TECHNICAL PROJECT FOR COMMUNITY SERVICES

BAJAJ INSTITUTE OF TECHNOLOGY

WARDHA - 442 001 (INDIA)

2021 - 22

Air Ventilated System for Driver Seats to Overcome the discomfort of sweating in the trunk part of the body

Project report submitted to
Dr. Babasaheb Ambedkar Technological University, Maharashtra
in partial fulfilment of the requirements for the award of
the degree

Bachelor of Technology
In
Mechanical Engineering

By

Vikram Potdukhe (1946491612059)
Harsh Verma (1946491612013)
Aditya Tadas (40464920181161210046)
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under the guidance of

Prof. Santosh Kumar

Department of Mechanical Engineering
Bajaj Institute of Technology
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2021-22

BAJAJ INSTITUTE OF TECHNOLOGY, WARDHA

DEPARTMENT OF MECHANICAL ENGINEERING

CERTIFICATE

This is to certify that the Project report titled

Air Ventilated System for Driver Seats to Overcome the discomfort of sweating in the trunk part of the body

has been successfully completed

by

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in partial fulfilment of the requirements for the award of

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Date: 06/07/2022
Place: Wardha

DECLARATION

We, hereby declare that the project report titled "Air Ventilated System for Driver Seats to Overcome the discomfort of sweating in the trunk part of the body" submitted by me to the Bajaj Institute of Technology, Wardha, in partial fulfilment of the requirement for the award of Degree of B. Tech. in Mechanical Engineering discipline is a record of Bonafede project work carried out by us under the guidance of **Prof. Santosh Kumar.**

We, further declare that this submission by the undersigned represents our original work and we have quoted the references where others' ideas have been included. We understand any above violation will levy a disciplinary action on us.

We, further declare that the work reported in this project report has not been submitted either in part or in full for the award of any other degree in any other Institute or University.

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ACKNOWLEDGEMENT

We are thankful to our guide **Prof. Santosh Kumar,** Assistant Professor, Department of Mechanical Engineering whose valuable guidance, everlasting enthusiasm, and continuous encouragement through the course, made it possible to complete this dissertation work.

We wish to convey our heartfelt thanks to **Dr. Deepak Bhope**, Associate professor and Head of the Department of Mechanical Engineering, for his extended encouragement towards this dissertation work.

We wish to express our profound gratitude to our beloved Principal **Dr. Narender M. Kanhe** Bajaj Institute of Technology for providing the opportunity and necessary facilities to carry out this project work.

We take immense pleasure in expressing our sincere heartfelt thanks to the faculty members of Instrumentation and Control System for their valuable guidance and suggestions at every stage of the completion of this project.

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ABSTRACT

This paper deals with the investigation of the performance of car seat fabrics in terms of physiological comfort of sitting, specifically their sweat-drenched on the back after long driving and air permeability. The current work presents an alternative approach to increasing the effectiveness of car seat fabrics through a combination of nearly designed arrangements between the front of the seat and the driver's back. The supplementary device was designed to supply air circulation at the back portion of the body by employing sweating to stop and not distract the driver focus from driving.

It consists of two components: A-frame to support the resting area of the back part of the body. Which helps to maintain back body posture while driving. And another component will supply air from the cabin to the required area of the body part. This will result to provide a proper air supply which avoids the cause of sweating. The outcomes of the study have several important implications for future practice. The combination of a car seat with our proposed device with channeled structure and continuous flow of air improves physiological comfort of seating which is a key issue for drivers.

The proposed device for continuous air flow through convection in the plane of car seat fabric has not yet been part of an actual car seat however it was previously built for the smart car which is not affordable for a middle-classed person whereas our device is cheaper and easy to use also there is no need of any installation or implantation in the seat we just need to keep in between the backrest of seat and the trunk part of the body. It works on the principles of Smart Ventilated Seats.

Keywords: Physiological comfort, Channelled fabric structure with compact design, Air supply, Proposed ventilation device with seat arrangement.

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CHAPTER 1

INTRODUCTION

1.1 Changes come in the automobile industry in the driver seat

Since every automobile vehicle started running on roads, seats have been an integral part of the automobile. From the very early times when there existed simple benches, to the latest state-of-the-art massaging chairs, automobile seats have changed immensely over time. They have transformed from a flat horizontal plank to contoured individual chairs capable of catering to individual needs. Heating and cooling features have turned car seats into ambient zones on the go. With the addition of softer and more comfortable foams, leather, and massage function, they have become much more luxurious. The implementation of a modern three-point seatbelt along with airbags has made seats safer. Conclusively, the plethora of features and functions on modern-day car seats turned them into an extremely complex system.

A feature to cool down seats for improved thermal comfort has been around for almost two decades. It was first introduced in a production vehicle, for the front seats, by a Swedish OEM in 1997 (saabhistory.com, 2009). Since then, it has been adopted by many manufacturers and fitted in a wide variety of vehicles in almost all market segments. This feature has been most commonly offered for the front seats. In recent times, it has been made available for the rear seats as well. Although, that remains confined mostly to high luxury brands, and their flagship model variants (Jaguar Configurator, 2016).

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Fig.1.1 Ford automotive introduce this seat in 19th century.

Fig.1.2 Swedish OEM in 1997 for front seats.

Fig.1.3 Ford advance safety featured front seats in 2016.

Fig.1.4 Toyota Camry in 2004 for front and back seats.

Even after having a considerable history, sparse research has been dedicated to cooling down seats. Most research so far was focused on utilizing Thermoelectric devices to provide a cool draft of air. But one of the most important factors for the limited research, as observed through multiple scientific articles, has been the human body itself. The complex biology of humans combined with the uniqueness of each human body has been a challenge in creating a universally constant cooling system. Added to that, the constantly changing driving conditions, and a weather system differing from place to place have put up extreme challenges towards the development of seat ventilation.

The temperature of an automobile vehicle can exceed hot on a summer day due to incident solar radiation while driving and parking also hot ambient air heat seats which will increase the temperature of vehicles. Under this extreme range of ambient conditions, drivers and passengers can experience painful localized heating and sweating, as exposed body surfaces (15 to 20%) make contact with the seat at back support and other open areas of the body without contact. Although the air-conditioning systems within an automobile vehicle attempt to respond to the comfort needs of customers, the thermal capacity of most cabin components limits the timely response of these heating and ventilation systems, resulting in driver or passenger discomfort after a long period. The cabin air temperature is an important factor in determining the level of thermal comfort however, conductive heat transfer from the body due to contact with a seat that is initially very cold but after but after some time body temperature with a contact area of back portion with seat increases thermal capacity of heat and due to which sweating and other problem faced by the driver or passengers.

1.2 Introduction to the problem

"We perform a survey of a few corporative societies where we find the problem for Drivers and passengers as we saw their Every driver is facing one common problem which is a skin infection in the trunk part of the body due to improper seating on the driver seat"

All automobile vehicle drivers have to drive for a long period and continuously due to which there is insufficient air circulation at the contact surface of the back of the body part and backrest of the seat. This results in continuous sweating and inflammation which leads to a skin infection.

1.3 Causes of distraction to the driver

As we discussed before, the problem is for driver's seat which is the most important subject when we talk about any road transportation. Driver comfort is very important because the number one cause of car accidents is "Distracted Driver".

Two main causes of Distraction

Fig. 2.1 Due to negligent use of gadgets while driving.

And

Fig. 2.2 Due to Discomfort Ness while driving.

Future mobility trends such as the automotive industry, connectivity, or electromobility are setting new focuses in the automotive industry. The transfer of the driving function to the vehicle will lead to variable seating arrangements, which leads to a new vehicle interior, the aspects of comfort, ergonomics, and air–conditioning system is the largest secondary energy consumer, and especially in electric vehicles, the driving range can be significantly reduced by heating and cooling. Therefore, it is necessary to enhance

the energy efficiency of air-conditioning systems by improving and developing a new concept. The challenge is to enable individual air- conditioning for each occupant in all possible sitting positions as shown in fig.2.3. Due to longer driving times and the focus on non-driving related tasks, the customer's demand for thermal comfort will thus become increasingly important.

Fig. 2.3

In this context, the vehicle seat represents the contact surface of the driver to seat with comfort also surface between passengers. Especially during the summer months, the thermal comfort of the vehicle interior plays a vital role. This investigation aims to develop an innovative ventilated arrangement with a seat based on a conventional driver's seat, which provides optimized thermal comfort close to the body. The main research question is:

- Can the seat play a dominant role to provide thermal comfort?

1.4 Air Ventilation System in Driver Seat

Presently there are some products/mechanisms in use. But they are not that effective, and the products which are fulfilling the requirement of drivers are very costly, and a limited income customer can't afford to buy as shown in fig.2.4, 2.5, 2.6.

Fig.2.4 Cheap but not effective for sweating

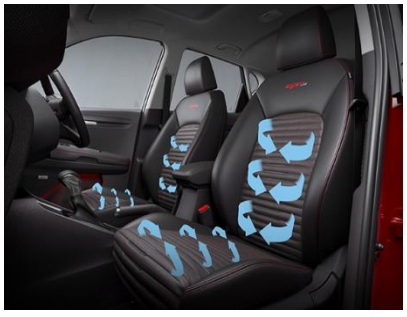

Fig.2.5 Not effective up to the expectation of drivers

Fig. 2.6 Effective but very costly and replaced complete default part of seat.

As we know automobile industry has grown so much for providing comfort (i.e. AC, Posture comfort seats). But still, there are some problems as shown.

Fig.3.1

So, after observing this problem we are trying to propose a system arrangement that will provide the proper air circulation at the front of the backrest of the seat, so the above problems shown in fig.3.1 can be minimized or limited up to a certain extinct.
The proposed system will work in such a way that it will limit the problem caused by sweating. We are providing a path for the air to reach up to the back part of the driver's body. We designed the backrest for better posture comfort and in that backrest component, there will be outlets for air to create a good air-vented environment in the trunk area of the driver as shown below in fig. 3.2 and 3.3.

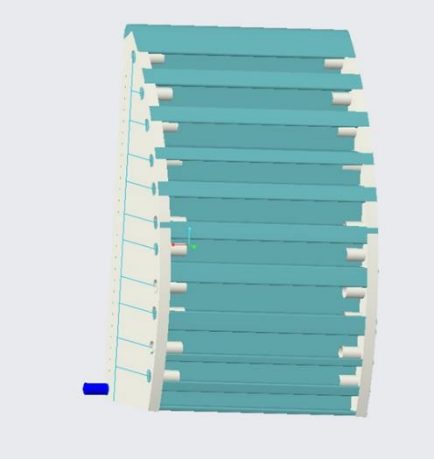

Fig. 3.2

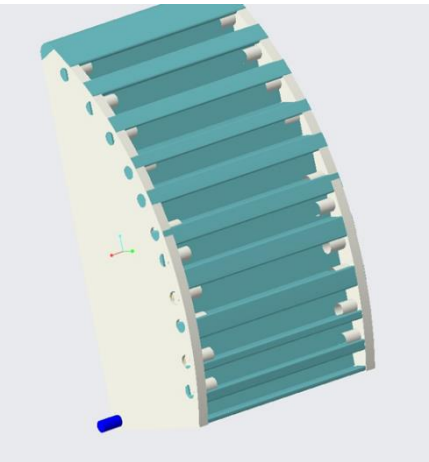

Fig. 3.3

This paper with an outlet concept that generates an air supply to the backrest portion of the body which will give physiological comfort to the driver and passengers. Furthermore, the seat with the proposed device will be verified to evaluate better posture to the back of the body.

CHAPTER 2
LITERATURE SURVEY

2.1) Design of Comfortable Advanced Ventilated Automotive Seat for Driver using CFD simulation (reference 5)

Detail study has been done to formulate a generalized process for designing and developing a ventilated seat for an automobile. Ventilation of an automobile seat may help to improve human comfort; ventilation can reduce the temperature of the seats if the vehicle was parked in the sun and they became hot. The research articles explain the use of thermal seats for car driver comfort. The research study formulates the use of computational fluid dynamics to predict the flow of cold air over the fabricated seat. Overall, the thermal comfort of the seat through computational fluid analysis was studied.

2.2) Improving the cooling performance of front seats for Volvo cars (reference 1)

The thesis aims to improve the ventilation system of Volvo's SPA platform front seats. This goal is to be achieved without compromising on existing levels of comfort, safety, or quality. The increment in performance, in this context, is defined as quicker cooling in focused areas. This cooldown is directly coupled with increased airflow. With better air circulation, moisture removal is also of interest. Furthermore, this thesis aims to compare the current ventilation system in the SPA seats with those offered by competitors as shown in the figures fig.4.1, 4.2 4.3.

The scope of the thesis also concerns changes required to be made to the ductwork to enhance performance. Complimentary changes to other components in the system are shown in (fig.4.4, 4.5) also a part of this thesis. The thesis also involves working in collaboration with the supplier, for testing, research, and development for performance improvement as well as benchmarking as shown in fig.4.6, 4.7.

Figure 11: Seat ventilation of Competitor 1. Source: Competitor 1

Fig. 4.1 Competitor 1

Figure 12: Seat structure of Competitor 2, Source a2mac1

Fig. 4.2 Competitor 2

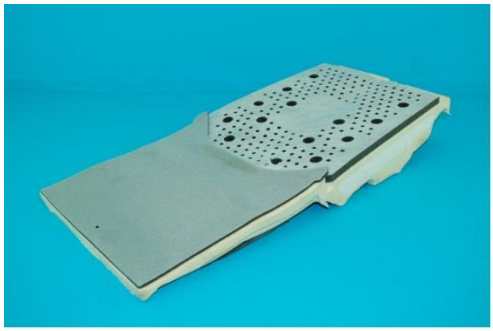

Figure 13: Cushion of Competitor 2, Source: a2mac1

Fig. 4.3 Competitor 2

Figure 14: Fan layout of competitor 3, Source: a2mac1

Fig. 4.4 Competitor 3

Figure 15: Shows the seat of Competitor 4 with the grooves on the backrest, source: a2mac1

Fig. 4.5 Competitor 4

Figure 16: A seat from Competitor 4 Source: a2mac1

Fig. 4.6 Competitor 4

Figure 17: The seat frame of Competitor 5, where the arrow shows the placement of cooling system

Fig. 4.7 Competitor 5

2.3) Air conditioning concepts for autonomous electric vehicles (reference 2)

This paper presents a new innovative ventilated seat being developed for new vehicle interiors regarding new seating positions and postures. A seat ventilation concept with division into seven different ventilation zones is presented. An outlet concept at the seat surface is investigated, which can climatize the occupant from the side and can be adjusted independently from the seat position. The equivalent temperature according to ISO 14505-2:2006 is used as the basis for the evaluation. The first results indicate that the seat system has good potential for new interior concepts as shown in fig.5.1. In warm environments, good results can be achieved for the head and upper body. However, in cold environments, the outflow concept is less suitable.

A new innovative ventilated seating concept is developed to meet future usage re-requirements. The main objective of the development is to improve the thermal comfort of the seat and to introduce new innovative concepts for future vehicle interiors and flexible seating positions all consideration is performed and the calculated result is shown in the table1.1.

Fig.5.1 Vehicle mock-up in the climate chamber for the experiment to generate individual interior climate for comfort studies.

Table. 1.1

	Parameter setting	Winter condition	Summer condition
Backrest angle	constant	68 °	68 °
Environment Temperature	constant	-20 °C	40 °C
Humidity	constant	40 %	40 %
Blower speed	stepwise	4000, 3000, 2000 rpm	4000, 3000, 2000 rpm
Cooling circuit	stepwise	-	5, 10, 15 °C
Heating circuit	stepwise	50, 45, 40, 35, 30 °C	-
Heat foils front/sides	constant	0 °C	52, 42, 35, 30 °C

CHAPTER 3
METHODOLOGY

I. Community problem identification and Topic finalization of project work is selected during the survey of corporative society which is done by us which estimate the problem statement on the ventilation system in seats. Else it is used in smart cars but due to parameters of much costly or replacement of whole seat dynamic structure, it is not worthy to install in vehicles. We decided to design a device as an arrangement in a seat that will use while seating in an automobile vehicle with a compact design for easily placed in front of seats.

II. Studying the existing air-cooling system and its mechanism of ventilation system used in seats of the branded and smart vehicles.

III. Designing the mechanism for air circulation to driver's seats at the backrest portion. To fulfill the need of drivers by providing proper circulation of air supply towards seats. The device we proposed to design helps the driver or passenger to give better comfort and posture to the back body rest area in sitting. With the affordable cost to purchase for any people and need less space to store or kept when it is not in use, a compact structural design.

IV. Modelling of mechanism. Making Proposed model design From the Creo software with version 8.0.

V. Selection of components and their dimensional structure with material selection is carried out with followed stages which will provide good strength and flexibility at the area of contact of the body with the device. Finalizing the prototype for the system to install for testing and resolving further defaults helps to know the performance of the device with proper functioning and gives an idea for any changes to be done on components of the proposed device.

VI. System formation and its fabrication with the installation process. In the end, making a mechanism with a properly working system to cover the whole area of the contact portion of the backrest of the proposed device arrangement with the seat ergonomics also have to maintain a posture of the body for a long-time during driving.

CHAPTER 4

IMPLEMENTATION OF PROJECT

A new innovative design in ventilated seating concept is developed to meet further usage requirements. The main objective of the development is to improve the thermal comfort of the seat and to introduce a new concept for future vehicle interiors and flexible seating positions.

A-frame to support the resting area of the back part of the body. Which helps to maintain back body posture while driving. And another component will supply air from the cabin to the required area of the body part. This will result to provide a proper air supply which avoids the cause of sweating. The outcomes of the study have several important implications for future practice. The combination of a car seat with our proposed device with channeled structure and continuous flow of air improves physiological comfort of seating which is a key issue for drivers costing of the proposed designed device is mention in the table1.2.

KEY FEATURE

1) Physiological comfort.
2) Channelled fabric structure with compact design.
3) Proposed ventilation device with seat arrangement.
4) Proper Air supply at the contact portion of the device.
5) To provide better posture to the body while sitting.

Table 1.2

COMPONENT NAME	MATERIAL	Amount of material used	COST (INR)
Nozzle Support Cage	Fibber reinforced plastic	500 x 300 x 10 mm Sheet x 2 pcs	200/-
Nozzles	Flexible PVC pipe	50mm, 10mm diam. x 24 pcs.	80/-
Piping	PVC, FRP, HDPE pipe	6 meter, 15mm diam. x 1 pcs	95/-
Backrest support	TPR Thermoplastic	500 x 300 x 60 mm Sheet x 1 pcs	800/-
Spring	Alloy steel	2 pcs.	450/-
		Material cost:	1600/- approx.

CHAPTER 5

RESULTS

The Proposed device is designed in such a manner that there are two components. The first one is having a proper backrest posture area to cover the person while sitting in contact with it and provide physiological comfort. Where it is adjustable when their body weight pushes to the area at back. Another is used to give continuous air supply to the left passage in the first components where the ventilation system is work to give cooling air which maintains back body temperature hence it reduces and stops the sweating hence it reduce and stop the sweating occurring at the backrest portion of the body. The two components are explained in fig.6.1, 6.2 and fig.7.1, 7.2 as shown.

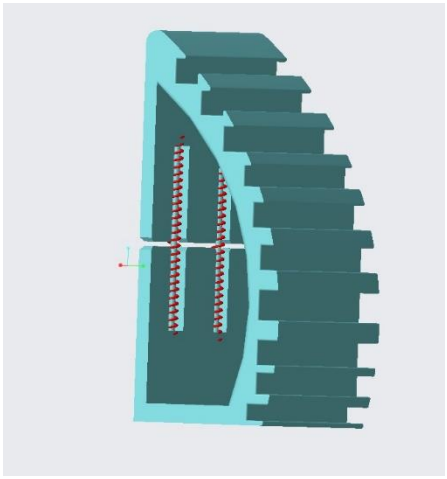

Fig.6.1 First component with ergonomics structural design to provide better comfort.

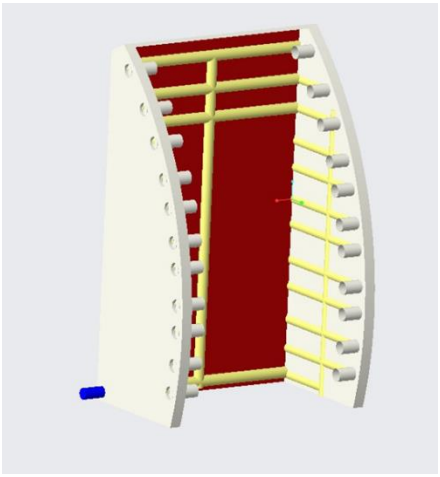

Fig.7.1 Second component which help to provide air supply ventilation at backrest part of body.

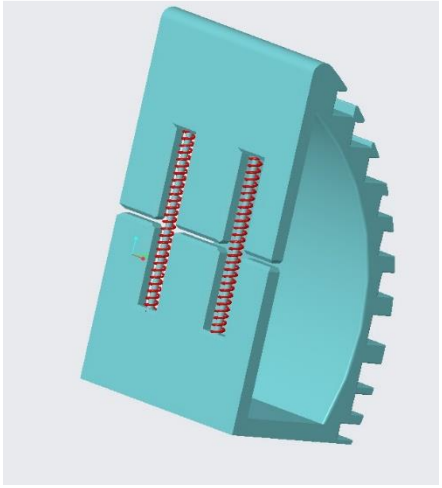

Fig.6.2 It has spring which help to sustain impact of tension while body perform pushing action to device.

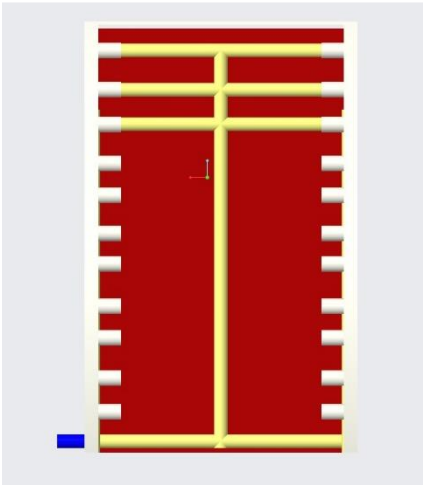

Fig. 7.2 In this component every passage is provide separate path for air supply to back rest area of body which provide better performance.

CHAPTER 6

CONCLUSIONS AND FUTURE SCOPE

6.1) Conclusion:

The objective of this paper was to give better comfort to the driver when compared with smart car seats with a high range of cost. To provide a pure supply of ventilation system at a back-rest portion of the person body with better posture to be maintained while sitting and driving of back truck part of the body of driver and passenger whom will use our proposed design device. It takes less maintenance and is not much costly to purchase. Everyone can use it while setting and it is adjustable at the body weight of every person who is below overweight. The material trial used in the proposed design is having good strength and flexibility which gives an excellent performance of the device and comfort to driver and passenger.

6.2) Future scope:

The design of structure and shape could be changed while the need for further comfort to provide for every citizen. In which we can specify were children, elders and older people can also get their choice with their need with posture and pain-relief from backrest part of the body with the size of contact of back part with seat. Also, it can be formed as a permanent part of the seat which will not much costly and effective to every customer of automobile vehicle as driver or passenger and there can be an addition to add control part in flow or supply of air with the requirement to personal use in climatic condition.

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Images:

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ANNEXURE A

1. Acupuncture Acupressure Back Rest Car Seat Lumbar Support Fabric

This study investigated the effects of an acupoint-stimulating lumbar backrest on pain and disability in office workers who suffer from low back pain (LBP) as well as the preference influence on pain and debility