processing an image so that the result is more suitable for a particular application.

### 2. Image restoration

This may be considered as reversing the damage done to an image by a known cause, for example:

- removing of blur caused by linear motion.

### 3. Image Segmentation

This involves subdividing an image into constituent parts, or isolating certain aspects of an image: finding lines, circles, or particular shapes in an image, in an aerial photograph, identifying cars, trees, buildings, or roads [3].

## II. BLISTER TESTING WITH MICRO-CONTROLLER USING MORPHOLOGY

The project is based on a pre-programmed PIC16F72 micro controller. The complete system divided in three sections. PC USB interfacing, Motor Driver, and power supply section

## III. SAFETY SYSTEMS

Safety of the devices is the measure concern of any device or machine. So for the safety purpose there is use of a two sensors i.e obstacle detection and fire detection with the help of buzzer.

### Power Supply:

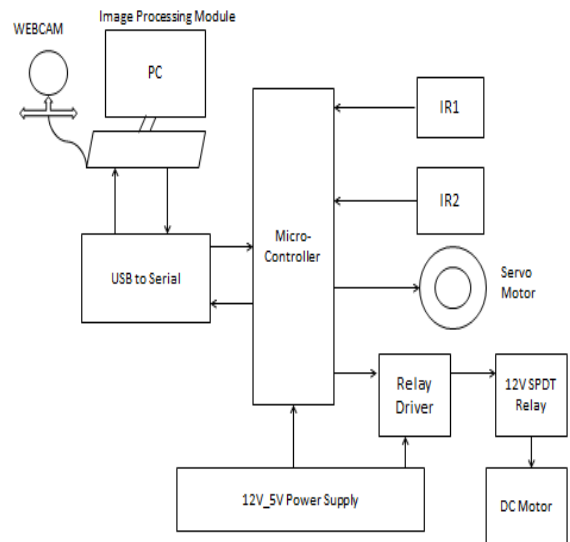
The power supply circuit. It's based on 3 terminal voltage regulators, which provide the required regulated +5V and unregulated +12V.

Power is deliver initially from standard 12V AC/DC adapter or 12V battery. This is fed to diode D1. The output of which is then filtered using 1000uf electrolytic capacitor and fed to U4 (voltage regulator). U4 +5V output powers the micro controller and other logic circuitry. LED L2 and its associate 1K current limiting resistors provide power indication. The unregulated voltage of approximately 12V is required for Motor driving circuit (U3) and DC Motor.

### Infrared light-emitting (IR LED – IR1-2):

An infrared light-emitting diode (LED) is a type of electronic device that emits infrared light not visible to the naked eye. An infrared LED operates like a regular LED, but may use different materials to produce infrared light. This infrared light may be used for a remote control, to transfer data between devices, to provide illumination for night vision equipment, or for a variety of other purposes.

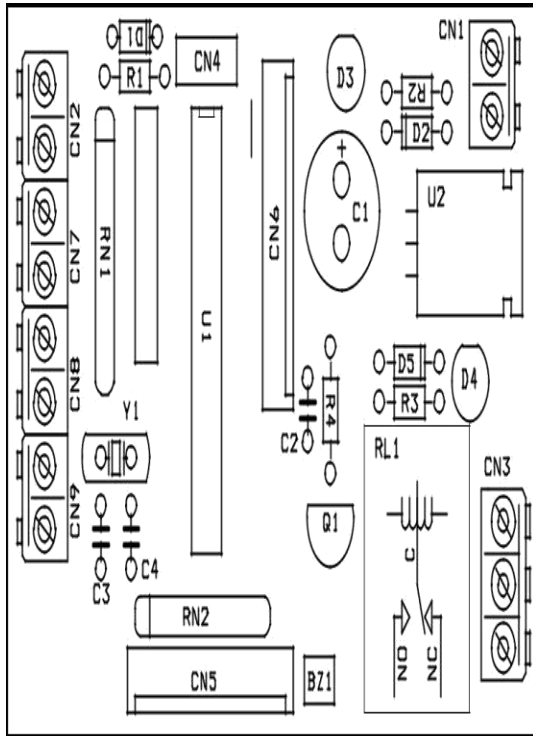
## IV. ARCHITECTURE



In this algorithm different types of sample of capsules and tablets.

One of the tablet sample (Fig 1) undergoes the steps to find whether there is any defect in the blister. In the process, the input image is converted into gray scale image (Fig 4). The industrial and other noises are filtered from the gray scale image which makes the image fit for further processing. Canny edge detection (Fig 5) operator is used for edge detection to filter the tablets from its background. The template image is stored in the system based on the type of input blisters. The template image undergoes all the pre-processing steps similar to the test image. The template image is of single tablet which is compared to each tablet in the blister. If the shape varies then the package is identified as defective tablet[9].

## V. CIRCUIT DIAGRAM



**VI. CONCLUSION**

The proposed system was analyzed with different type of samples such as defective and non-defective tablet packs and also different kinds of tablet packs such as clear PVC pack, colored PVC pack and opaque tablet pack. The table-I list out the result obtained for different type of tablet packs.

**TABLE 6.1- RESULT OBTAINED FOR DIFFERENT TYPE OF TABLET PACKS**

Condition	Detection		
	Clear PVC pack	Colored PVC pack	Opaque pack
Missing Tablets	Yes	Yes	Yes
Damaged Tablets	Yes	Yes	No
Size Mismatch	Yes	Yes	Yes

The defective blisters were easily identified. With iball 20.0 HD webcam the system was able to inspect 60 tablet packs per minute. Required system speed can be achieved by use of higher resolution and better image sensory camera. This prototype is a solution

for small scale pharmaceutical companies where the inspection of tablet packs are done manually[9].

**REFERENCES**

Below the reference of the various research paper and various website of which the complete study had been done and after that we had written paper.

**Journals**

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# MOBILE APPLICATION INTERFACE TO REGISTER CITIZEN COMPLAINT: E-POLICE COMPLAINT

Rima Amalendu Biswas, Shailesh Indradev Gupta, Nitesh Jaya Bhandari, Azaruddin Aianuddin Nayakwadi,  
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**Abstract**—The Governmental bodies were built to work for the public's ease and serve the nation for the better future. But the vision becomes blur if the subject too does not coordination in developing the nation. One such issue is the reporting of any crime witnessed by anyone to police stations. The paperwork for such task is tedious. The aim is, to be retired of this excuse of time and physical energy drained with the technologies found to be in and around everyone. With the increase in the technological usage and the usage of the electronic devises, it is firmly the era of the utilization of these technologies not blindly but knowingly. This paper primarily focus on the future implementation idea an application such as to ease the efforts to diminish lengthy process of crime reporting and thus encouraging the time utilization in solving cases.

**Keywords**—Web Portal; Android App; track; Global Positioning System;

## I. INTRODUCTION

The Government of any state is built for the helping of its subjects. Which turns out to be filled with process too time consuming and also maintaining the records are much more then stressful process. The Governmental serving bodies have the police serving bodies, the municipal corporations, to name some. The public finds it too much suffocating to register their complaints to the police station. The reason primarily found universal were that a) the time taken to fill up the form or any paperwork; b) the travelling for others were and issue too to not to be neglected. The problem cannot be eradicated completely but can be optimizngly reduced to a certain level.

Our idea about this eradication is that to utilize the technologies with which every naïve user is friendly with. The e-service, since past decades has been an area of research for the implementation not only in the social medias only to define them into the day to day life to be more beneficial. Surely it will help both the bodies to work with each other more efficiently. Also, digitalizing the work which was manually done will sure help in maintaining the records more better than that on paper. Each city has been divided into wards/ divisions and every division has been allotted some official to look after for the ward.

The digitalized approach will be easy and fair for the bodies to know the problem faced by the public which they might not be able to express earlier. The confidence is busted and the working for the swiping out of the crime and thus decrementing the rate of it can be done silently without the threat to many lives. the daily use of internet and applications which uses internet is a normal thing in today's world. And so we firmly believe that our project will be a help in the progression of clearing covertness and coming forward for fighting the crime.

The citizen participation and handling of the job by correct ward in-charge will definitely work. The citizen has to take a step of installing an app and uploading a complaint he/she want to register. The complaint is issued using an electronic device which is commonly used by every person. The interface used is easy one so as one need not be a pro might also manage to launch complaint. The launching of compliant is proceeded by registration of the user or victim or the complainer. The registered user who reported the crime will be given a trace-number which is a very unique id number and will be used to trace down the work progress done on the issue complained.

## II. PROBLEM STATEMENT

Develop an application for the client side to operate and a web portal on the other hand for the higher official to work on is not a tiny task to implement. The correct use of such a system to decrease the headache of all is the main purpose of this paper. Secure surrounding and crime rate drowning, will let the Nation shine in pride farther then just describing.

## III. EXISTING SYSTEM

Website named "Aaple Sarkar" was launched by the Chief Minister DAVendra Fadnavis of Maharashtra state in the year 2016. As an initiative to improve the problem of state, the Web Portal and the App of the same system was monitored from the Chief Minister's Office(CMO).

The moto was to encourage the general public to put forth the step towards the acquaintance of their problem to the authorities who are supposed to solve them. The complaints-

redressal time downed to 7 days as deadline would have the system work in discipline<sup>[3]</sup>.

The citizen can mention the complaint type, give description of their complaint, fill the location where this issue is particularly about, his/her personal details<sup>[1]</sup>.

Further, a code number was generated by the administrative body for the user who registered their grievance will be also able to trace the amount of work done on their complaint<sup>[3]</sup>.

Another system built by the clustering efforts of District Administration and National Informatics Centre in Ranga Reddy (AP, India) to be called as Prajavani<sup>[2]</sup>. It was providing job opportunities for those in need in its area i.e. in Ranga Reddy.

#### IV. PROBLEM WITH EXISTING SYSTEMS

1. The data is not secure enough.
2. Although there is the GPS introduced, these systems needed a manual check too for the confirmation of the complaints.
3. The identity of user registering the complaint is not hidden which might force the user in some to roll-back the complaint launched.

#### V. SYSTEM FEASIBILITY

##### A. Technical Feasibility

Introduction to new system in an environment of the long working requires a much training and understanding. However, our proposed system is working with the Android phone application which is widely used by the majority of the public. Easy to use as the Internet has also been embedded part of our day to day lives, it is least to cause any issue to handle.

##### B. Economic Feasibility

The cost required to have this application according to our proposed system, is negligible. The user has to download app from the site for once and then use it for the purpose it is proposed for. Also, Android phones are daily used device so the maintenances cost of it is not much to be clear.

#### VI. PROPOSED SYSTEM

This paper assembles the drawback and tries to integrate the solution for them. The proposed system enables and assists citizen to lodge complaint and follow through complaints using their mobile phone. The main objective of this proposed system is to provide an easy way to lodge complaint related to crime or any other catastrophe without the need of so much time

The system proposed by us can be disintegrated into modules, namely client-side module and another is server-side module.

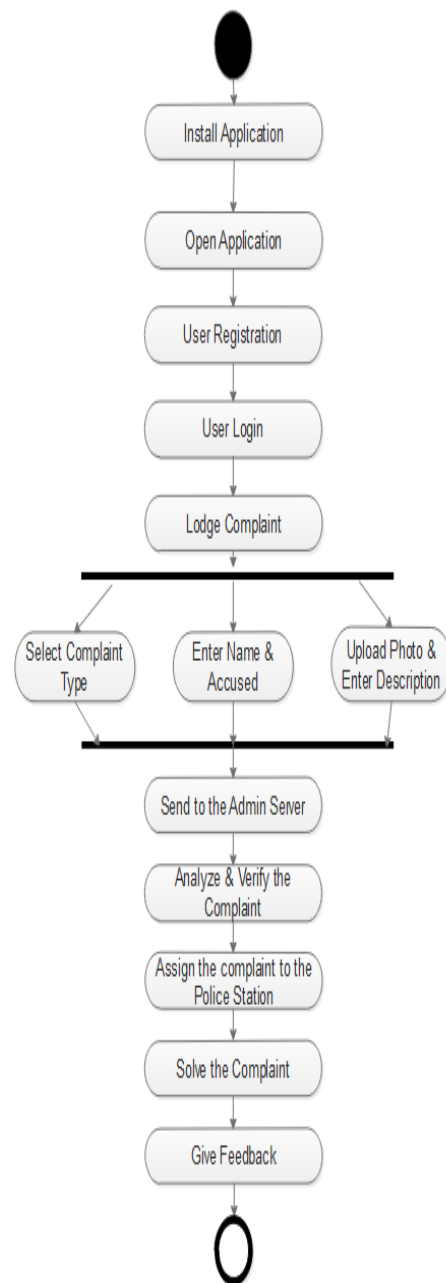


Fig1: proposed system

##### A. The client-side module

The client or naïve user downloads the Android application developed for them from the site. While doing so, the client will have to fill some details about themselves. Once the application is downloaded and the installation is done, then the real work will start.

The user when witness any incidence which is supposed to be handled by the officials, will then open the app in his/her Android phone and have to register themselves (if they are using the application for the first time ever since they downloaded and installed it).

The user now can have the authentication to further access the application and fill a form stating the description of the incidence he/she is complaining about. Also, the user is allowed to upload a photo which depict the scenario stated by the user in the complaint launched.

Soon when the complained is fired and is been registered, the user will get a Unique ID number which is a tracking number. Using this number, the user can trace the progress state of the complaint launched.

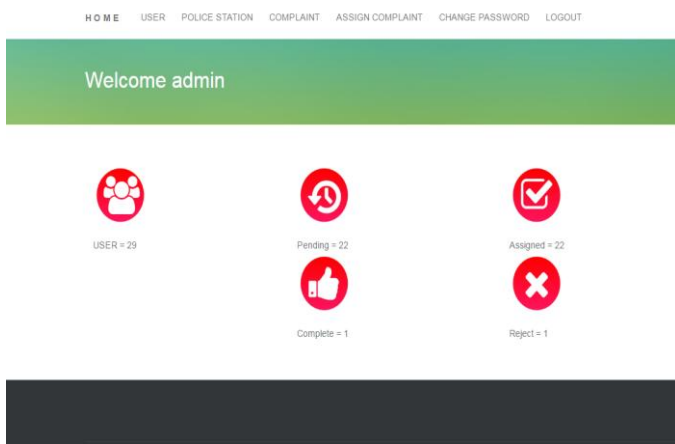
**B. The server-side module**

On the other hand, the server side is the side handled by the official such as the Central office(CO) on a region and those by the sub-office where the complaints are actually supposed to be reported.

Each region is sub-divided for the better monitoring of the area. The Web Portal forms the server-side working module. The Android app used by the naïve user to get registered and generate complaint are stored in the database which is connected to the Web Portal present at the Central office.

The allocation of the complaint according to the location mentioned in it is done by the CO. The branches where these complaint is discarded to from the CO is the one which is nearest to the place of incidence.

The branch which get the complaint, immediately defines the state of the complaint (as stated working/ pending). Once allotment is done, the user can use its tracking number provided to them via an e-mail and trace the work progression if they wish to.

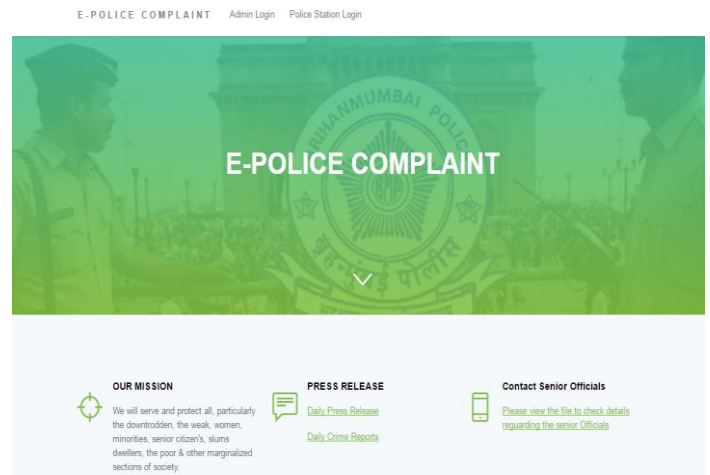


**Fig2: Web page**

**VII. PROPOSED SYSTEM WORKING**

The following components used and its role for its working in our system:

**A. Web Portal**



**Fig:3 Web Portal**

The Portal is a digital display notice board which is present at Central Office and at the sub police stations. At Admin’s Portal, on logging in, he/she can view if any new complaint arrived, can see the status of the complaints already registered, can have a list of all those police stations under his region which further helps in allocation of cases to the police station.

**B. Databases**

Keeping the records of cases solved, pending, progress states, registered users, the records of police station existing and updating the new police station, updating the in-charges of those police stations.

**C. Mobile Application**



**Fig4: App Icon and Splash page**



Fig5: Complaint Form on App

#### D. Server

The monitoring of the functions is to be done at the server section. Generation of unique ID is done by the server.

It is where the acceptance of complaint is done. Also, the division where the complaint is/are to be headed is decided by the server. Only handful of people which is mostly the group or team of Admin are granted the access to the server.

#### E. Communication network

The communication network allows the interaction between the mobile system and the server which is located at a static geostationary location. Also the satellite via which the GPS system interact to find the location detail mentioned in the complaints. Also for the application, the internet is required (uploading photo supporting the incidence).

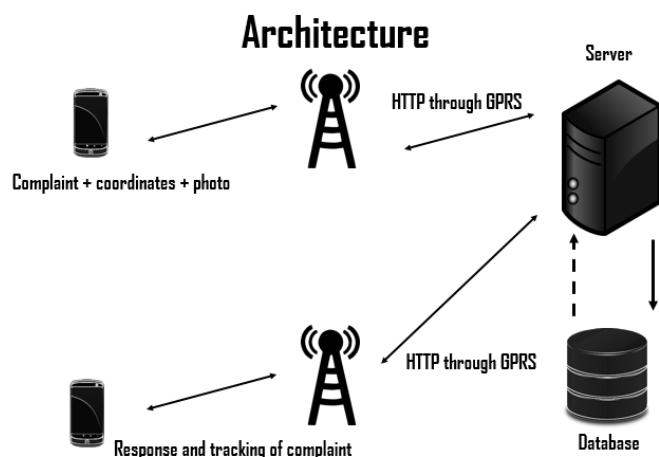


Fig6: Architecture

#### F. Global Positioning System

The complaint launched by the user cannot be just like that carried forward. The user will use his/her mobile phone to register complaint [5]. The Admin using the GPS can trace the location of the registered user (by tracking the mobile device

operated for the complaining) and also about the place of accident mentioned in the description given by user. Google Map and APIs [4] are used for this.

#### VIII. FUTURE SCOPE

1. The project we proposed through this paper is limit to uploading of images. Further work on this system will be enhancing the picture quality and its media sharing to videos also.
2. This project is a mere move towards the better environment around ever common man but increment of feature such as to work for the visual impaired people will create ease for the distinguishably abled human too.

#### IX. CONCLUSION

To maintain discipline throughout the crowd of such a vast Nation is not a cup of tea. Technologies are for the easy and smooth processing which now is the time to be utilized in a manner that it adds to the growth of the Nations' prosperity and peace.

Our project proposed a system which lets both the police and the common man to eradicate the crime. This can be done when the common man feels safe enough to come forward and police to investigate on the crime rather than on the complainer.

The system does not reveal the identity of the complainer at the police station. Only the central Office knows the identity of the complainer.

Moreover, the time to find the proper police station to complain and the paper work maintaining is reduced. The maintaining of the digitalized data is efficient than the file system management. Being mobile and internet a daily partner of every live, it is not hard to use it by majority of people.

#### X. ACKNOWLEDGMENT

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# Investigation of Aerodynamic Forces on Vehicle using CFD Technique

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**Abstract**— The customer needs are increasing day by day due to which the advance technology plays an important role in the automobile industry. At considerable speed, forces like drag & lift, weight, side forces and thrust acts on a vehicle which significantly affect the fuel consumption. The drag force is produced by relative motion between air and vehicle and about 60% of total drag is produced at the rear end. Reduction of drag force improves the fuel utilization. The drag force can be calculated by Experimental or Computational fluid dynamics (CFD) technique. Due to competitiveness in the market as well as high cost, time and other limitation. It can be advantageous to use CFD over traditional experimental-based analysis. The purpose of this work is to use CFD software for finding out drag, lift forces and other flow features at different velocities on Audi car profile. The velocities are 80, 100, 120 kmph. This study proposes an effective validation of results between experimental method and CFD methods. The software used in this work are Solidworks 2015 (Modelling), GAMBIT 2.4.6 (Meshing), ANSYS Fluent 17.0 (CFD Solver) as well as Tecplot 360 (Post Processing).

**Index Terms**— Aerodynamics, Ansys-fluent 17.0, CFD, GAMBIT 2.4.2, Solidworks 2015, Tecplot 360.

## I. INTRODUCTION

Now-a-days, the demand of high speed cars is increasing in which vehicles' stability, low fuel consumption, less pollution, are of major concern. When a vehicle is moving on road, the fuel consumption of the vehicle is affected due to aerodynamic forces like drag, lift, weight, side forces and thrust [7]. Aerodynamic drag is the result of interaction between the vehicle shell and the surrounding air molecules. It is caused by relative motion between the air and vehicle which results in a net force opposing motion [6]. Aerodynamic drag increases the square of velocity [8]. Therefore, it

becomes critically important at higher speed. Thus, reducing the drag coefficient in an automobile improves the performance of vehicles as it pertains to speed and fuel efficiency [10].

In automotive industry, mainly wind tunnel and computational fluid dynamic approach are used to estimate the drag. Due to competitiveness of the market as well as high cost, time and other limitation, the use of CFD over traditional experimental-based analyses can be advantaged. Since experiments have a cost directly proportional to the number of configurations desired for testing, unlike with CFD, where large amounts of results can be produced practically with no added expenses. CFD has increasingly provided the methodology behind an important design tool for the automotive industry [1].

## II. AERODYNAMICS

### A. Aerodynamics

“Aerodynamics” is a branch of fluid dynamics concerned with studying the motion of air particularly when it interacts with a moving object [9]. Anything that moves through air is affected by aerodynamics. The rules of aerodynamics explain how an airplane is able to fly.

### B. Automotive aerodynamics

Automotive Aerodynamics is the study of the aerodynamics of road vehicles. Its main goals are reducing drag and wind noise, minimizing noise emission and preventing undesired lift forces and other causes of aerodynamic instability at high speeds [11].

*C. Factors contributing to flow field around vehicle*

The frictional force of aerodynamic drag increases significantly with vehicle speed [2]. The major factors, which affect the flow field around the vehicle, are the boundary layers, separation of flow field, friction drag and lastly the pressure drag.

III. COMPUTATIONAL FLUID DYNAMICS (CFD)

According to Oleg Zikanov [3] CFD can be defined as: “CFD (Computational fluid dynamics) is a set of numerical methods applied to obtain approximate solution of problems of fluid dynamics and heat transfer.”

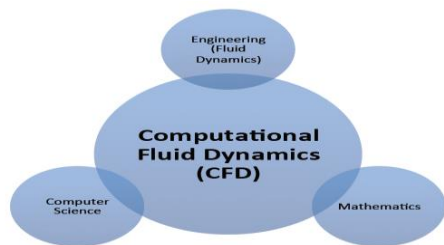


Fig. 1. The different disciplines contained within computational fluid dynamics.

According to this definition, CFD is not a science by itself but a way to apply methods of one discipline (numerical analysis) to another (heat and mass transfer). In retrospect, it is integrating not only the disciplines of fluid mechanics with mathematics but also with computer science as illustrated in Fig. 1. The physical characteristics of the fluid motion can usually be described through fundamental mathematical equations, usually in partial differential form, which govern a process of interest and are often called governing equations in CFD. Jiyuan Tu, Guan Heng Yeoh and Chaoqun Liu [4] has discussed how to solve mathematical equations with using CFD.

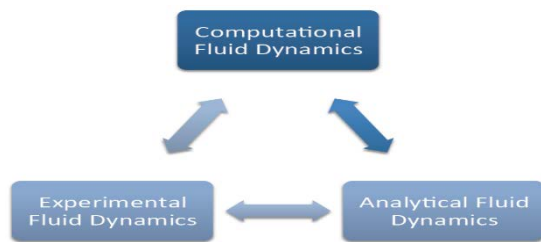


Fig. 2. The three basic approach to solve problems in fluid dynamics and heat transfer

CFD has also become one of the three basic methods or approaches that can be employed to solve problems in fluid dynamics and heat transfer. As demonstrated in Fig. 2, each approach is strongly interlinked and does not lie in isolation.

*A. How does a CFD code works?*

CFD codes are structured around the numerical algorithms that can be engage in fluid problems. In order to provide easy access to their solving power, all commercial CFD packages include difficult user interfaces input problem parameters and to examine the results. Hence all codes contain three main elements.

- Pre-Processor
- Solver
- Post-processor

*B. Pre-processor*

A pre-processor is used to define the geometry for the computational domain of interest and generate the mesh of control volumes (for calculations). Generally, the finer the mesh in the areas of large changes, the more accurate the solution. Fineness of the grid also determines the computer hardware and calculation time needed [5].

*C. Solver*

The solver makes the calculations using a numerical solution technique, which can use finite difference, finite element, or spectral methods. Most CFD codes use finite volumes, which is a special finite difference method. First the fluid flow equations are integrated over the control volumes (resulting in the exact conservation of relevant properties for each finite volume), then these integral equations are discretized (producing algebraic equations through converting of the integral fluid flow equations), and finally an iterative method is used to solve the algebraic equations [5].

*D. Post-Processor*

The post-processor provides for visualization of the results, and includes the capability to display the geometry/mesh, create vector, contour, and 2D and 3D surface plots. Particles can be tracked throughout a simulation, and the model can be manipulated (i.e. changed by scaling, rotating, etc.), and all in full colour animated graphics [5].

*E. Problem solving with CFD*

There are many decisions to be made before setting up the problem in the CFD code. Some of the decisions

to be made can include: whether the problem should be 2D or 3D, which type of boundary conditions to use, whether or not to calculate pressure/temperature variations based on the air flow density, which turbulence model to use, etc. The assumptions made should be reduced to a level as simple as possible, yet still retaining the most important features of the problem to be solved in order to reach an accurate solution.

After the above decisions are made, the geometry and mesh can be created. The grid should be made as fine as required to make the simulation 'grid independent'.

#### IV. GEOMETRY AND DIMENSIONS

Geometric models were modeled using Solidworks 2015 modeling software. For the present analysis only 2-D profile of Audi R8 car model was used. The modeling process involved importing the vehicle blueprints into Solidworks with the help of which, 3D curves were projected. These curves then acted as boundaries to generate surfaces. The final surface model was converted into IGS file format before importing it to Ansys. The **Fig. 3** shows 2D profile of Audi R8 car model and the **Fig. 4** shows the final surface model of the car.

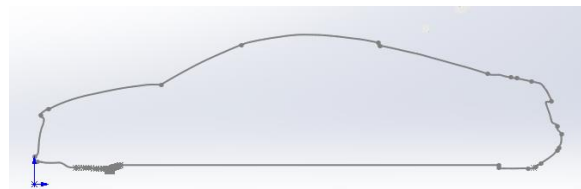


Fig. 3. CAD Profile.

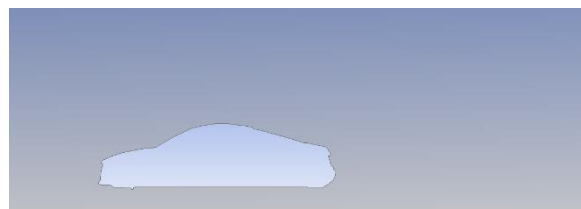


Fig. 4. Surface geometry

#### V. CREATING FLUID ENCLOUSER

In order to simulate the air flow around the vehicle, a fluid volume needs to be created which will encompass the vehicle. This was done by creating an enclosure around the vehicle and subtracting the vehicle body. This enclosure acts as the air domain.

To reduce the overall computational cost and time, the vehicle was considered symmetric laterally. Dimensions of analysis domain are presented in **Fig.5**. Where  $L = 4431$  mm.

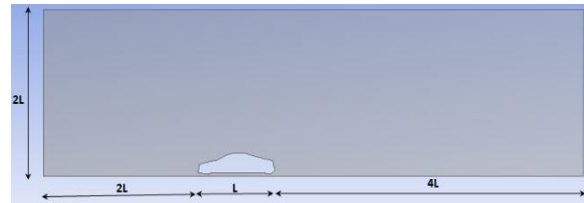


Fig. 5. CFD domain

#### IV. MESH GENERATION

While generating the mesh, sizing functions were used wherever necessary in order to obtain accurate lift/drag parameters. Two bodies of refinements were added to properly capture the flow in the region closest to the vehicle and also capture the flow in the wake since, boundary layer separation has a significant effect on drag. After meshing problem in GAMBIT, the mesh consists of quads and triangular. The total number of elements obtained was 58.102 thousand. **Fig. 6 & 7** shows the final mesh.



Fig. 6. Mesh away from profile.

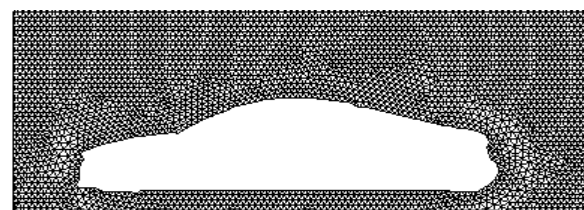


Fig. 7. Mesh closer to profile.

#### V. BOUNDARY CONDITIONS

Three different velocity of the air at the inlet boundary condition is set in Fluent and velocities are shown in Table I.

TABLE I. INLET VELOCITIES

Sr. No.	Velocities	Unit
1	22.22	m/s
2	27.77	m/s
3	33.33	m/s

The outlet boundary condition is set to pressure outlet with the gauge pressure of 0 Pa. The car contour, the top and the bottom of the virtual wind tunnel are set as symmetry. The density of air is set as 1.225 kg/m<sup>3</sup> and the viscosity of air is 1.7894 x 10<sup>-5</sup> kg/ms. **Fig. 8** represent the boundary conditions.

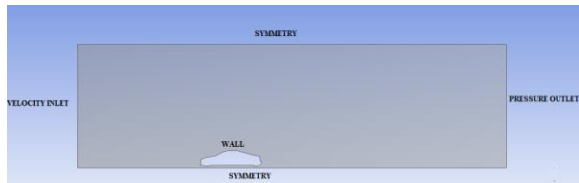


Fig. 8. Boundary conditions

V. SOLVER

For this analysis, a pressure based transient state solver was used. The solution methods, equations used along with the input data are listed below:

- Pressure based transient state solver
- Shear stress transport (SST  $k-\omega$ ) model
- Air velocities at inlet are 22.22 m/s, 27.77 m/s and 33.33 m/s respectively

D. Transient flow analysis

Transient flow is the flow, wherein, the flow velocity and pressure are changing with time. When changes occur to a fluid system such as during starting or stopping, in such a situation transient flow conditions exists. Otherwise the system is in steady state. Often, transient flow conditions persist as oscillating pressure and velocity waves for some time after the initial event that caused it.

Time step size ( $\Delta t$ ) must be small enough to resolve time-dependent features observed in transient flow and to make sure convergence is reached within the number of Max Iterations per Time Step. The setting selected were listed in Table II.

TABLE II. SOLVER SETTINGS

Sr. no.	Velocities (m/s)	Time step size (s)	No. of time step	Max. iteration/time step
1	22.22	0.057969	14000	20
2	27.77	0.046383	18000	20
3	33.33	0.038646	21000	20

IV. RESULTS

The various flow features and parameter of Audi R8 2D car model are shown in **Fig 9-26**. Table III show the results for  $C_D$  with different flow velocities

TABLE III.  $C_D$  FOR DIFFERENT VELOCITIES

Sr. No.	Velocities (m/s)	$C_D$
1	22.22	0.243702
2	27.77	0.241598
3	33.33	0.239977

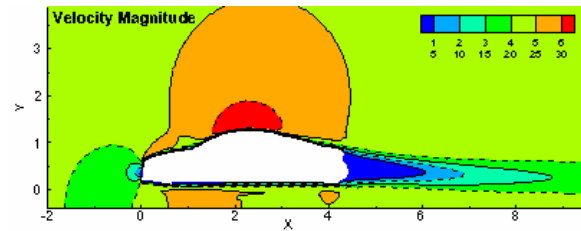


Fig. 9. Velocity contour at 22.22 m/s

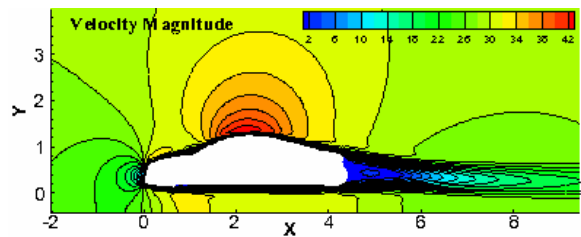


Fig. 10. Velocity contour at 27.77 m/s

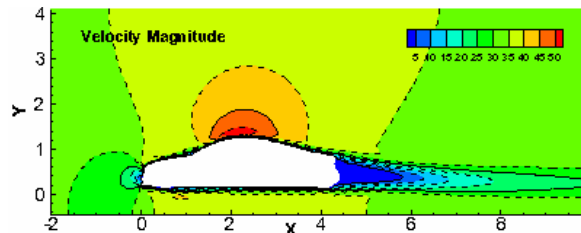


Fig. 11. Velocity contour at 33.33 m/s

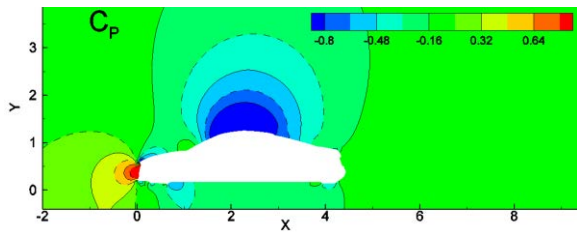


Fig. 12. Coefficient of pressure at 22.22 m/s

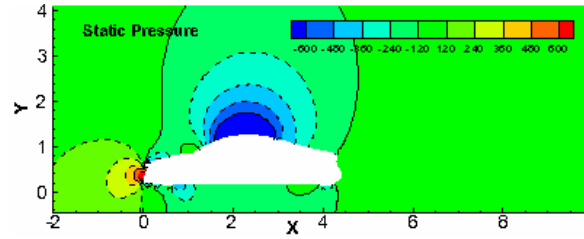


Fig. 17. Static pressure at 33.33 m/s.

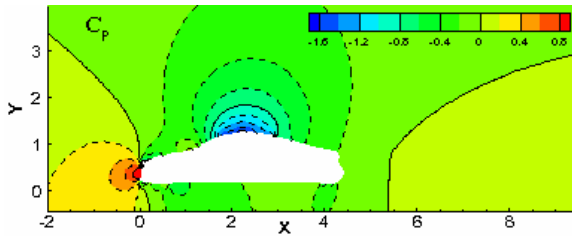


Fig. 13. Coefficient of pressure at 27.77 m/s

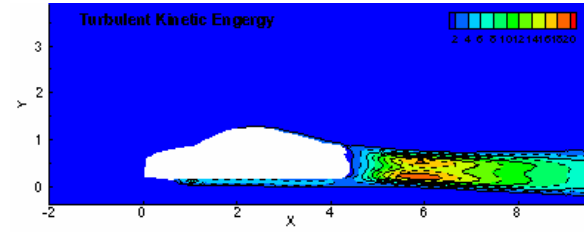


Fig. 18. Turbulent kinetic energy at velocity 22.22 m/s

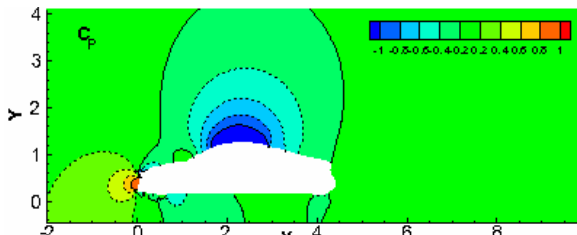


Fig. 14. Coefficient of pressure at 33.33 m/s

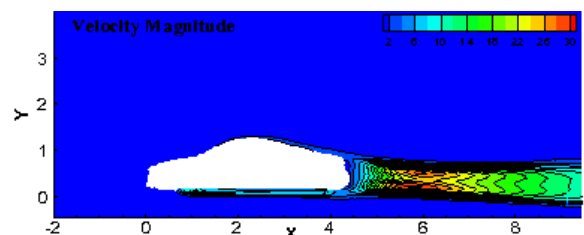


Fig. 19. Turbulent kinetic energy at velocity 27.77 m/s

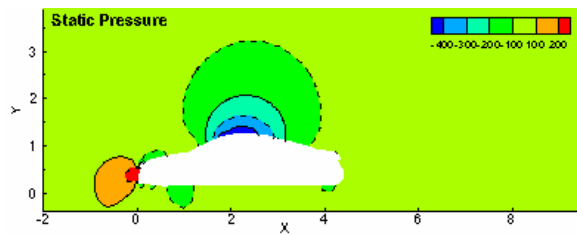


Fig. 15. Static pressure at 22.22 m/s

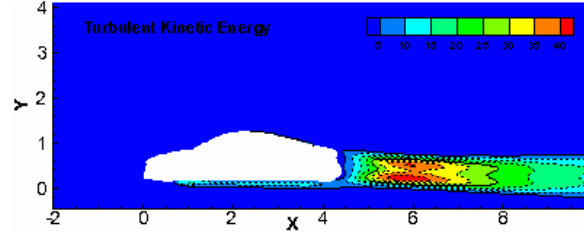


Fig. 20. Turbulent kinetic energy at velocity 33.33 m/s

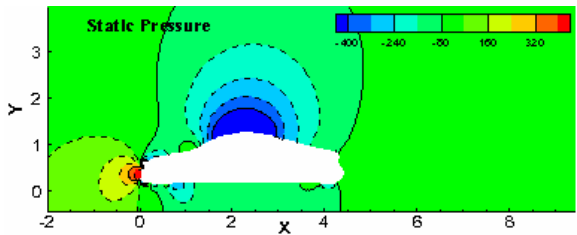


Fig. 16. Static pressure at 27.77 m/s

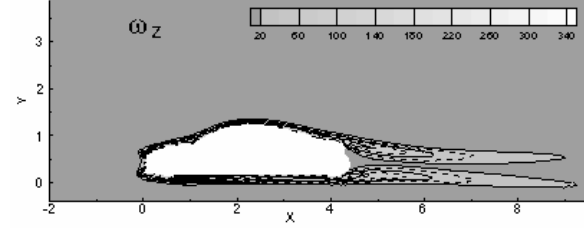


Fig. 21. Vorticity at velocity 22.22 m/s

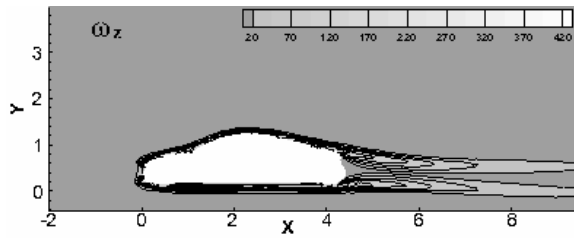


Fig. 22. Vorticity at velocity 27.77 m/s

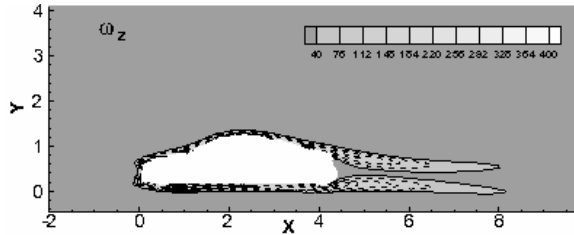


Fig. 23. Vorticity at velocity 33.33 m/s

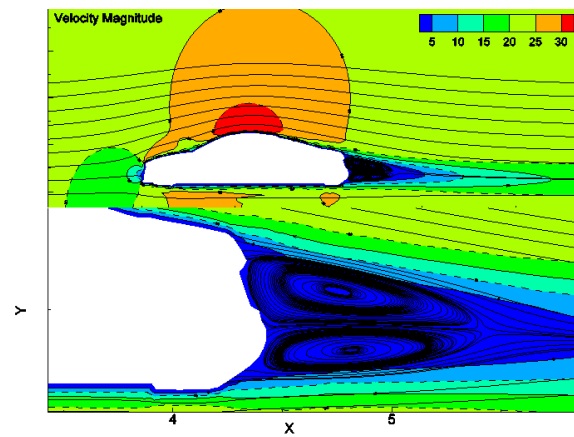


Fig. 24. Streamlines and flow separation at velocity 22.22 m/s

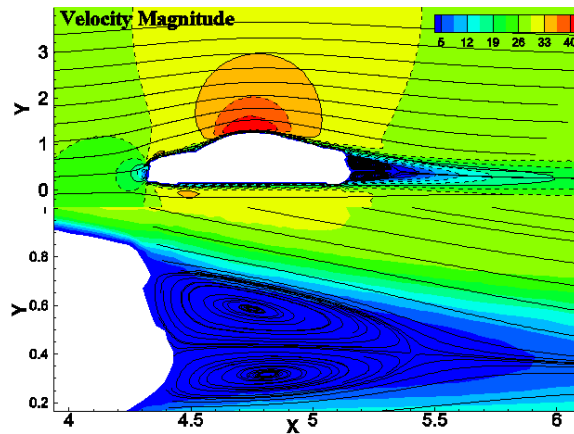


Fig. 25. Streamlines and flow separation at velocity 27.77 m/s

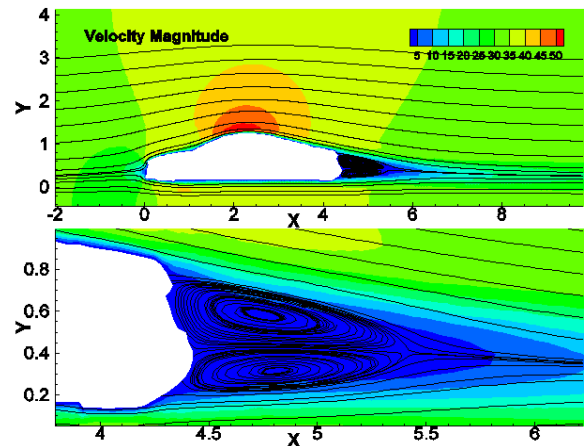


Fig. 26. Streamlines and flow separation at velocity 33.33 m/s

Since 1991 to 2017 the experimental result of coefficient of drag ( $C_D$ ) of Audi car model ranges from 0.23 to 0.33 [12]. The coefficient of drag ( $C_D$ ) obtained from current analysis of Audi model using CFD is given in Table III, which is within the range of experimental result. Thus the obtained result is reliable and validate the experimental result.

## VII. CONCLUSION

On the basis of obtained result, it can be concluded that CFD can provide near about accurate result in comparison with experimental result. In this work three different flow velocity were studied and it is observed that drag force increases as velocity increases. Thus, require more motive power which affects the fuel consumption. 2D analysis is very helpful and usually preceded by a 3D analysis, because they can provide some basic guidelines that could be used to redesigned and enhance the solution. This approach can significantly shorten the time of analyzing a problem.

## ACKNOWLEDGMENT

We express esteemed gratitude sincere thanks to our worthy lecturer guide Prof. Mohd. Raees, our vocabulary does not have suitable words benefiting to high standard at knowledge and extreme sincerity, deviation and affection with they have regularly encouraged us to put heart and soul in this work.

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## **DEVELOPMENT OF TEST RIG FOR SHOCK ABSORBER ENDURANCE TEST**

**Shubham Mishra<sup>1</sup>, Navin Singh<sup>2</sup>, Imran Khan<sup>3</sup>, Ashish Gond<sup>4</sup>, Sarjeel Sayyed<sup>5</sup>**

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**Abstract**—The main function of a Shock Absorber is to damp the Vibration, Shock Absorber is designed to resist the vertical motion of the wheels which were caused by rough or uneven surface. The paper presents the test on shock absorber as per Indian standards (IS: 5423:1989, IS 12648:1989, IS 10063:1982) to perform endurance test. The performance of shock absorber is significantly affected by shock absorber damper. It is difficult to achieve unless and until all parts of damping system perform their assigned work satisfactorily. To overcome this performance it requires mechanism which shall generate and stimulate the real road conditions which were faced by shock absorber. The mechanism should be perform a vehicle situation in which one side shock absorber levied with load conditions and other side should be subjected to vibrations and jerks. So this paper encompasses the design and development of shock absorber test rig by using scotch yoke mechanism in which all above mentioned conditions are simulated and perform as per requirement.

**Keywords**—*Shock Absorber, Endurance Test, Scotch yoke mechanism, Indian Standard.*

### **I. INTRODUCTION**

Assembly of suspension consist of suspension spring, damper, and linkage that is connects a vehicle to its wheels. The main function of shock absorber is to minimize the vertical acceleration and vibration which is transmitted towards the passenger. In other words suspension system is a mechanism that physically separates the car body from the car wheel. The vehicle suspension system is used to improve the rid comfort and road handling by controlling the relative position and motion between the vehicle body and the wheel mass. Vehicle suspension system can be classified in three categories i.e. passive, semi-active and active suspension.

A test rig is used to study the behavior of vehicle due to vibration of the road profile which is commonly known as the rid vehicle analysis. Performance of the suspension system is characterized by the ability of the suspension system in reducing the performance criteria.

### **II. INDIAN STANDARD FOR SHOCK ABSORBER TESTING**

The test deals particularly with Endurance test of Shock absorber, test should be done on Damper unit. Test should be conducted by referring the Indian standard.  
(IS 5423:1989, IS, 12648:1989, IS 10063:1982)

#### **2.1. Terminology**

##### **2.1.1. Bore**

The inside diameter of main working cylinder of the shock absorber.

##### **2.1.2. Compressed length**

Length between mounting eyes or mounting face and mounting face in case of eye and stud of a shock absorber when it is compressed its maximum length.

##### **2.1.3. Dead length**

Length constituted by built in components of shock absorber when the stroke is zero.

**2.1.4. Compression stage**

A stage in which the mounting of shock absorber approach each other.

**2.1.5. Extension length**

A stage in which the mounting of shock absorber move away from each other.

**2.1.6. Stroke**

The difference between the extended length and compressed length.

**2.1.7. Fitment dimensions**

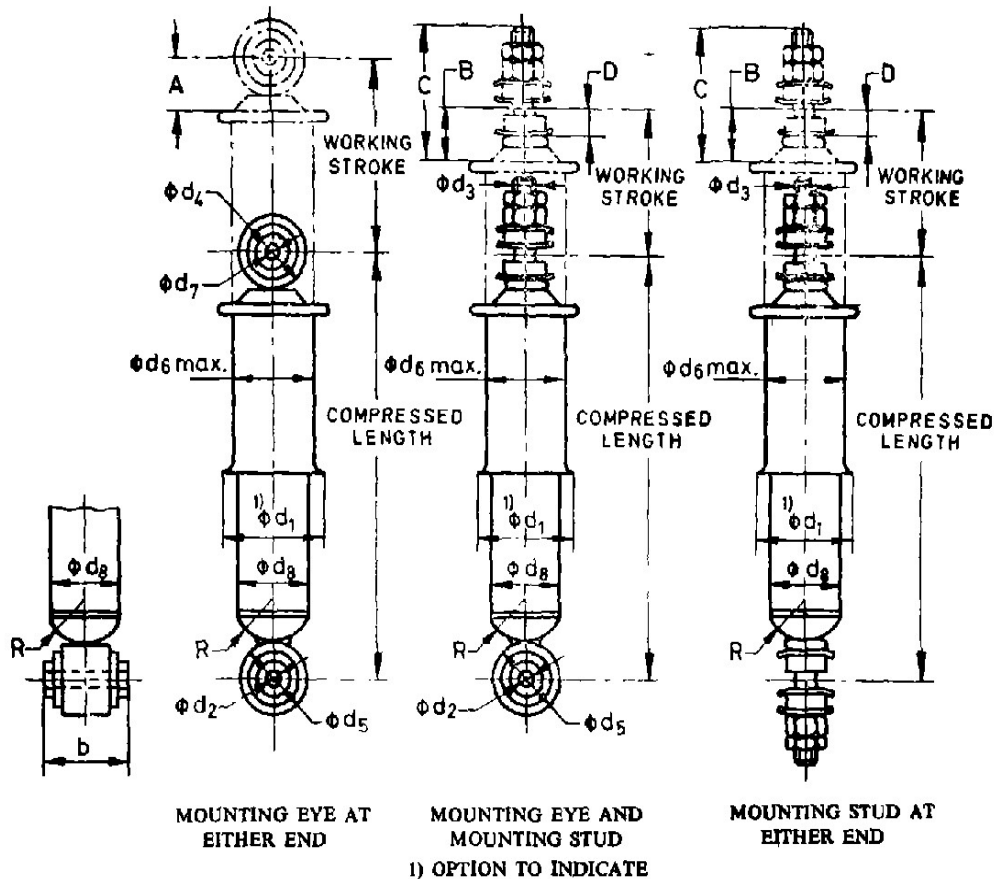


Figure1. Fitment dimensions

**2.2. Test**

Test shall be carried out by referring IS 5423:1989. Test outline in this shall be carried out on the shock absorber without the suspension spring.

**2.2.1. Damping force test**

It is required for ascertaining the force piston velocity characteristics of shock absorber and shall be carried out as follow:

- Working chamber should free from air pocket.
- Shock absorber shall be tested along its own axis
- Damping force shall be recorded between the sixth and length
- Effect of temperature as given shall be applicable wherever necessary.

### 2.2.2. Endurance test

It is type of test applicable for shock absorber having a resistance of 200N or more. It shall be carried out as follow:

- Shock absorber shall be mounted on dynamic testing machine and initially damping resistance in tension and compression shall be recorded.
- After damping resistance test, shall be mounted on endurance testing machine. Testing speed shall be 60 cycles/minutes. Test shall be conducted at 100mm stroke.
- During test temperature shall be controlled between 70<sup>0</sup>C to 90<sup>0</sup>C which should be measure at outer tube of shock absorber.
- Test shall be conducted for one million cycles. At end of test, no leakage shall be noticeable.

## III. DESIGN OF TEST RIG.

### 3.1. Introduction

After completing back ground knowledge of shock absorber the design process of the entire system is initiated. Test rig should be design as per IS: 5423:1989.

### 3.2. Design elements

- Geared motor
- Base(C-Chanel)
- Fix plate
- Rectangular slot(scotch yoke mechanism)
- Hollow circular pipe
- Rotating disc

### 3.3. Available data

- Motor specification: power =2 HP, speed=60rpm.
- Frequency of the test 60 to 100 cycles/minute.
- Stroke length which is to be applied on shock absorber.
- Test shall be conducted for one million cycles.

### 3.4. CAD design (Solid Works)

This design comprises of CAD modeling of the test rig. The rig design is important segment of this stage. Design of shock absorber test rig is done in Solid Work 2014 edition software.

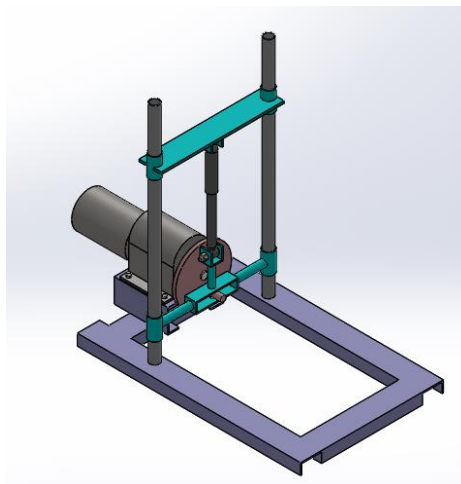


Figure 2. CAD model of test rig

### 3.5. Design and calculation for rotating circular disc

$D = 250\text{mm}$ .

$T = 16\text{mm}$ .

We will calculate the circumferential stress

For disc with hole in the Centre

Circumferential stress will be

$$\sigma_c = \rho \times \omega^2 \times r$$

Where

$\sigma_c$  = circumferential stress 'N/mm<sup>2</sup>'.

$\rho$  = density of material 'Kg/mm<sup>2</sup>'

$r$  = radius of the disc mm.

$$\omega = 2\pi N/60$$

$$= 6.28\text{rad/sec}$$

$$\sigma_c = 7850 \times 6.28^2 \times 125$$

$$= 38698928 \text{ N/m}^2$$

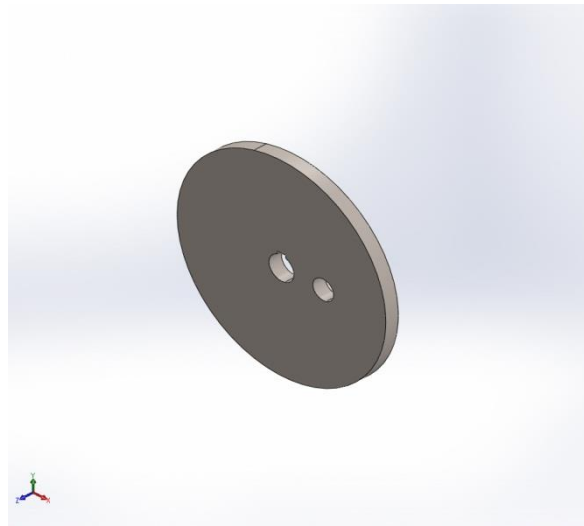


Figure 3.circular disc

### 3.6. Design calculation for hollow pillar

$D = 42\text{mm}$

$d = 36\text{mm}$

$l = 950\text{mm}$

Condition for shaft is both ends fixed

Hence we will find the buckling load

$$p = \pi^2 \times E \times I / l^2$$

Where,

$p$  = maximum buckling load 'N'

$E$  = modulus of elasticity ( $2 \times 10^5$ ) N/mm<sup>2</sup> for mild steel

$I$  = moment of inertia mm<sup>4</sup>

$l$  = length of hollow shaft

$$I = 70297.06 \text{ mm}^4$$

$$p = 48938.6 \text{ N}$$

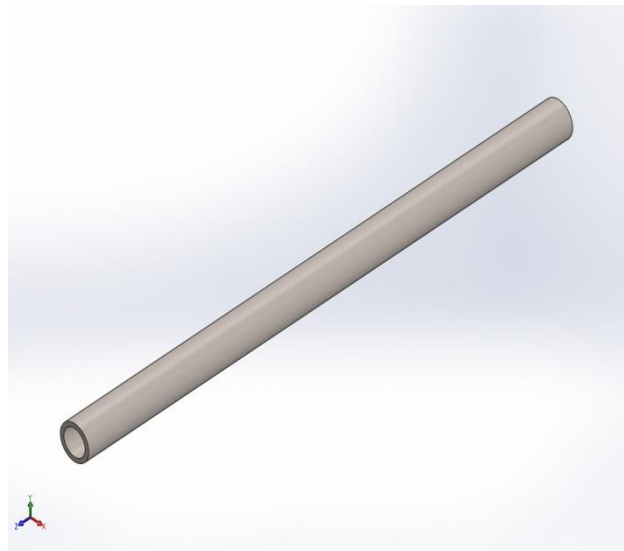


Figure.4 Hollow shaft

### 3.7. Calculation for selection of motor

As per Indian standard shock absorber should be tested by using following parameters:

- Frequency should be 60 to 100 cycle/min
- Shock absorber whose resistance is more than 200N.
- Displacement should be 100 mm.

Hence

We know that

$$T = F \times R$$

Where

T = torque in N-m

F = force in N

R = displacement as specified in 'm'

For worst case

$T = 200 \times 0.1 = 200 \text{ N-m}$

Hence we shall design for worst case i.e. 200N-m, we shall select a motor such that which can give output torque of 200 N-m.

Hence we need a 2HP motor whose output will be 200 N-m. and initial rpm of motor will be 1440 which will be reduced to 60 by using gear.

#### IV. Specification of the test rig

The detailed specification of the various standard and manufactured components is given in the table 4.1.

##### 4.1 Specification of test rig

Sr. no.	Component	Quantities	Specification
1.	AC motor	1	P = 2HP, 60RPM
2.	Circular disc	1	D = 250mm, t = 20mm
3.	Bearing	1	C = 12000, I.D.=25mm, O.D.=47mm
4.	Shock absorber	1	Wagon R(rear)
5.	Pillar	2	I.D. =37mm, O.D = 42mm, H =950mm
6.	C-Chanel	1	L = 1000mm, b= 540mm, h= 50mm
7.	Rectangular slot	1	L =180mm, h=47mm, t=6mm

#### V. CONCLUSION

The purpose of this project is to perform endurance test on shock absorber as per Indian standard. Hence we conducted study and perform endurance test on shock absorber. As conclusion the shock absorber test rig is capable to perform endurance test on different types of shock absorber.

#### VI. ACKNOWLEDGMENT

The successful completion of the project and paper work is incomplete without mentioning the name that made possible. I am thankful to my guide Prof. Sarjeel Syeed in automobile engineering department, for his encouragement and support to carry out this work.

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# Study of Improving Mechanical Efficiency and Power for SI (Gasoline) engine using Turbo-charger

Rana Varad<sup>1</sup>, Parmar Mayur<sup>2</sup>, Shringarpure Swapnil<sup>3</sup>, Khan Wasim<sup>4</sup>

**Abstract**— Engine is the main or important component of any automobile. Due to rapidly increase in usage of petroleum product supplies, these are depleting at faster rates. Although many researches are working on the reducing the fuel consumption in the vehicle, it's major point for automobile sector. For the engine analysis these is major factor for decrease in volumetric efficiency of the engine is increase in temperature, which in turns decrease volume supplying in the engine chamber. This reduces power developed because of low charge density. Researchers have been finding solution to increase the efficiency (volumetric) for the engines via consuming less fuel. In SI engine, lean-burnt combustion can be a method for increasing fuel efficiency along with lower emission rate of harmful gases. Apart of lean-burnt combustion method, in this project paper we will use turbocharger to increase both efficiency and power of petrol engine. Thus, we can study how to increase the efficiency (volumetric) and power for SI engine using turbocharger over naturally aspirated engine. A turbocharger is basically a turbine-driven forced induction device that helps to increase an internal combustion engine's efficiency and power output by forcing extra amount of air into the engine chamber. This increases charge density by forcing more air and proportionally fuel into the engine chamber. The second thing which turbocharger helps in is to burn the remaining unburnt gases leaving from the engine chamber.

**Keywords** - I.C. engine, S.I. engine, Turbocharger, Mechanical Efficiency, Volumetric Efficiency, Power, Overall Efficiency.

## 1 INTRODUCTION

In today's growing world, we all are interested in having more power output using minimum fuel consumption. Although small engines consume less quantity of fuel, but their power output is not that satisfying. This can be achieved by providing more air to the engine chamber. For understanding this we all need to understand the basic working of a standard IC engine. This is a mechanical device which converts chemical energy (depends on fuel grade) of the fuel into mechanical work which will provide motion to our vehicle. It works basically on 4 major cycles or strokes namely [1] Suction [2] Compression [3] Expansion [4] Exhaust. Initially fuel and air mixture is sucked (brought) into the engine chamber and then it's compressed with the help of piston. Just as it's fully compressed, a high intensity spark is given to the charge to burn, this explosion pushes the piston and we obtain mechanical work which is used. After all charge is burnt all

which is left behind are exhaust gases which are then removed from the engine chamber.

There are many ways to improve the power developed in the engine like cylinder reboring, using cold air intakes, ECU remapping, etc. But one of the most productive and most used methods worldwide is turbocharging. By using turbocharger we in fact can increase the volume and mass of the air in the engine chamber and also simultaneously allow more fuel to burn thus creating more power. This also increases volumetric efficiency and also increases engines overall efficiency.

Mostly turbochargers are being used in high compression CI engines used in trucks, SUV's, etc. But in the past few years due to introduction of GDi (Gasoline Direct Injection), it has become possible to integrate turbocharging in gasoline engines. But still in India turbochargers are most commonly used in diesel engines as compared to gasoline engines.

Also due to increasing stress on fossil fuels and environment, there has been greater importance given to "Downsizing". If a car is having a smaller capacity of engine than its than its other outgoing high capacity model, but it can still provide the same output or also an even better performance, then this phenomena is called as 'downsizing'.

## 2 TURBOCHARGER

### 2.1. CONSTRUCTION

A turbocharger is basically a mixture pack of a compressor and a turbine combined together, both supported on a

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same individual shaft. Turbocharger intakes basically use engine exhaust gas, to rotate the turbine blades which help to move the compressor blades.

Centrifugal compressors are basically used where size of turbocharger used is smaller, for e.g., turbocharger in automotive system.

Axial flow is one of the type of compressors which are most widely used where there are applications of larger radial units in which internal modifications to it can be done as per the need. These are the most efficient compressors with engines using heavy oil.

### 2.1.1. Main Parts

There are three major parts constituting a turbocharger:

- Turbine
- Impeller / Compressor
- Central Hub

The wheels of both turbine and compressor are implanted/situated in their own conical housing. The quantity of air which is to be provided to the assembly depends on the sizes of wheels. The shaft is being supported in the hub with the help of bearings and therefore connecting the turbine wheel and impeller wheel. Due to high speed of rotation, more amount of heat is generated in the housing. Hence to lower amount of heat, cooling system is provided to prevent temperatures from rising.

To prevent mixing of gases from compressor and turbine some a particular arrangement is done. Before incorporation of exhaust gases into turbine air is first filtered so that impurities could not enter in it.

### 2.1.2. Turbine

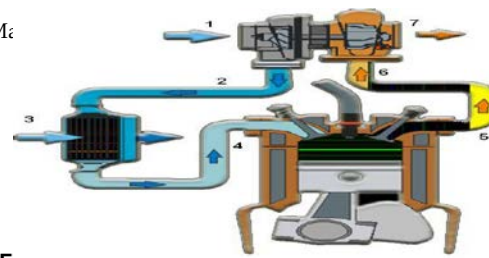
Nozzle blades are provided in the turbine housing for following requirement

- To guide the gas into the turbine housing onto the blades of turbine properly on the blade of turbine wheel
- To house the bearings of turbine

The outlet side of the turbine casing constitutes of both blower and air passages for supply of air to labyrinth seals.

### 2.1.3. Compressor Side

The compressor side is mainly made of aluminum alloys and it also constitutes of two parts. The inlet part draws air from the surrounding areas- i.e engine room or deck spaces, etc. If air is drawn through the deck spaces, special ducting is made for that. The advantage for this drawing of air from the deck spaces is both low air temperature and humidity. While the advantage for this drawing of air from the engine space is that the air obtained is pressurized and there is no special need for those long and complex ducting arrangements.



**Figure 1.** Sectional view showing turbocharger's working System

1. Compressor inlet part
2. Compressor output part
3. Transition from air cooler
4. Intake valve
5. Exhaust valve
6. Turbine inlet part
7. Turbine output part

## 2.2 Working

The turbine uses heat energy and velocity from the exhaust gases to convert heat energy into rotational motion. This rotational motion of turbine drives the compressor, which sucks in ambient air from the surrounding atmosphere and compresses it and pumps compressed air with high density and pressure output into the intake manifold.

The exhaust gas from engine chamber enters the inlet side of turbine of the turbocharger through a pressurized chamber and a series of consecutive filters. The nozzle blade rings help to concentrate the exhaust gas on to the turbine wheel. The movement of the turbine wheel due to pressurized gases rotates the shaft which in turn rotates the impeller of the compressor as it is connected. A portion of this air goes to the labyrinth seal from the outlet side of turbine.

As the impeller starts rotating, air is sucked in via the centre of the impeller casing and due to the heavy rotational movement, centrifugal force is created and it experiences circumferential velocity which pushes it outwards towards casing. A radial velocity is gained by these which force the air further outwards to the inducer. Relative to this additional resultant velocity is gained/obtained due to the accurately designing of inducer inlet angle which provides max. Compressor efficiency.

Excessive pressure obtained leads to spoiling or fouling of the both impeller and inducer surfaces. This results in the change of angle of incidence and thus dropping efficiency.

All heavy fuel engines are subjected to heavy load variations hence results in fluctuation of exhaust gas pressure. A prolonged fluctuations occurring in pressure may lead to detrimental effects on the internal parts of the compressor. For this above reason, a constant pressure chamber is provided in most of the engines. The exhaust gas coming from engine, instead of entering directly, first enters the pressure chamber and from there it is taken to the turbine at constant pressure. This leads to reduction of the excessive stress that is created on the shaft bearing and sealing.

## 2.3: TYPES OF TURBOCHARGERS:

### 2.3.1 SINGLE

It is the majorly used type of turbocharger. It provides low boost pressure (upto 18psi). Single small turbos have advantage over large turbos as they spin faster and also accounting of ball bearing helps to obtain less friction for turbine and compressor to spin easily.

### 2.3.2 PARALLEL

Some of the engines, that are V-type engines, utilize two identical sized turbos, each is given a separate set of exhaust outlet streams from the engine. Having of two smaller turbos gives advantage to produce the same aggregate amount of boost required as a larger single turbo gives them to reach their optimal higher rpm, quickly, hence it improves boost delivery. Such an arrangement made of turbos is typically known to as parallel twin-turbo system. The first production automobile which used the parallel twin turbochargers was the Maserati Biturbo of the early 1980s.

### 2.3.3. SEQUENTIAL

Another type of twin-turbo arrangement obtained is "sequential", where one turbo is always in action across the entire rev/rpm range of the engine and the other will activates at higher rpm. Under this rpm range, both exhaust and air inlet ports of the secondary turbo will be shut. The turbos being individually smaller in size they have reduced lag and the second turbo operating at a higher rpm range allows it to get to full rotational speed before it is been required. Such combinations of turbos are known to as a sequential twinturbo. Cars using sequential twinturbos are as follows the Porsche 959, Mazda RX-77, Toyota SupraS and Subaru Legacy. Sequential twin-turbos are usually more complex than a single or parallel twinturbo systems because they usually require three sets of intake and waste gate pipes and valves to control the proper direction of the exhaust gases.

### 1 TRIPLE-TURBO

BMW's diesel N57S is the only tri-turbo engine currently available.

### 1 QUAD-TURBO

The Bugatti Veyron uses a quad-turbo W16 engine. The Bugatti EB110 from 1991 uses a quad-turbo V12.

## 3 Intercooler

Intercooler, a cooling element is used to the cooling of heated air to the turbo compression results in turbocharged engines.

If coldest air enters in the engine, highest power gets from it. This is the reason for the larger or bigger size of the intercooler always means more amount of air molecules can send into the engine.

Thus, by providing an increased volume of air get some benefits; the increasing of fuel economy, the engine power, increasing engine durability and reduction of a gas harmful emissions. Intercooler is fixed with various geometric shapes of fins. To compare and check the performance of finned surfaces, two factors should be taken into consideration those are

Intercooler valuations are taken into account when making design limitations are determined by the properties of the motor vehicle manufacturing companies. These are: ingoing and outgoing temperatures, size, airflow passing, cooling power, compressor efficiency and turbine efficiency

## 4 Problem Definition

In an normally aspirated engine there are more occurence of pumping losses as compared to turbocharged engine, this will decrease the efficiency of respected engine thus it is only fair that we can use the full potential of engine in order to obtain the best significance output possible.

Also due to inadequate compression in the combustion chamber its not possible to get a high torque curve in all conditions. Due to this the powerband shortens which reduces the usability of particular engine

The engine we are being using for this project is a naturally aspirated engine: in short which means a stock engine developed by the company itself which runs on its original power and torque figures and it doesn't have any external means to run it. Due to this it has a drawback that all the power developed doesn't reach on the wheels which reduces its efficiency.

It reduces its volumetric efficiency that is the ratio of air intake through manifold in cylinder to engine volume capacity is less.

## 5 Proposed Methodology

In order to overcome the above listed problems definition discussed a turbocharger can be used. It gets power from the pressurised exhaust gas from engine. Exploding a mixture of fuel and air in the engine chamber, the mixture turns into gas due to combustion and is pushed into the exhaust manifold. At this stage, the gas pressure tailpipe along a path rotates the turbo propeller and a significant portion of the gas goes in turbine.