



S.No	CONTENT
1.	<u>INTRODUCTION</u>
2.	<u>SYNOPSIS OF AIR BOOST TECHNOLOGY</u>
3.	<u>WHAT IS AIR BOOST TECHNOLOGY QUADROMOTOR</u>
4.	<u>HOW IT FUNCTIONS</u>
5.	<u>WHAT IS A HYPERCAR</u>
6.	<u>DIFFERENCE BETWEEN NORMAL AIR BOOST ENGINE AND QUADROMOTOR AIR BOOST ENGINE DESIGN</u>
7.	<u>PROSPECTS AND DEVELOPMENTS</u>
8.	<u>CONCLUSION</u>



AIR BOOST TECHNOLOGY QUADROMOTOR

INTRODUCTION

Quadromotor concept is the version of airboost technology designed to meet the needs of hyper car design and dynamics. In addition to the 3 phases of airboost technology model already dealt in my research dissertation titled “Automobile Architecture”, this version of quadromotor concept is designed especially for cars that features speed, performance and dynamics as its features for the users.

Like there are varied segment of automobiles in the market with different design and performance specification to meet the user preferences, quadromotor concept is a variant added to concept lineup of the air boost technology to meet the diversified preferences and needs of the users.

Quadromotor concept helps the air boost engine technology to extend its application to an much advanced segment of automobiles built in specific as performance vehicles whilst the basic air boost engine would serve to build the basic segment vehicles that are designed for normal day-to-day driving routine. This concept will increase the application boundaries of the air boost concept, making the technology more versatile.



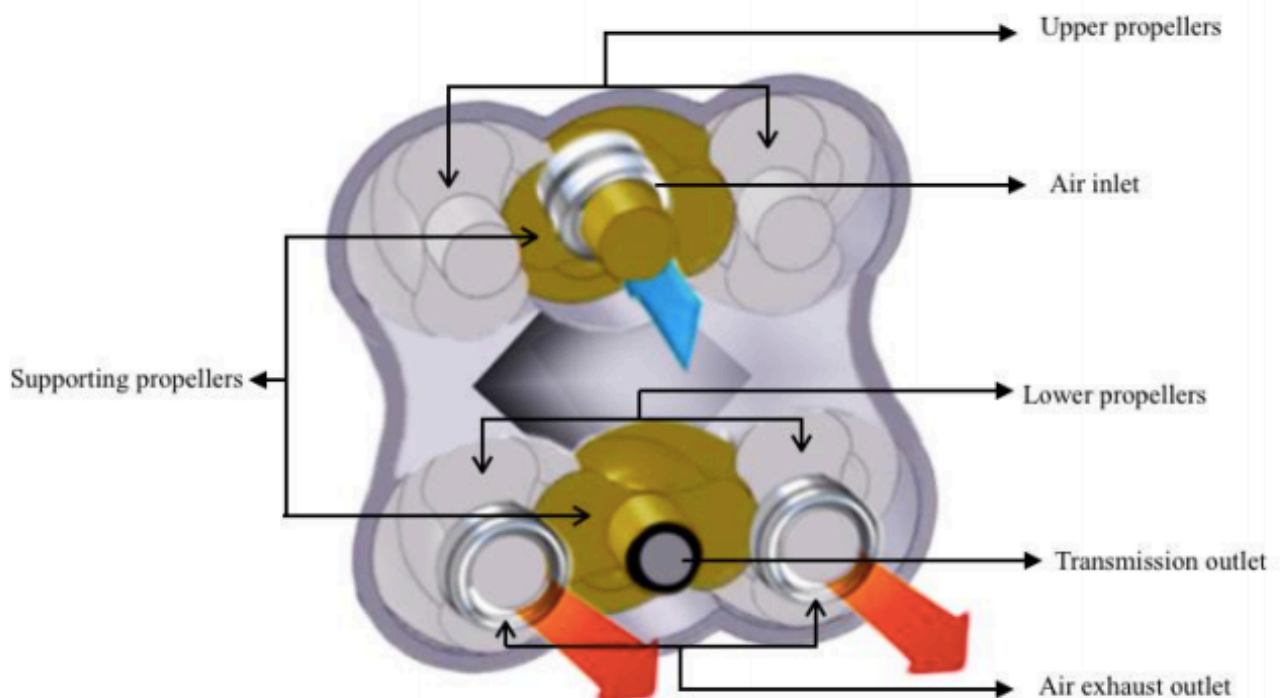
Before explaining about the quadromotor concept, let me give a quick run-down of the air boost technology for readers who are exclusive to this paper without any prior introduction to my dissertation. To know about the air boost technology in detail and to know about the earlier discussed phases of the air boost technology do visit and have a look at my research dissertation “Automobile Architecture”. A gist of air boost technology here, will also help us all to connect the quadromotor concept with the base technology and aid in understanding the quadromotor concept powered by air boost technology better.

SYNOPSIS OF AIR BOOST TECHNOLOGY

“*Airboost technology*” as its name suggest is a technology that uses air as it fuel to power the automobile. The basic airboost technology involves four step process, (i) intake, (ii) compression, (iii) purification and (iv) power distribution. The air to the engine is fed through the air intake box which is then purified and sent to the booster engine for the next stage of process, compression.

The air boost motor contains two pairs of propellers, (i) the upper propellers and (ii) the lower propellers. Each propellers has two individual propellers placed side to side with a supporting propellers in-between. The filtered air entering the booster engine is first directed to the upper propellers through the upper supporting propeller where the process of amplifying the air pressure starts. This

generates the needed initial mechanical energy, then the pressurized air gets directed towards the second pair of propellers located below the first. Here, the generated energy gets intensified to initiate the vehicle's propulsion where the generated mechanical energy is sent to the transmission through the lower supporting propellers. With the generated mechanical energy directed to the transmission (power distribution) stage, the air inside the engine is sent to the second stage of purification which is then exhausted back to the atmosphere.



With the generated energy being sent to the transmission, the clutch balances and equates the speed of the engine and the speed of the wheel, simultaneously,



the transmission regulates and distributes the power received according to the gear set, creating torque. From the differential gear, the power is distributed to the wheels via the half shaft. Additionally, in the compression stage the two pairs of propellers, the upper and the lower propellers are connected by a pulley system to reduce the power wastage.

This is the core concept of the air boost technology, how this technology could function in a duo-engine concept and in an entirely new framework of automobile design are discussed as separate phases of the air boost technology in the dissertation.

The airboost technology was designed as an alternate for the world and the automobile industry when both faced several different problems with the use of the existing Internal Combustion Engine. Airboost technology also stands as a reliable alternative for the electric powertrain. Use of airboost technology will also decontaminate the atmospheric air from pollution. The positive changes that can be brought to the environment with the presence of the air boost engine are remarkable. This addition of quadromotor concept made to the air boost engine's design further enhances the ultimatum that was set to the design earlier.

With this brief introduction to the air boost technology, let us now take a look in the quadromotor design concept.



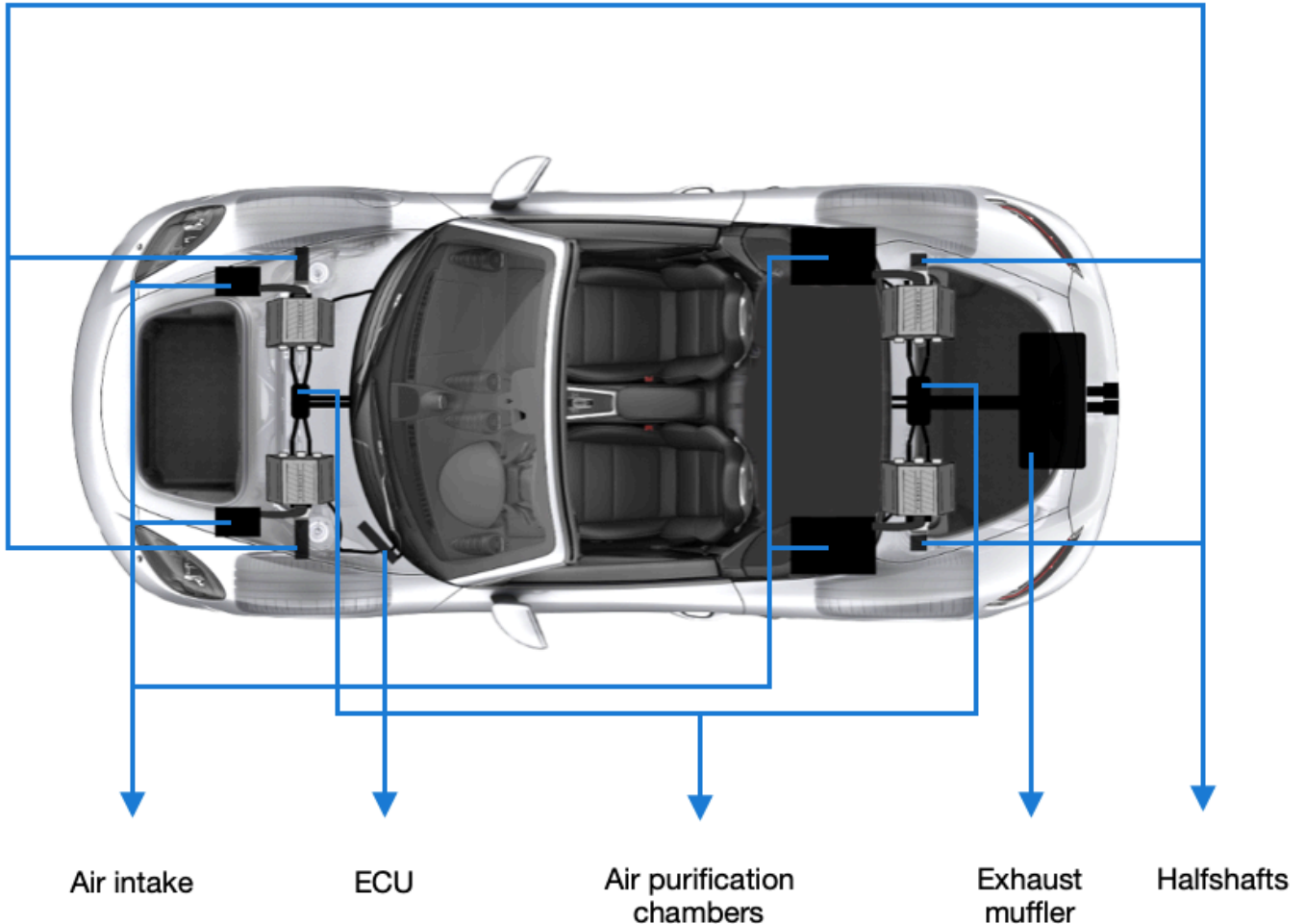
WHAT IS AIR BOOST QUADROMOTOR

The airboost engine's quadromotor design was designed to make the air boost engine serve its functioning in higher end performance oriented cars that are designed in specific for speed and hyper performance. The basic air boost design which just had one single engine dedicated for the entire functioning of the car, the quadromotor design has 4 individual air boost engine dedicated to the functioning of each wheel specifically that enables better performance of the vehicle in terms of better speed and torque production.

HOW IT FUNCTIONS

Quadromotor technology's functions are kept simple and easy to implement. The technology is just as straight and simple as the original airboost technology's design. Instead of a single air boost engine, four air boost motor's will be placed in each wheel that would power them individually. This allows the air boost technology to be incorporated as a powertrain in the hyper performance car segment, broadening the presence of the technology. Before an in-depth detailing of how the technology functions, let me preface the process step-by-step for a better understanding.

STEP-BY-STEP PROCESS



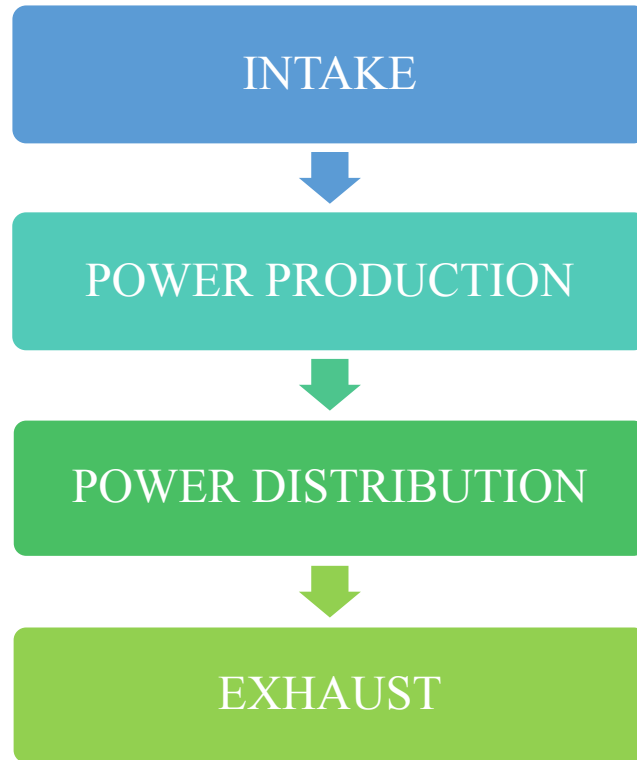
- The air enters the airboost motor once it's switched on, via the air intake points that brings in air through the front air dam for the front motors and via air ducts located on the rear haunches of the vehicle for the rear motors.
- Once the air enters the air boost motor, the air helps in the process to produce mechanical energy just like the original air boost engine.



- Depending on the pressure applied on the accelerator, the feedback is sent to the ECU which splits the input evenly between all four air boost motors, which opens the throttle body of each air boost motor accordingly for them to work in harmony and help avoid any specific motor to be overpowered causing vehicle imbalance.
- Produced mechanical energy is transferred to the wheels via a half shaft that's connected to the motor.
- The traction control system that is integrated within the ECU will receive the feedback from each wheel helping the ECU to split the input given to the throttle body of each motor accordingly to avoid traction issues, allowing maximum grip and reduced unnecessary wheels spin which would lead to power loss.

These are the steps that the technology functions with. The quadromotor technology, like the all the previous technologies discussed in the dissertation has a user-friendly interface and are affordable in manufacture perspective with being extremely potent and competent to its counterparts. Now that the step-by-step process for the technology is explained let's get into the topic of how the quadromotor technology functions in detail.

The functioning of quadromotor technology consists of four stages, which are,

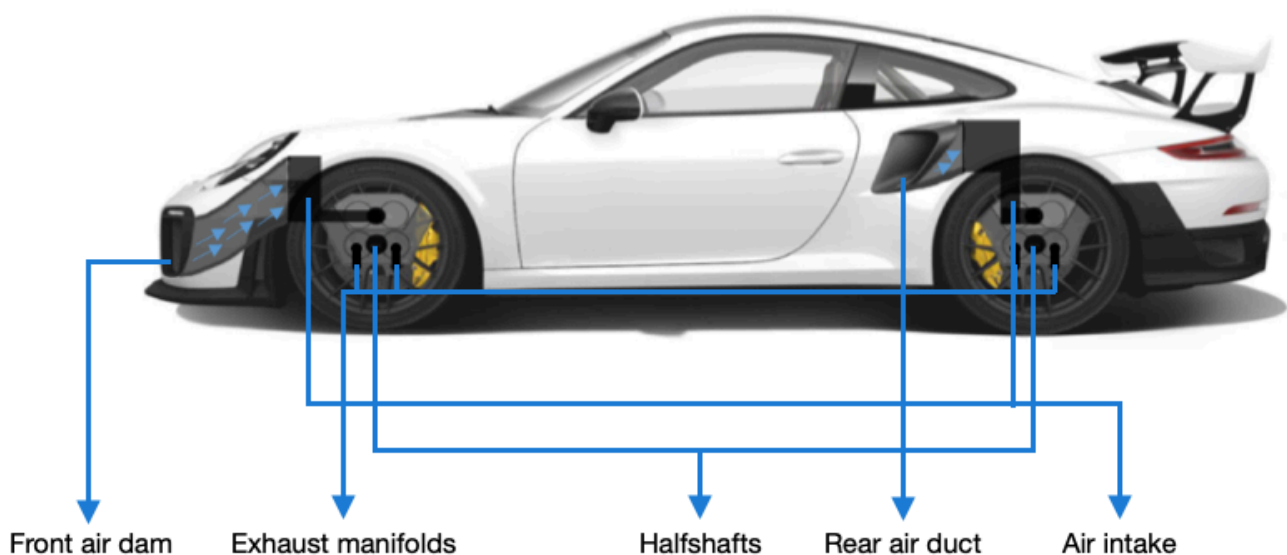


INTAKE

The first stage, intake. When the motor is switched on, it intakes the air. Unlike the base version of air boost technology, where the air intake is done through the front grill, in quadromotor concept, the air intake is done individually for the respective motors from various points like, for the front motor, the air intake is from the front air dam where the air is then channeled into the motor near the axles. While for the rear motors the air is channeled in through air ducts located on the rear wheel haunches on either side to the rear axles. This further reduces



unnecessary drag force as the car utilizes the air that the car body pierces through as it moves forward increasing the flow of air better allowing the automobile to perform better.



POWER PRODUCTION

Once the process of air intake is done, the air goes through a purification chamber where unnecessary contaminants and particles are removed from it in order to protect the components of the air boost motor.



After the purification process, the air enters the motor. The design and the process of the air boost motor is similar to that of the air boost technology. Each motor has two pairs of propellers placed one below the other. Each pair of propellers have individual propeller placed side to side which is connected by a supporting propeller in-between them. The arrangement of these propellers are in screw pattern that movement of one would initiate the rotation of all other propellers in the pair.

The upper propellers and the lower propellers are connected with pulley which ensures its functioning to be in harmony. This coordinated functioning of the propellers helps in intensifying the production of mechanical energy to best of its form.

The air enters the motor through the upper supporting propeller which directs the air to upper propellers where the generation of mechanical energy is initiated. The generated energy further intensifies when passing through the lower propellers and helps in producing the needed mechanical energy to power its respective wheel.

POWER DISTRIBUTION

The quadromotor technology functions on the design of gearless transmission that requires no additional component for its functioning that would complicate



the design or would increase the production cost in multifold affecting the factor of affordability.

When required power and torque is generated in the air boost motor, the generated power is sent to its respective wheels via the half shaft. Since this designed with the technology of gearless transmission, the forward drive and reverse drive mode can be opted by the user through the paddle located behind either side of the steering wheel whose instruction will be transmitted to the vehicle by the ECU. The power received from the motor is transmitted to the wheels via the half shaft.

Traction control system is integrated within the ECU which constantly receives feedback from each wheel helping the ECU to configure the input given to the throttle body of each motor to avoid wheel spinning and traction issues during severe weather conditions and off-roading times. The presence of traction control system ensures improved handling of the vehicle and aids to reduced power loss.

Depending upon the pressure applied to the accelerator the ECU splits the input equivalently to the throttle body of each motor and when the pressure on the accelerator pedal is reduced, the ECU sends input to close the throttle body of the all motors accordingly which would result in reduced power production of



the motor and reduced driving speed of the vehicle helping the quadromotor to work in harmony.

EXHAUST

Once the air passes through the motor helping to generate mechanical energy to move the automobile, the air is purified for the final time and exhausted from the vehicle. And this is how the quadromotor design of the air boost technology functions. The performance of the air boost motor can be increased by simple mods like lowering the size of the pulley and tuning. Higher capacity motors can be used to further increase the performance output depending upon the requirement to meet the performance of a hypercar segment.

WHAT IS A HYPER CAR

Hypercar is the top most variant in the performance car segment. How does a performance car differentiated from the basic car segment? Performance car focus on speed, while the basic car segment are designed to meet the purpose of transport. Performance car segment focus their build design on hybrid and high end technology to enable the vehicle deliver surpassing output in terms of speed and efficiency. Performance car segment are categorized into 3 which is, sport car, super car and hyper car.



Starting from sports car, sports car belong to the base version of performance segment. They are a step above the normal car that are used for routine on-road drive. Super car constitutes the next-level up performance features, next to which is the hyper cars. Rarity, performance output, innovation and leading and state of the art technology involved decides the category to which an automobile belongs to. The categorization of an automobile model in a category isn't fixed and would get shifted to a category below with every updated introduction.

At present, cars with secondary/supplementary powertrain are categorized as hyper cars, where, along with the traditional Internal Combustion Engine (ICE) an electric motor is paired as supplementary or addition powertrain that would help in reducing the initial lag caused by the low-end torque of the combustion engine. These supplementary/secondary electric motors are located either on the rear wheels or the front wheels.

So hypercar is a category in performance car segment which constitutes car that has the advanced technology in it and is capable of delivering the best efficiency making it to be specific for tracks and that could be handled by the professionals. At present, these segments of cars are mostly manufactured by sports car brands like Ferrari, McLaren, and Porsche. They are usually record-breaking with their astounding performance, these models of cars are usually known as the halo models in their brand's performance line-up.



There's always confusion between a supercar and a hypercar, to have a better understanding of the hypercar segment, let me explain what defines a supercar. Supercars are the type of performance vehicles that are outstanding to distinguish itself from a crowd, are performance-oriented, and expensive. In the simplest way to describe the difference between a supercar and a hypercar is, every hypercar is a supercar but, only some supercars are considered as the hypercar because of its ultra-striking features and high-performance. While the Porsche 918 Spyder, Ferrari La Ferrari, and McLaren P1's are considered as hyper cars, they belong to the segment called the hybrid-gasoline performance cars, neither one is incorrect. This is because they are ultra-extraordinary, they were produced in limited numbers and are best performing vehicles that the brands have made during the time. Because their design mechanically is an internal combustion engine supplemented by electric motors, it can also be classified under the Hybrid-electric performance sportscars.

The explanation of the hypercar or the hybrid electric cars was necessary because the quadromotor design was conceptualized for the air boost engine to be powered in an extreme performance-oriented car that belongs to this segment. Compared to the existing market economies of the ICE, electric and hybrid vehicles, both the quadromotor and the air boost technology is economical and affordable with more benefits to the industry, world and the users.



The quadromotor design features individual motors for each wheel. This increases the stability of an automobile and enhances the weight distribution aspect of an automobile. Each motor produces power depending on how the manufacturer wants to tune them. Because the quadromotor takes a step further and has four individual motors located on each wheel the delay in power implication is considerably reduced. And the overall weight balancing is better than a car that is built in a more traditional design layout, this makes the quadromotor design to be functional, productive, and capacious. That being said, the quadromotor design also brings in further safety and performance prospects which will be discussed later in this paper. As said before, the multi-motor design is currently being tested and used in some extremely top-notch and high-performance automobiles. But with a much simple and direct design that comes in with a much lesser manufacturing cost, the quadromotor design will help in bringing the heavy priced performance segment in an much affordable range.

To further understand the quadromotor design and how it works better, let me explain the design's differentiation between the standard air boost engine design and the quadromotor design.



DIFFERENCE BETWEEN NORMAL AIR BOOST ENGINE AND QUADROMOTOR AIR BOOST ENGINE DESIGN

To understand the difference between how the quadromotor technology of the air boost concept can make a significant improvement in an automobile compared to the basic air boost engine mounted in a traditional design, learning about the engine mounting points in an automobile is important.

An engine can be mounted in any preferred part of an automobile depending on what the automobile is designed for. For example, an engine can be front-mounted, mid-mounted, rear-mounted and axle mounted. These are the places where an engine is usually mounted in an automobile.

The front-mounted engine design layout is mostly preferred by the manufacturer for multiple reasons, as the engine builds heat, placing the engine upfront helps the heat to dissipate faster, placing the engine weight upfront helps in increasing the steering feedback as it increases the traction to the front wheels while taking corners and it is also easy to develop and assemble a rear-wheel-drive vehicle with front engine mounting design layout.

Mid Mount engine design layout is used to accommodate larger capacity engines without ruining the performance, this design is also used to reduce the overhang in a vehicle's design, it improves the weight distribution which increases the



stability of the vehicle. The mid-engine set-up is mostly used in the performance car segment. The mid-mount engine setup also increases the comfort of ride and handling as the engine is situated on top of the front or rear axles. Mid-Engine layout is being used as both front mid-engine and rear mid-engine.

Rear mount engine setup is used mostly in performance cars like Porsche, using a rear mount engine better enables the vehicle to evenly distribute the traction to all four wheels while braking, which is better for a car that is designed to be track capacious. While there is an advantage to this design, it also has significant downfalls to it. Because the engine is located behind the rear wheels it creates an imbalance in weight distribution, especially a rear mount engine with rear-wheel drive set-up in a car can cause oversteer while slowing down causing the vehicle to be unstable at turns. Also this design is inconvenient and complicated for liquid-cooled engines as it requires the coolant piping line to run to the rear for a front-mounted radiator. Thus, this is why rear mount engine car brands in the early days like Porsche mostly utilized an air-cooled engine system. The only other alternative that can make the design of a liquid-cooled engine to be fit for a rear mounted vehicle would be to place the radiators either on the side or at the back of the car and to redesign the vehicle's body to channel the air to the radiators via air ducts.



The axle mount design is the closest one in terms of design to the quadromotor technology's design. As the quadromotor design also uses the air boost motors to be placed on the axles but as of now the axle mount layout is being used in premium range of the performance segment cars and electric cars like tesla with the dual motor design, where, one motor is located on the front and the other on the rear axles. While the quadromotor design is used in the Rimac C Two All-electric hyper sports car, that was limited to only 150 cars produced which had 4 individual electric motors that are liquid-cooled. Quadromotor air boost design is less complex and will help bring this design to the masses by having the scope to be included in many affordable cars and make them perform better.

The difference between the traditional engine mounted air boost technology layout and the quadromotor airboost technology is not the mechanical or engineering of the engine but the design placement of the engine and how it delivers the produced power to the wheels. The basics of the air boost engine is the same and unchanged. The quadromotor design adds a variation to the airboost series and enables the airboost powerplant to be used in a wider range of segments increasing its boundaries. Single airboost engine that was placed upfront in a traditional front mount engine layout will be spilt into four dedicated power air boost motor in quadromotor design that would be located near the wheels where individual motor will power its respective wheels independently receiving constant inputs from the Electronic Control Module (ECU) which



connects all four motors to work in harmony. The quadromotor system though can be slightly expensive compared to the basic air boost technology design due to its requirement for multiple motors, it would still be considerably economical when compared to cars with similar powertrain design. As the quadromotor airboost design was synopsized as to what the design is and how it differentiates itself from the original airboost technologies design. In the next chapter let me explain how the quadromotor design functions.

PROSPECTS AND DEVELOPMENTS

The prospects and developments that quadromotor technology can bring to the automobile industry and the performance aspect of a vehicle are exponential. As the technology is focused more on making the air boost engine feasible to the performance car segment, it doesn't mean that it is impractical to be used in an automobile that is used for day to day commodities. As much as the quadromotor technology help increase the performance and handling of an automobile it is also extremely functional, safe, and practical that it can be used in a vehicle that is used on a day to day basis to get from point A to Point B, and make the driving experience of any automobile better and engaging for the masses by making the technology affordable.



- BETTER WEIGHT DISTRIBUTION
- BETTER PERFORMANCE
- INCREASED SAFETY
- INCREASED CABIN AND STORAGE SPACE
- SIMPLE AND COST EFFECTIVE DESIGN

These are the prospects that the technology could bring to society and the automobile industry. Now let me explain these prospects in detail.

BETTER WEIGHT DISTRIBUTION

The main criteria that would enhance a performance car's handling around corners would be for it to have a better weight distribution configuration. This is why performance cars mostly have a variety of engine mounting layouts and it also depends on what wheels the engine is powering. For a rear-wheel-drive car using a rear-mid engine mount set-up is better as it gives a better weight distribution and traction to the rear wheels as the engine sits right above rear wheels. In a similar case, high-performance cars have electric motors mounted on the axles. The quadromotor technology uses a similar design by having motors on all four axles, this helps increase the stability of the automobile as all four corners of the vehicle have an equal amount of weight. Having equal weight



distributed on all four corners, it helps the vehicle's handling better at turns even in high speeds. It also enable better control of vehicle at turns even when it runs in high speed for the tyres gain better grip having its engines right on the wheel's side.

BETTER PERFORMANCE

The air boost motor being located right by the wheel not only reduces the use of unnecessary components like transmission, differential gear, and driveshafts but also reduces the drivetrain loss, as the engine is connected directly to the wheels via half shafts. This allows the engine to transmit the generated power and torque without any loss, enhancing the performance of the vehicle. This also allows the vehicle to be responsive and agile as the input given by the user is immediately reflected without delay, increasing the performance and agility of the vehicle. It helps the manufacturers to use a considerably smaller capacity engine and acquire similar or better performance compared with a vehicle in the same class using a traditional single engine setup.

INCREASED SAFETY

This is one of quadromotor technology's strongest suit as the engine being located by the axles it leaves open space upfront or behind the cabin where normally a vehicle's engine would be located at, in this case when the vehicle



that is equipped with the quadromotor technology gets into a collision the occupants of the vehicle would have a better chance of walking out without injuries as there is no engine to get pushed into the cabin unlike an automobile with a traditional single engine setup. Having the engine located by the axles also helps in reinforcing the automobile's structure better without compromises done in any area, increasing the safety standards of automobiles.

INCREASED CABIN AND STORAGE SPACE

Because the engines are mount by the axle, it liberates more room which can be used to increase the cabin space and storage space making an automobile design to be ergonomically friendly. This increases the automobile's reach to a wider range of audience living in countries with narrow and congested road infrastructure, as the use of quadromotor technology allows a hatchback to be just as comfortable and roomy as a significantly larger sedan equipped with a larger capacity front mount engine setup.

SIMPLE AND COST EFFECTIVE DESIGN

Quadromotor technology like my other technologies is a cost-effective, and simple design language eliminating complexities. As it can be seen in the diagrams presented in this paper, this technology is straight forward and has a user-friendly interface in terms of operation. The quadromotor technology was



designed to make the air boost engine feasible for vehicles that are built to achieve extreme performance and to make automobiles be more user-friendly and cost-effective that it can be used in any modern-day automobile making them just as fun and engaging to drive like a performance vehicle yet not compromising on comfort, convenience and safety factors. Because the quadromotor design uses the gearless transmission technology, the technology removes all the complicating components that would add weight and cost to a traditional automobile making quadromotor technology to be simple and cost-effective.

CONCLUSION

Prospects and developments that the quadromotor technology could bring to the automobiles, industry, and the society are valuable, like, it makes the automobiles safer, spacious, powerful, comfortable, environment friendly, economic and suitable to all road conditions encouraging more people to buy a car now that it suits their requirements and nimble to be driven around congested and narrow roadways. The technology also upgrades the handling and agility of a performance automobile to another league, making automobiles better in every perspective still keeping the manufacturing cost and ownership affordable. The use of air boost technology in hyper-performance cars will help in making



trackability of an automobile to be eco-friendly yet fun and engaging like it's internal combustion engine counterpart.

The quadromotor technology was designed to increase the horizon of the air boost technology into the category of vehicles that are extreme where the air boost engine as a powertrain would have great potential to perform. The design also shows that a simple change in an automobile design could make it better in every way possible. This technology serves its purpose of making safer, competent, and durable automobiles for the future.