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MAPPING OF DESIGN DRIVERS

(advancements post year 2000) w.r.t. THE FIELD OF MOBILITY

Design Reserch Seminar Project
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Guided by Prof. Sugandh Malhotra

DECLARATION

I declare that this written submission represents my ideas in my own words and where others' ideas or words have been included, I have adequately cited and referenced the original sources. I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in my submission. I understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited of from whom proper permission has not been taken when needed.

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APPROVAL SHEET

This project report entitled “Mapping of Design Drivers (Advancements post year 2000) w.r.t. the field of mobility”, by Abhishek Gogoi is approved in partial fulfilment of the requirement for Master of Degree in Mobility and Vehicle Design.

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ABSTRACT

Human evolution, Technology advancements and our environment plays a huge role in driving one's design inventions in the field of mobility. Using these three factors and breaking them down further into varied sub categories, namely 19 factors, for the case of this project; post year 2000, the developments, advancements that have happened was studied and analyzed. This includes a wide variety inventions and innovations right from textile levels, all the way to nanotechnological levels. For instance, one of the most evident change happening in the recent past is the onslaught invasion of electric powered vehicles. We can see here, that although these are majorly to target the issues of rising population and giving a better economic output, but these have also resulted in a new aspect of looking at designing vehicles because of the absence of a gasoline powertrain. Hence one innovation, but it can be connected to multiple factors.

We tried to map all these into categories and ultimately mapping them on a broader spectrum relating to the initial three factors, i.e., 'Human', Technology' and 'Environment'.

CONTENTS

1. INTRODUCTION

To set a starting point to begin with the research of mapping design drivers, three major factors were decided which pays a very important role in the field of design; namely *'Human'*, *'Technology'* and *'Environment'*. As we look deeper into these categories, there are more factors that broadly defines each of them.

The factor 'Human' has roughly eight parameters:

1. Joy of using.
2. Safety and Hygiene
3. Convenience
4. Comfort
5. Affordability
6. Styling
7. Social Advancement
8. Cultural Advancement

The factor 'Technology' can be roughly explained in another eight parameters:

1. Control System
2. Energy Resource
3. New Structural Concept
4. Maintenance
5. Manufacturing Process
6. Materials
7. Mechanism
8. Scientific Principle

The factor 'Environment' covers up three parameters:

1. Renewal of environment
2. Preventing deterioration of environment
3. Environment as source of inspiration

Moving onto these factors and sub factors, the advancements that has happened in the past decade were researched, studied and analyzed using various sources of information. It was found that many of the factors fall in multiple categories. After the brief research, all the factors were mapped based on the three aforementioned factors, i.e., Human, Technology and Environment.

2. HUMAN

1. Joy of riding
2. Safety and Hygiene
3. Convenience
4. Comfort
5. Affordability
6. Styling
7. Social Advancement
8. Cultural Advancement

2.1. JOY OF RIDING

2.1.1 RYNO MOTORS

The Ryno is "sleek and simple, while evoking a deep-seated yearning for a more progressive future," the manufacturer says. It looks a cross between a Segway and a motorbike.

To park, the front of the vehicle's frame comes together in a rubber-footed bar. Simply tipping the vehicle forward rests it on that bar like an oversized kickstand. Little foot pegs fold out from the sides of the tire; you can flip them down if you want to use them or lock them upward if you want to ride free-footed.

2.1.2. ONE WHEEL SELF BALANCING SKATEBOARD

The One Wheel Skateboard is a self-balancing vehicle much like the Segway, but is shaped like a skateboard and only has one wheel. To use it, one just must hop on and lean forward to speed up and lean backwards slow down or stop. Started with the dream of creating the *'Back To The Future'* Hoverboard, the one wheeled skateboard is great for getting around town, or just surfing or snowboarding season. The board is powered by a 48V Lithium Nano-phosphate that will charge in just 2 hours' time that will take you up to 4-6 miles in distance at speeds of up to 12 mph. The one wheel skateboard is still in a funding phase on Kickstarter.

2.1.3. ORGANIC TRANSIT ELF

The Organic Transit ELF (which stands for **Electric, Light, Fun**) is part *'recumbent trike'* (A recumbent bicycle is a bicycle that places the rider in a laid-back reclining position), part *'velomobile'* (a human-powered vehicle (HPV) enclosed for aerodynamic advantage and protection from weather and collisions) and part cargo bike. Borne on Kickstarter in 2013, the first_generation

ELF reached more than double its funding goal and has turned heads and hearts all over the world with some owners scooting to the grocery store and others crossing continents (Montana to Argentina to be exact).

In short, the ELF is a custom-made aluminum frame with three 26″ wheels, a high power centrally-mounted hub motor, a composite canopy with built in solar panel and LED lights and a battery pack.

Powering this unique electric bike is a custom build 600 watt direct drive (gearless) hub motor mounted near the middle of the chassis. Most hub motors on *electric bikes* serve as the hub in one of the wheels but Organic Transit chose to integrate it separately to step up the torque while simultaneously protecting it from the elements and vibration.

2.1.4. **HOVERTRAX**

Inventist, aka Shane Chen, has a track record when it comes to personal mobility. He invented the Solowheel electric wheel, the Hydroglider electric surfboard and most recently, the Hovertrax.

The Hovertrax is like a Segway boiled down to the bare essentials: two balancing wheels you control with your feet.

The Hovertrax 2.0 looks like any other electric scooter: It's two feet wide, with two rubber wheels covered by plastic hoods with bumpers. Our model was a beautiful shade of blue, with LED taillights in front and a battery indicator and power-on switch in the middle, between where your feet fit. It can support up to 220 pounds of weight on it.

It is also a self-balancing device. Your foot movements control the board's forward and backward movements: It consists of two identical parts connected at the center, having foot placement on each of them. Angle a foot forward, and the motor starts. TO bring the Hovertrax to a standstill position, angle a foot backward and it stops.

2.1.5. **HONDA U3-X EASY RIDER**

The Honda U3-X Easy Rider is a self-balancing one-wheeled electric vehicle designed for personal transport. Honda developed the U3-X with technology originally developed for ASIMO the

bipedal human robot project. Honda states that the "U" stands for unicycle and for universal.[1] It weighs 10 kg and travels at 6 km/h.

It was unveiled by Honda's CEO on September 24, 2009 and it was announced that it would be shown at the 2009 Tokyo Motor Show. And in the same year, Time Magazine called it one of the 50 best inventions of 2009.

2.1.6. **GM's EN-V**

General Motors' EN-V is a concept two-wheeled vehicle for personal transportation in the cities of the future. In the above picture, Xiao (Laugh) model design is pictured.

It is estimated that by 2030, urban areas will be home to more than 60 percent of the world's eight billion people. That does not bode well for cities with public infrastructure that is already struggling to meet the growing demand for transportation. General Motors (GM) and its strategic partner, Shanghai Automotive Industry Corp. Group (SAIC) have come up with a concept two-wheeled vehicle to address the need for personal urban transportation in the cities of the future.

EN-V, short for Electric Networked-Vehicle, is a two-seat, local emission-free vehicle as it is powered by an electric motor. In each of its two driving-mode wheels. The motors not only provide power for acceleration, but also bring the vehicle to a stop. The vehicle's drivetrain platform is an evolution of the platform of the Popular Segway Mobility and Accessibility (P.U.M.A) prototype developed by Segway. Segway has worked with GM to develop and deliver multiple copies of the drivetrain platform that connect to and power various EN-Vs.

Power for the motors is provided by lithium-ion batteries and recharging can occur from a conventional wall outlet using standard household power. The EN-V can travel at least 40 kilometers on a single charge. It can also communicate with the electric grid to determine the best time to recharge based on overall usage.

Dynamic stabilization technology gives EN-V the ability to carry two passengers and light cargo in a footprint that is about a third

of a traditional vehicle as well enabling it to *"turn on a dime"*. It even boasts of drive-by-wire, giving the vehicle the ability to operate autonomously or under manual control. By combining the Global Positioning System (GPS) with vehicle-to-vehicle communications and distance-sensing technologies, the EN-V concept can be driven both manually and autonomously.

The concept also leverages wireless communications to enable a *"social network"* that can be used by drivers and occupants to communicate with friends or business associates while on the go.

In addition to these, the ability to communicate with other vehicles and with the infrastructure could dramatically reduce the number of vehicle accidents. Using vehicle-based sensor and camera systems, EN-V can "sense" what is around it, allowing to quickly react to obstacles or changing driving conditions.

2.1.7. **ROCKET SKATES**

Roller skates powered by electric motor, is what Rocket Skates are. Launched on Kickstarter (US) in the year 2014, these use four hub motors and can zoom up to 12 miles per hour.

These can be worn over any regular shoe – simply strap it on and on is ready to get started. It comes with either a large or small foot plate depending on the size of your feet.

The rider also has to decide which foot they want to be their lead skate; the lead skate tells the other skate what to do. Just like how Segways work, to accelerate, simply tilt forward, and to slow down, just tilt back on the heels. It consists of an on-board microprocessor in each one and both are powered by a lithium-ion battery pack. Turning the skates on is done by a power button on the back of the skates. One can even walk while wearing these, a boon when one has to come across a flight of stairs in between skate sessions.

2.1.8. **C-1 Electric Two Wheeled Car – Lit Motors**

Lit Motors Inc. is a San Francisco-based company that designs two-wheeled vehicles, including a fully electric, gyroscopically stabilized vehicle. Founded by Daniel K. Kim in 2010, Lit Motors designed C-1 with a focus on innovative a0nd disruptive technologies.

The C-1 showcases an enclosed two-2heeled vehicle self-balanced by two single-gimbal control moment gyroscopes and is powered by lithium iron phosphate batteries. It uses a small steering wheel instead of handlebars. Direct-drive-in-hub motors in both wheels were designed to provide high amount of torque, stability and traction control, whole allowing for the body form to be about half the size of a car.

Two gyros located beneath the seat whirl clockwise at 5,000 to 12,000 rotations per minute. Like any rapidly spinning disc, such as an airborne Frisbee, the rotors naturally stay level.

Secondly, a single-axis gimbal assemblies, which hold the gyros, can tilt forward and backward. When tilted forward, the gyro generated a powerful torque that pushes the C-1 to the left. When backward, the vehicle leans to the right. The computerized stability-control module changes the tilt of the gimbals to keep the C-1 balanced. The vehicle remains level when driving straight or standing still and leans at an angle when making turns.

A 10.4 kilowatt-per-hour battery pack lasts 150 to 200 miles on a single charge.

2.1.9. **ULTRAVIOLETTE TWISTER**

The thought of riding a cycle to work seems rather appealing, but the idea of heading to office sweaty and showering there puts most people off. Wouldn't it be great if there was a vehicle that gave you the convenience of a motorbike or scooter while rushing to work and the exercise benefit of a cycle while heading back from work? This is exactly what was the moto behind this idea.

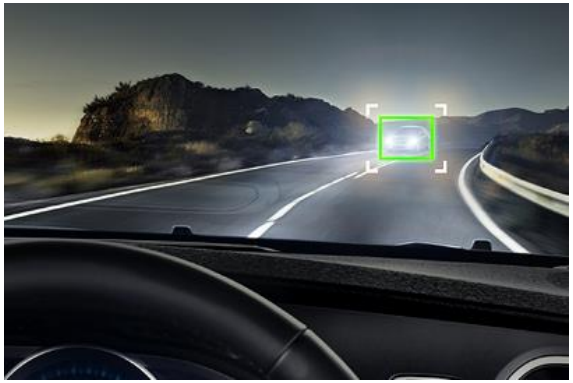
Borne in a startup based in Bangalore co-founded by Narayan Subramaniam, Neeraj Rajamohan and Preetham Murthy, Twister concept was conceived in the year 2015.

The Twister is built differently, it works as a cycle and a bike. The frame can be rotated 180 degrees; in one mode, it offers you the ergonomics of cycling. The other mode offers you the ergonomics of riding a bike. Unlike the cycle with a motor, the experience, seating position and the performance of the vehicle is different in the cycle and bike mode.

Twister went on to win an Excellent Design Award, and was showcased at the International Bike Show, Taiwan in March 2016.

2.2. SAFETY AND HYGIENE

2.2.1. AUTOMATIC HIGH BEAM



Automatic high beam lamps support you during night driving by automatically switching the headlights to low beam when necessary, then returning to high beam when the road ahead clears.

A camera integrated in the rear-view mirror monitors ambient brightness and traffic conditions, and can detect the headlights of approaching vehicles up to 1000 meters away and the rear lights of vehicles ahead up to 500 meters away.

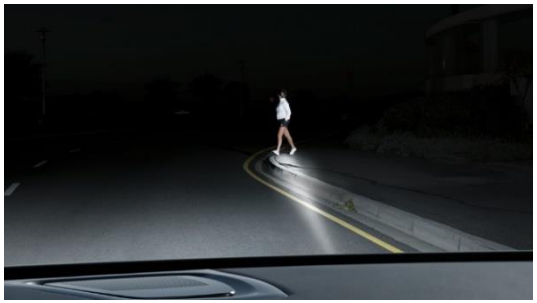
The system switches the headlights from full beam to dipped beam automatically. As soon as the other drivers are no longer in danger of being dazzled, the system automatically switches up to high beam again.

Driving at night with Automated highway beam relieves you of the need to constantly adjust your headlight's beam and gives you a significant boost to driving safety.

2.2.2. CORNERING LIGHTS

Cornering lights provide additional illumination of the area to the side of the vehicle, making night-time parking and turning safer. Cornering lights compliment the functionality of Adaptive Headlights. While Adaptive Headlights provide superior illumination of curves when driving at normal speeds, cornering lights give you better lighting when carrying out low-speed manoeuvres: parking, turning into a driveway, U-turns and taking extremely winding roads, for example.

2.2.3. NIGHT VISION HEADLIGHTS WITH PEDESTRIAN DETECTION



An automotive night vision system uses a thermographic camera to increase a driver's perception and seeing distance in darkness or poor weather beyond the reach of the vehicle's headlights. Such systems are offered as optional equipment on certain premium vehicles. The first introduction was in 2000 on Cadillac Deville.

2.2.4. VOLVO PEDESTRIAN SAFETY AIRBAG

The pedestrian airbag technology as being one possible solution to cushion an impact helps to protect pedestrians in certain situations when struck by the vehicles front end with a consequent impact to the hood and the area around the windscreen wiper recess and A-pillar, where there may be a risk of head impacts.

2.2.5. RIDING AIRBAG JACKET

Motorcycle clothing company Dainese has been experimenting with suit-mounted airbags since 2008 – its D-Air system is already available in Race and Street versions. The Race version pops out of the collar to protect neck, shoulders and collarbones, and the Street version is a much larger bag that protects the wearer's entire torso, front and back.

These systems activate in a slide or a crash, using data from a bike-mounted control box to decide when it's time to pull the pin.

2.2.6. CARBON FIBRE REINFORCED HANDGLOVES

With the advacement in carbn fibre technology, these materials have also found use in handgloves. These find purpose in protection of ligaments and the fingers as well as the titanium knuckle protectors and shock absorbing construction of backhand, in case of any accidents.

2.2.7. CERAMIC CLOTH

Zircar Zirconia Inc., a New York manufacturer of thermal product, created this cloth from ceramic fibers which can insulate against extreme temperatures. Ceramic cloth is a woven material made from alumina-silica ceramic fiber and has a continuous operating temperature of 2300°F /1260°C.

It has excellent chemical stability and strong resistance to thermal shock and corrosion attack.

2.2.8. ANTI-FOG FILM

Anti-fog agents, also known as anti-fogging agents and treatments, are chemicals that prevent the condensation of water in the form of small droplets on a surface which resemble fog. Anti-fog films are now often used on transparent glass or plastic surfaces used in optical applications, such as the lenses and mirrors found in glasses, goggles, camera lenses, and binoculars. The treatments work by minimizing surface tension, resulting in a non-scattering film of water instead of single droplets. This works by altering the degree of wetting. Anti-fog treatments usually

work either by application of a surfactant film, or by creating a hydrophilic surface.

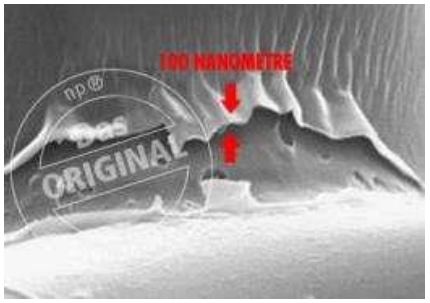
2.2.9. E - TEXTILES

E – Textiles, also known as smart garments, electronic textiles, are fabrics that enable digital components.

Military applications such as tracking the position and status of soldiers in action and soldiers' bulletproof Kevlar vests; if the wearer is shot the material can sense the impact and send a radio message back to the base.

2.2.10. STERLIZING SPRAY

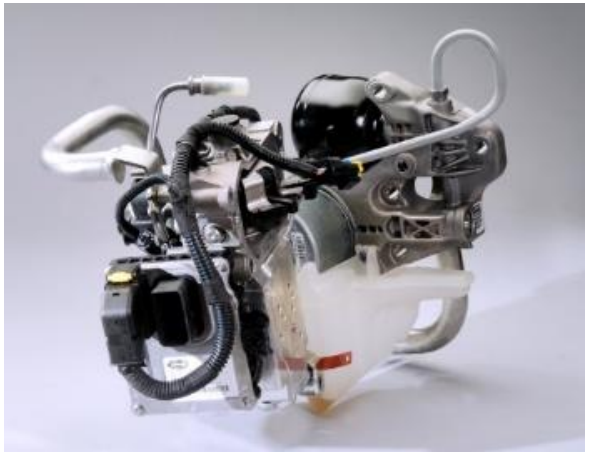
The special glass coating known as "SiO2 ultra-thin layering" protects practically any surface against water, UV rays, dirt, heat, acid, stains, mildew, fungus, bacteria and viruses.



The coating is environmentally friendly *(Winner of the Green Apple Award*). It can be applied within seconds to make any surface very easy to clean and safe from anti-microbes

2.3. CONVENIENCE

2.3.1. AMT – AUTOMATED MANUAL TRANSMISSION



AMT is based on an electronic control unit and a hydraulic system that supervise the use of the clutch and the gear shifting, allowing the driver to change gear without using the clutch, either sequentially or fully automatically. As the need for engaging and disengaging the clutch is eliminated here, it becomes quite convenient for the driver to operate. It also becomes very comfortable during stop and go traffic as well as is more efficient than traditional automatic transmission.

2.3.2. DUAL CLUTCH TRANSMISSION

A dual-clutch transmission, (DCT) (sometimes referred to as a twin-clutch transmission or double-clutch transmission), is a type of automatic transmission or automated automotive transmission.

They are usually operated in a fully automatic mode, and many also have the ability to allow the driver to manually shift gears in semi-automatic mode, albeit still using the transmission's electro-hydraulics.

As there is a use of dual clutches for the odd and even gear sets, there is very minimal energy loss and is extremely efficient in terms of power and fuel efficiency, in some case even more than the manual transmission. The only downside, they are expensive and require higher maintenance.

2.3.3. AUTONOMOUS DRIVING

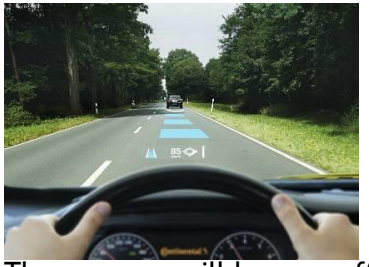
The year 2016 was termed as The Year of Autonomous driving.

As the name suggests; Autonomous car or driverless car; it can detect their surroundings using a variety of techniques such as radar, lidar, GPS, odometry and computer vision.

Even though the first self-sufficient truly autonomous cars appeared in 19080s, with Carnegie Mellon University's Navlab and ALV projects, only recently has this become an emergent experience with Tesla motors launching production ready Model S and Model 3 and previously, the Tesla Roadster. Apart from Tesla, new concepts such as LeEco, Faraday FF91 and Google Autonomous cars have also been conceptualized.

With these modes of driving, the users need not be behind the wheel at all. Only when they wish for. It is bound to get highly convenient.

2.3.4. PRE – COLLISION TECHNOLOGY



Pre-collision systems place small radar detectors up near the front of the car, usually within the grill, where they constantly send out quick bursts of high-frequency radar waves. These waves will bounce off the nearest objects and return to the sensor, where a separate unit connected to the sensor calculates how long it took for the signal to leave and bounce back. With this information, a PCS unit can determine another car's position, distance, speed and relative velocity almost immediately, and if any sudden changes in those factors could potentially cause a collision, the system can provide information or assist the driver in avoiding a potential accident.

Some systems sound an alarm to notify drivers that a collision may be imminent - a sound simply to alert the driver and get him or her ready to take evasive action. Other systems take control of certain aspects of the car. One of the earliest usage of this system was the Mercedes-Benz Pre-Safe system in the 2003 S-Class sedan.

2.3.5. V2V – VEHICLE TO VEHICLE COMMUNICATION

Vehicle-to-vehicle (V2V) communications comprises a wireless network where automobiles send messages to each other with information about what they're doing. This data would include speed, location, direction of travel, braking, and loss of stability. Vehicle-to-vehicle technology uses dedicated short-range communications (DSRC), a standard set forth by bodies like FCC and ISO. Sometimes it's described as being a WiFi network because one of the possible frequencies is 5.9GHz, which is used by WiFi, but it's more accurate to say "WiFi-like." The range is up to 300 meters or 1000 feet or about 10 seconds at highway speeds.

Connected cars, meantime, will help cities and states cut down on congestion and improve safety. On the road, cars will talk to each other, automatically transmitting data such as speed, position, and direction, and send alerts to each other if a crash seems imminent. This future of vehicle-to-vehicle, or V2V communication, is already in the works, with the U.S. Department of Transportation.

2.3.6. START-STOP-TECHNOLOGY

In automobiles, a start-stop system or stop-start system automatically shuts down and restarts the internal combustion engine to reduce the amount of time the engine spends idling, thereby reducing fuel consumption and emissions. This frees the user from continuously have to operate gearbox of manually powered vehicle when it comes to bumper-to-bmper traffic.

2.4. COMFORT

1.4.1. ACTIVE BODY ROLL CONTROL (ABC)

ABC is arguably the highest-quality suspension system on the market, offering the ultimate in driving dynamics and comfort by automatically adapting the suspension setting to the prevailing driving situation.

1.4.2. ACTIVE CURVE TILTING

This system allows the cabin of the car to angle around curves in order to significantly lessen the lateral acceleration experienced by its occupants and ensure their comfort inside. The frequent rocking motion within the car during times when the car passes through several curves can be very uncomfortable for passengers, especially those who are prone to car sickness. Theoretically, the Active Curve Tilting feature of the comes to be the solution to the problem.

1.4.3. AUTOMATED RAIN SENSING WIPERS

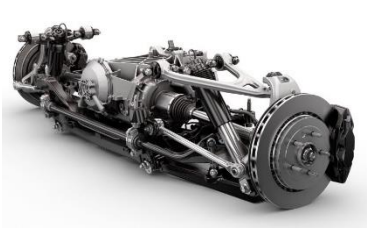
With drivers exposed to an ever-increasing number of distractions, automatic rain-sensing wiper systems become an even more appealing feature, as they work to minimize the time the driver must take his/her hands off the wheel.

As the manual rain wipers require constant monitoring of the stalks to operate efficiently, the automated rain sensing wipers are a boon in enhancing the comfort of the driver.

1.4.4. HYDRAULIC BODY MOTION ROLL CONTROL (HBMC)

This system was employed initially in the Nissan Patrol, and subsequently the Infinity QX. It was developed by Nissan Motors and was tested in the Middle East. The system helps reduce body lean while turning for a comfier ride. Utilizing hydraulic cylinders located at the shock absorbers, it adjusts roll stiffness by allowing transfer of fluid between the left and right sides of the vehicle through passive weight transfer during normal driving. It also helps reduce bump shock by setting bounce and roll damping force separately.

1.4.5. MAGNETIC DAMPERS



By varying electric current through a ferrous fluid, Magnetic Ride Control dampers can adjust their stiffness in response to driving conditions. It was originally developed by General Motors (GM) and the first vehicle to come into production was the Chevy Corvette in 2003. Currenty in its third generation, it improves on its prior designs by adding a second wire resulting hthe ferrous fluid to be actively switched from firm to complaint, unlike before which had a lag as the particles naturally returned to their relaxed state.

1.4.6. BOSE SUSPENSION

While there have been many advancements in vehicle suspension system, but some experts have gone so far as to say that the Bose Suspension is the biggest advance in automobile suspensions since the introduction of independent suspension design. The system uses a linear electromagnetic motor (LEM) at each wheel in lieu of a conventional shock-and-spring setup. Amplifiers provide electricity to the motors in such a way that their power is regenerated with each compression of the system. The main benefit of the motors is that they are not

limited by the inertia inherent in conventional fluid-based dampers. As a result, an LEM can extend and compress at a much greater speed, virtually eliminating all vibrations in the passenger cabin.

They can reduce sweating and dry any moisture between your body and the seat. They can reduce the temperature of the seats if the vehicle was parked in the sun and they became hot. Also, it can be used together with the heated seats function to make the seats warm during winter.

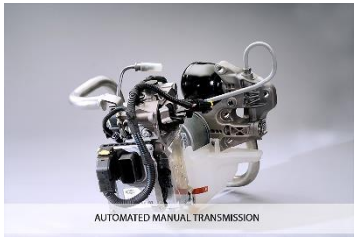
1.4.7. VENTILATED SEATS

Ventilated Seats or seat ventilation is a feature that is built into the seats and it directs air through the seat unto the occupant for increased comfort especially on long journeys.

Ventilated seats function via several small fans in the seat cushion and backrest. The fans draw air from inside the cabin and into the seat. The air then goes through plastic ducts, an air permeable fabric and distributes it evenly throughout the seat via perforations in the leather.

2.5. AFFORDABILITY

2.5.1. AUTOMATED MANUAL TRANSMISSION



Pioneered by Magneti-Marelli, Tata Motors providing AMT in its most affordable car Nano, AMT has breached inside among the most notable affordable technological and human advancement in the recent years.

2.5.2. HUMAN MACHINE INTERFACE

In the industrial design field of human-computer interaction, is the space where interactions between humans and machines occur. The goal of this interaction is to allow effective operation and control of the machine from the human end, whilst the machine simultaneously feeds back information that aids the operators' decision-making process.

With automotive companies, such as Renault launching their most affordable vehicle Kwid with touchscreen interface, the HMI has become a lot more affordable than how it used to be a decade ago.

2.5.3. SMARTPHONES

Smartphone advancements are on the edge of transforming in some crazy ways, but it isn't like what it was perceived before.

"Smartphones as a category is growing at a phenomenal pace. The Rs 5,000-15,000 category is exploding and we expect this trend to continue in 2015," Nokia India Sales (Microsoft Mobiles Oy subsidiary) Managing Director

Ajey Mehta told PTI. With the rising trend in more and more smartphones being launched at lower price value, these gadgets have become ultra-affordable.

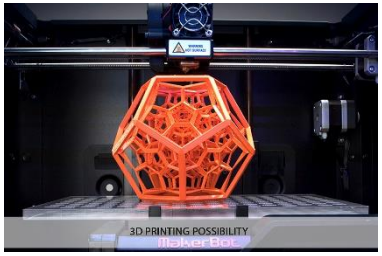
2.5.4. TATA NANO

The Tata Nano, a city car manufactured by Tata Motors. Made and sold in India, the Nano was initially launched with a price of one lakh rupees or ₹100,000, which has increased with time. Designed to lure India's burgeoning middle classes away from motorcycles, it received much publicity.

TATA NANO

2.6.STYLING

2.6.1. 3D PRINTING



One of the biggest news in the last few years is the proliferation and application of 3D printing technology.
It has caught the imagination of the public and the manufacturing community like nothing since the invention of the personal computer and the internet. With these, highly intricate delicate ideas can be turned to reality at ones living room.

2.6.2. CARBON FIBRE

Apart from Carbon fibre having high strength and extremely light in weight, it als serves the purpose of being used in styling consideration. As seen here, carbon fibre finish is used in the engine overhead cover enhancing the look and feel, thereby increasing the style quotient of the product.

2.6.3. FLEXIBLE DISPLAYS

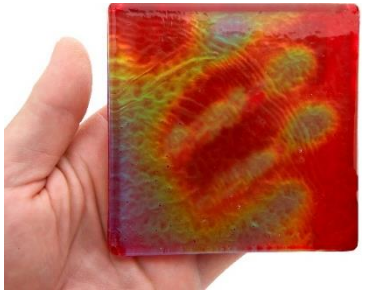
With flexible displays still a little far away getting into mainstream production to the public, it is however garnering a lot of hoopla over conceptual ideas in recent times. Nokia, Samsung being one of major companies showcasing style and innovations, using this material advancement.

2.6.4. TRANSLUCENT CONCRETE

These are concrete based building material with light-transmissive properties due to embedded light optical elements — usually optical fibers. Light is conducted through the stone from one end to the other. Therefore, the fibers must go through the whole object. This results in a certain light pattern on the other surface, depending

on the fiber structure. Shadows cast onto one side appear as silhouettes through the material.

2.6.5. TEMPERATURE SENSITIVE GLASS



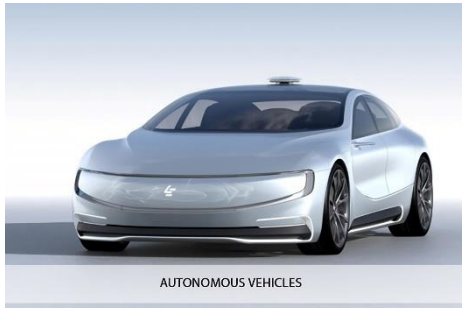
These are glass tiles that change color in response to temperature. Created by California based Moving Color, they have already used the ties to create shower with walls that change color as the water hits them. Other applications include mood rings, battery condition display and coffee cups.

2.6.6. E - TEXTILES

E-textiles, also known as smart garments, smart clothing, electronic textiles, smart textiles, or smart fabrics, are fabrics that enable digital components. Smart textiles are fabrics that have been developed with new technologies that provide added

value to the wearer. Pailes-Friedman of the Pratt Institute states that "what makes smart fabrics revolutionary is that they have the ability to do many things that traditional fabrics cannot, including communicate, transform, conduct energy and even grow".

2.6.7. AUTONOMOUS CAR



Today we have so many different styling languages that come from the form of a car. For instance, the first Renault Espace successfully defined the MPV, or multi-purpose vehicle, as new vehicle styling, rather than a converted van. The same thing has happened with 4x4s and SUVs. And now with the arrival of electric powered vehicles and subsequently autonomous vehicles, many designers have felt that this new energy system would liberate them to find a new source of design

creativity leading them to, probably a new styling when it comes to autonomous mode.

2.6.8. DAYTIME RUNNING LAMPS (DRLs)

A daytime running lamp (DRL, also daytime running light) is an automotive lighting and bicycle lighting device on the front of a roadgoing motor vehicle or bicycle, automatically switched on when the vehicle is moving forward, emitting white, yellow, or amber light to increase the conspicuity of the vehicle during daylight conditions.

These were primarily popularized by Audi, using a rather unconventional styling to the DRLs. And in the current context, every other manufacturer use DRLs, despite not really having any necessary means of it, to enhance its styling factor.

2.6.9. LASER HEADLAMPS

The BMW i8 is the first production vehicle to implement laser powered headlights, a pioneering high beam function that heralds a new era in the development of vehicle headlamps. Along with this, it gives the vehicle a futuristic head on aesthetic styling.

3. TECHNOLOGY

1. Control System
2. Energy Resource
3. New Structural Concept
4. Maintenance
5. Manufacturing Process
6. Materials
7. Mechanism
8. Scientific Principle

3.1. CONTROL SYSTEM

3.1.1. CLOUD COMPUTING MANUFACTURING

CLOUD COMPUTING MANUFACTURING

Cloud computing is the practice of using a network of Internet-connected remote services along various points to store, manage, and process data. Many companies are already using cloud computing, although the manufacturing industry is still taking time to warm up to the technology due to connectivity and security concerns. Over time, to the present day, cloud computing grows more stable and reliable.

In implementing cloud computing, manufacturers reduce costs, gain greater quality control, and increase the speed of production. In the future, it is feasible that all manufacturing facilities will have a connection to the cloud.

3.2.2. NANOTECHNOLOGY MANUFACTURING

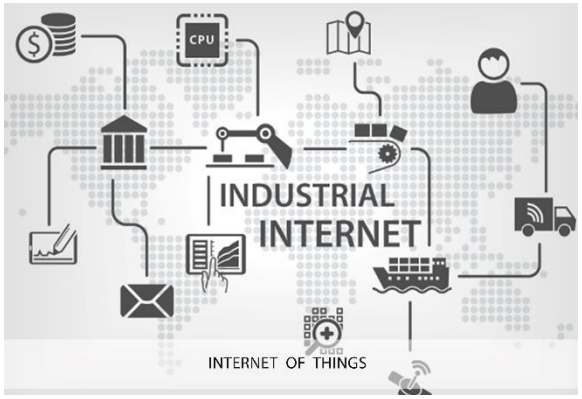
NANOTECHNOLOGY MANUFACTURING

Nanotechnology is the technology of the future. As quoted by Ning Xi, president of the Nanotechnology Council for IEEE and a professor at Michigan State University, says nanotechnology is at something of a midpoint in its development. It involves the manipulation of matter on atomic, molecular and supramolecular scales; thus, bringing with it super-precision manufacturing. Currently applied mostly in space technology and biotechnology, it is going to play an indispensable role in every manufacturing industry in the future.

3.3.3. INTERNET OF THINGS (IoT)

The Internet of Things (IoT) is a revolutionary manufacturing technology that allows electronic devices connected to each other, within the existing Internet infrastructure, to communicate

with one another without human intervention. An IoT device connects to the internet and is capable of generating and receiving signals.



This type of small, but critical, application of IoT in manufacturing results in reduced downtime, increased quality, reduced waste and less overall costs.

3.3.4. ACTIVE BODY CONTROL SYSTEM

Also known as ABC, pioneered by Mercedes-Benz brand, used to describe hydraulic fully active suspension, that allows control of the vehicle body motions and thereby virtually eliminating body roll in many driving situations including cornering, accelerating and braking.

3.3.5. ACTIVE CURVE TILTING

ABC already counteracts roll, lifting and pitching movements in the suspension; curve tilting takes the theory a step further.

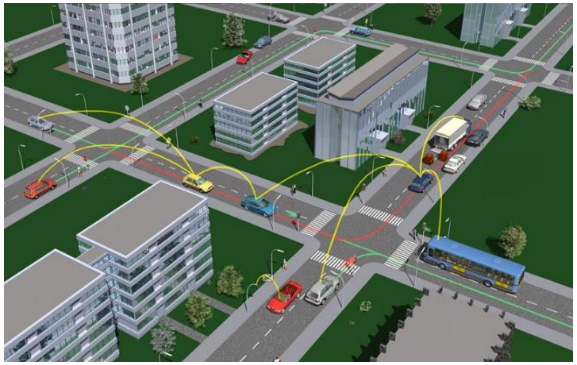
For the sake of a simpler explanation, picture a motorcycle racer taking a bend, one can notice that when such instance happens, the rider shifts his body opposite the inclination of the motorcycle to maintain the balance and prevent the motorcycle from careering out of the track. That is exactly what the Active Curve Tilting function does. The feature works together with ABC suspension to make sure the occupants of the car are comfortably seated even when the car is going around on a curve on the road.

3.3.6. BOSE SUSPENSION

The Bose Suspension system uses a **linear electromagnetic motor** (LEM) at each wheel in lieu of a conventional shock-and-spring setup. Amplifiers provide electricity to the motors in such a way that their power is regenerated with each compression of the system. This entire system controls enables the wheel's motion to be so finely controlled that the body of the car remains level regardless of what is happening at the wheel. The system can also counteract the body motion of the car while accelrating, braking and cornering, giving the driver a greater sense of control. But unfortunately the entire setup turned out to be quite heavy, thus never making into production level.

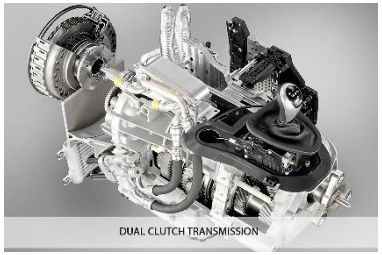
3.3.7. VEHICLE-TO-VEHICLE COMMUNCATION SYSTEM

As mentioned in previous section under factor 'Human', V2V also serves as a means of convenience. On a broader spectrum, Vehicle-to-vehicle (V2V) communications comprises of wireless network where automobiles send messages to each other with information about what they're doing. The data could range from speed,location, direction, braking to loss of stability.



It is different take on control system as it does not neccesarily take control of the vehicle from the driver but warns. However, implementations of vehicle control such as braking, steering around obstacles and eventually merge with self-driving is on its way.

3.3.8. DUAL CLUTCH TRANSMISSION (DCT)



Again, if we recall, DCT is new technology advancement that fulfills human convenience. But it can also be mapped under control system, as it automatically controls the entire

vehicle gearbox system and thereby controlling the way a vehicle performs on the road.

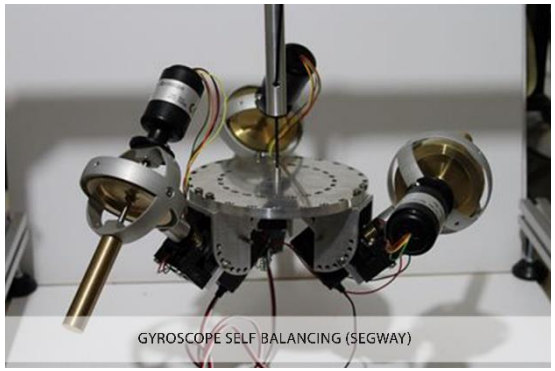
3.3.9. EYE SCANNER


EYE-SCANNER

Eye Scanner or in more technical term, retinal scanner, is a biometric technique that uses the unique patterns on a person's retina blood vessel. Although it was first introduced during 1978 getting patented, followed by a commercial model in 1981. But only recently has it been widely used right from educational academics to ATMs to prison cell access, etc. Take for example, in a science lab, to access a major laboratory, eye scanner plays a very important role. Thereby controlling the entire subsequent following stage of processes to be carried.

3.3.10. GYROSCOPE SELF BALANCING

Gyros installed in vehicles or even personal mobility device such as the Segway and Lit Motors C-1, can tilt forward and backward.


GYROSCOPE SELF BALANCING (SEGWAY)

When the vehicle is tilted in a direction, the gyro system generates a powerful torque that pushes the vehicle on the opposite direction.

To function better, two gyros are located, take the case of C-1. The computerized stability control module changes the tilt to keep the vehicle balanced. The vehicle remains level when driving straight or standing still, and leans at an angle when making turns. Thereby controlling the way a vehicle manoeuvres.

3.3.11. PRE-COLLISION SYSTEM


PRE-COLLISION DETECTION

As described in previous section under Human – Convenience, Pre-Collision system is somewhat like Vehicle-to-Vehicle communication. Based on the

inputs received via wireless network, the system can prevent vehicle collisions and thereby controlling the vehicle motion in respect to its environment situations.

3.3.12. START-STOP SYSTEM

Also, covering the part of convenience, yet again, the Start-Stop system automatically shuts down and starts up a vehicle when it the need arrives. Thereby controlling the behavior of the vehicle and also regulates better fuel efficiency.

3.2. ENERGY RESOURCE

3.2.1. BIO-GAS

Biogas typically refers to a mixture of different gases produced by the breakdown of organic matter in the absence of oxygen. Biogas is a renewable energy of source and in many cases, exerts a very small carbon footprint.

Bio-Bus is among the first of the very few buses to be powered entirely by human faeces and food waste.

3.2.2. HYDROGEN GAS

With modern inventions, Hydrogen as a source of energy for vehicle propulsion is on its way to be brought to the mainstream buyers.

Toyota Mirai launched in 2015. One of the first hydrogen fuel cell vehicles to be sold commercially. The power plant of such vehicles convert the chemical energy of hydrogen to mechanical energy either by burning hydrogen in an internal combustion engine, or by reacting hydrogen with oxygen in a fuel cell to run electric motors.

3.3.3. ELECTRIC POWERED VEHICLES

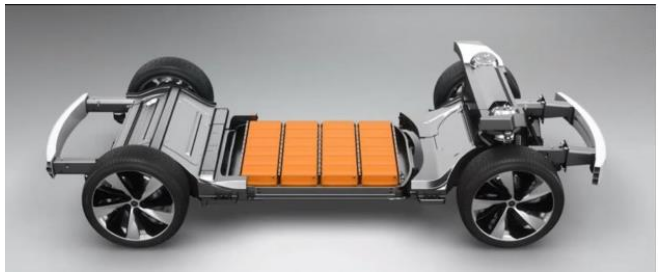
Although electric power has been in use since more than a century ago when Porsche invented the world's first notable electric vehicle in 1898. Only recently there can be seen an invasion of electric power as the source of powering automobiles. Tesla being one of the most notable brand and Zero Motorcycles in two-wheeler arena.

3.3. NEW STRUCTURAL CONCEPT

3.3.1. MONOCOQUE MOTORCYCLE CHASSIS (DUCATI PANIGALE)

Ducati Panigale practically doesn't have a chassis to support its body. It uses a monocoque styled frame, called Monoscocca chassis, forms its structural backbone. Cast in aluminum, it attaches at its rear directly to the heads of the engine and contains the steering head and bearing at its front. In addition to performing the function of a traditional frame, the frame also serves as the airbox and in this way significantly contributes to lowering overall weight of the motorcycle. It uses the engine as the stress member. Weighing at just 167kg (dry weight) despite being powered by a 1299cc twin cylinder engine, this is a unique and a revolutionary advancement to the world of motorcycle construction.

3.3.2. FARADAY FUTURE'S VARIABLE PLATFORM



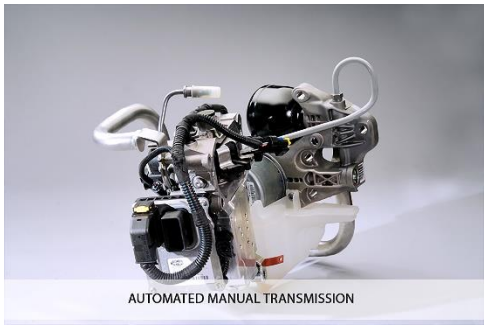
Faraday Future unveiled nearly impossible electric car plans, and the variable platform architecture to do so, still in development stages, although a working prototype has been established. The platform, as Faraday Future says, enables the company to develop nearly any kind of four-wheeled vehicle.

The technology is basically a Skateboard sort of vehicle platform. Any sort of upper shell can be placed on such a platform. The interesting invention is that Faraday Future's design can be lengthened for a longer wheelbase that also contains more battery storage and the drive train accommodates up to four electric motors which are located next to the wheels.

This will give extreme flexibility to develop new vehicle designs.

3.4. MAINTENANCE

3.4.1. AUTOMATED MANUAL TRANSMISSION (AMT)

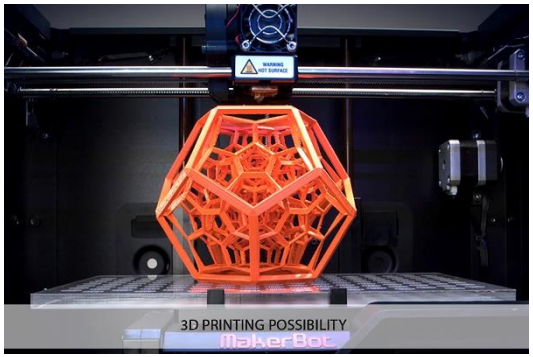

AUTOMATED MANUAL TRANSMISSION

AMT is not a clutch-less solution, it has a clutch but there is no clutch pedal on.

It is more like a kit that can be added to any manual transmission. As described in earlier sections, this advancement is a significant step ahead in the direction of increasing human convenience and also another key factor to it, is the low maintenance it involves. It is much lower in comparison to automatic transmission system as well as DCT. It is convenient to the manufacturers because it doesn't replace the manual transmission, unlike automatic transmission system. Add to it, it is more fuel efficient than manual transmission, unlike automatic transmission which reduces efficiency by up to 10%, in most cases.

3.5. MANUFACTURING PROCESS

3.5.1. 3D PRINTING MANUFACTURING



Also can be termed as Additive manufacturing; Three-dimensional printers not only hold the promise of achieving high quality at volumes as low as a single unit, but also opening the door to entirely new designs and material structures and combinations. It is indeed one of the biggest news in the manufacturing advancements in the last few years.

Within a few years, the technology has evolved so much that it is now possible to produce almost any component using metal, plastic, mixed materials and even human tissues.

3.5.2. CLOUD COMPUTING MANUFACTURING

As mentioned in the control system section, Cloud Computing manufacturing is the practice of using a network of internet-connected remote services along various points to store.

Manufacturers are increasingly implementing cloud computing software in manufacturing plants spread out in various geographic areas in order to share data quickly and efficiently.

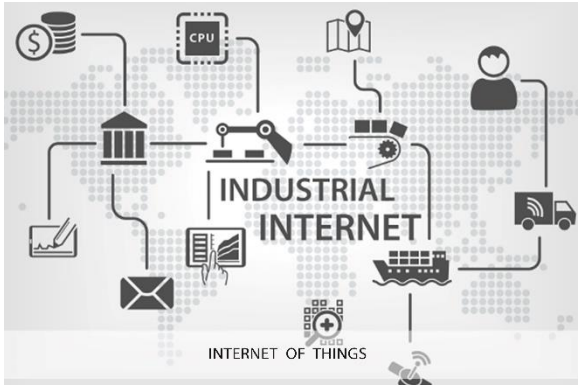
As a result, manufacturers reduce costs, gain greater quality control, and increase the speed of production.

3.5.3. NANO MANUFACTURING

A nanometer is one-billionth of a meter, so manufacturing means being able to manipulate materials on a molecular and even atomic scale. Nanomaterials are expected to play a future role in production of things like high-

efficiency solar cells and batteries and even biosystem-based medical applications, such as a sensor inside human body which could inform doctor about the status of the body. Future generations of electronics and computing devices may also rely heavily on nanomanufacturing.

3.5.4. INTERNET OF TECHNOLOGY (IoT)



As described, IoT, i.e., Internet of things is a revolutionary manufacturing technology that allows devices to be connected via internet. This type of application of IoT manufacturing results in reduced downtime, increased quality, reduced waste and less overall costs. This technology also has scope that can lead to the development of new types of positions for the manufacturing workforce.

3.5.5. ARTIFICIAL INTELLIGENT RETHINK ROBOTS

Also called as Baxter, is an industrial robot built by Rethink Robotics, is used for simple industrial jobs such as loading, unloading, sorting and handling of materials.

The interesting part of Baxter, is that it has an animated screen which allows it to express itself through several facial expressions. Its face can show what it is focused on, and its current status. Baxter can even express its confusion when something isn't right.

Industrial robots can operate 24 hours a day, seven days a week, with repeatable and increasingly fine precision – to hundredths of a second and in less space than is detectable by the human eye.

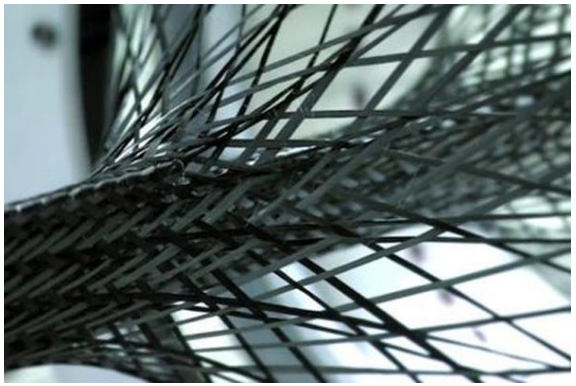
With advancements in biotechnology and nanotechnology, robots are expected to become capable of doing ever more intricate things, like drug processing and growing full-blown organs.

3.5.6. BIO MANUFACTURING

This field uses a biological organism, or part of one, in an artificial manner to produce a product – like developing drugs and medical compounds. It has wide applications ranging from improvements in energy efficiency and in the creation of new methods of nanomanufacturing.

3.6. MATERIALS

3.6.1. CARBON FIBRE

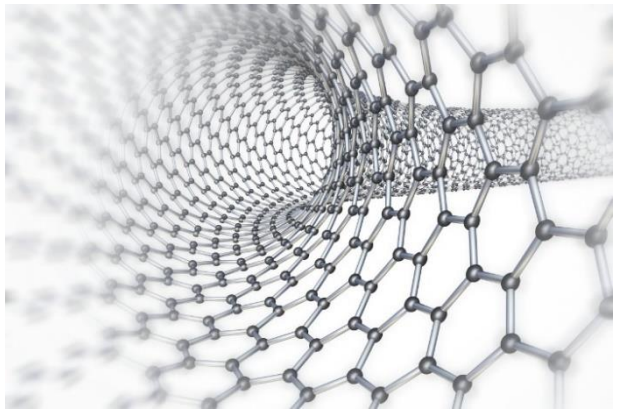


Carbon-fiber-reinforced polymer (CFRP) composites — also called carbon-fiber laminates — are the next-generation materials for making cars lighter, more fuel efficient and safer. Carbon laminate is extremely strong and stiff because of its woven layers of nearly pure carbon fibers bonded together by a hardened plastic, such as epoxy resin.

Because the fibers are entirely carbon, their density is only about 1.6 grams per cubic centimeter (g/cc) — comparable to the density of table sugar — resulting in carbon laminates with densities of around 1.3 to 1.5 g/cc.

However, the carbon laminate manufacturing process is complex and requires either manual labor or expensive robotic machines, both of which result in high costs for the finished part. And, the most commonly used polymer (epoxy resin) requires 24 to 50 hours to solidify after it's infused into the carbon fiber, further increasing costs. In contrast, the density of steel is about 7.8 g/cc. Carbon fibers are slightly stiffer than steel, but have one-fifth the weight. Carbon laminate density is so low, it even beats the lightest structural metal, magnesium, which has a density of 1.8 g/cc.

3.6.2. CARBON NANOTUBES



Now that carbon-fiber composites have migrated from the world of blank-check motorsports to semi-affordable production cars such as the BMW i3 and Chevrolet Corvette, what's next? Is there another breakthrough material that will reset our expectations for strength, stiffness, and weight the way carbon fiber has?

Carbon nanotubes will. Imagine a tiny pipe with walls made of carbon atoms linked neatly together. The “nano” part of the name comes from nanometer, meaning one-billionth of a meter. Each carbon nanotube is only one nanometer in diameter, which is 2000 times smaller than a carbon-fiber filament. But more significant than size are the dramatic differences in crystal structure and physical properties between carbon nanotubes and carbon fiber. Versus the nanotube’s neatly organized, tightly bonded configuration, carbon fiber is what quantum chemists call turbostratic, meaning flat layers, each one a single carbon atom thick, stacked somewhat haphazardly on top of one another. The carbon nanotube’s superior atomic-bonded crystal structure is what makes it the strongest, stiffest material known to man and nearly 20 times stronger per pound than carbon fiber.

3.6.3. CERAMIC CLOTH

Zircar Zirconia Inc., a New York manufacturer of thermal product, created this cloth from ceramic fibers which can insulate against extreme temperatures. Ceramic cloth is a woven material made from alumina-silica ceramic fiber and has a continuous operating temperature of 2300°F /1260°C.

It has excellent chemical stability and strong resistance to thermal shock and corrosion attack.

3.6.4. FLEXIBLE DISPLAY

A **flexible display** is an electronic visual display which is flexible in nature; as opposed to the more prevalent traditional flat screen displays used in most electronics devices. In the recent years there has been a growing interest from numerous consumer electronics manufacturers to apply this display technology in e-readers, mobile phones and other consumer electronics.

3.6.7. E - PAPER

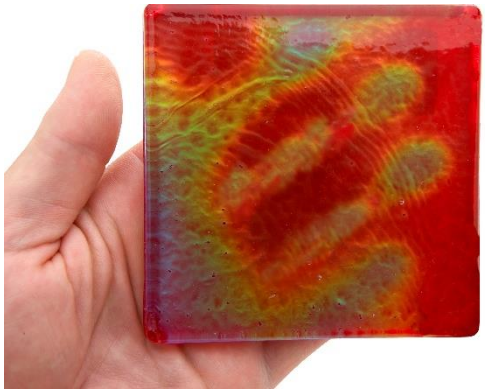
Electronic paper and e-paper are display devices that mimic the appearance of ordinary ink on paper. Unlike conventional backlit flat panel displays that emit light, electronic paper displays reflect light like paper. This makes them more comfortable to read, and provide a wider viewing angle than most light-emitting displays. The contrast ratio in electronic displays available as of 2008 approaches newspaper, and newly developed displays are slightly better. An ideal e-paper display can be read in direct sunlight without the image appearing to fade.

Some of the popular applications of it in the past decade has been in the Motorola F3 display, which used e-paper instead of an LCD. Also, popular devices such as Kindle, Sony Librie, Sony Reader also use these technologies.

3.6.8. TRANSLUCENT CONCRETE

A Hungarian architect invented these translucent concrete tiles, they are now sold through his company Litracon Bt. These are concrete based building material with light-transmissive properties due to embedded light optical elements — usually optical fibers. Light is conducted through the stone from one end to the other. Therefore, the fibers must go through the whole object. This results in a certain light pattern on the other surface, depending on the fiber structure. Shadows cast onto one side appear as silhouettes through the material.

3.6.9. TEMPERATURE SENSITIVE GLASS



These are glass tiles that change color in response to temperature. Created by California based Moving Color, they have already used the ties to create shower with walls that change color as the water hits them. Other applications include mood rings, battery condition display and coffee cups.

3.6.10. ANTI-FOG FILM

Anti-fog agents, also known as anti-fogging agents and treatments, are chemicals that prevent the condensation of water in the form of small droplets on a surface which resemble fog. Anti-fog treatments were first developed by NASA during Project Gemini, and are now often used on transparent glass or plastic surfaces used in optical applications, such as the lenses and mirrors found in glasses, goggles, camera lenses, and binoculars. The treatments work by minimizing surface tension, resulting in a non-scattering film of water instead of single droplets. This works by altering the degree of wetting. Anti-fog treatments usually work either by application of a surfactant film, or by creating a hydrophilic surface.

3.6.11. AMORPHOUS METAL

Amorphous metals, also called metallic glasses, consist of metal with a disordered atomic structure. They can be twice as strong as steel. Because of their disordered structure, they can disperse impact energy more effectively than a metal crystal, which has points of

weakness. Amorphous metals are made by quickly cooling molten metal before it has a chance to align itself in a crystal pattern. Amorphous metals may be the military's next generation of armor, before they adopt diamondoid armor in mid-century. On the green side of things, amorphous metals have electronic properties that improve the efficiency of power grids by as much as 40%, saving us thousands of tons of fossil fuel emissions.

3.6.12. TRANSPARENT ALUMINA

Transparent alumina is three times stronger than steel and transparent. The number of applications for this are huge. Imagine an entire skyscraper or archology made largely of transparent steel. There a number of conceptual applications of it; skylines of the future could look more like a series of black boxes (opaque private cubicles), rather than the monoliths of now. And if one goes crazy, a *transparent bicycle frame!*

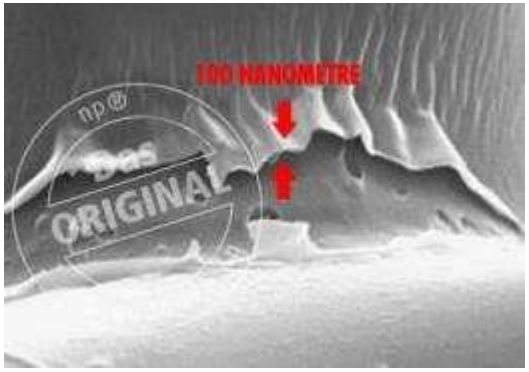
3.6.13. E – TEXTILES

E-textiles, also known as smart garments, smart clothing, electronic textiles, smart textiles, or smart fabrics, are fabrics that enable digital components (including small computers), and electronics to be embedded in them. Smart textiles are fabrics that have been developed with new technologies that provide added value to the wearer. Pailes-Friedman of the Pratt Institute states that "what makes smart fabrics revolutionary is that they have the ability to do many things that traditional fabrics cannot, including communicate, transform, conduct energy and even grow".

These have been in use for monitoring personnel handling hazardous materials, to monitoring pilot or truck driver fatigue to

military applications such as tracking the position and status of soldiers in action and soldier's bulletproof Kevlar vest; if the wearer is shot, the material can sense the bullet's impact and send a radio message back to the base.

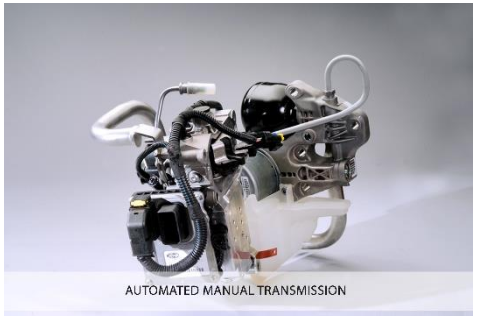
3.6.14. STERILIZING SPRAY



This latest science invention is a spray-on invisible thin glass coating that sterilizes, protects and strengthens surfaces. The coating also repels water, dirt, stains, mildew, fungus, bacteria and viruses. The liquid coating invented at the Saarbrucken Institute for New Materials in Turkey and patented by Nanopool GmbH Germany, is a flexible and breathable spray-on glass film.

3.7. MECHANISM

3.7.1. AUTOMATED MANUAL TRANSMISSION (AMT)


AUTOMATED MANUAL TRANSMISSION

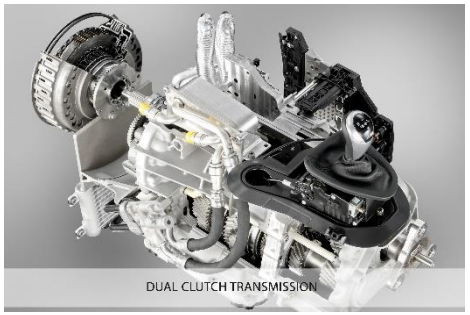
Automated Manual Transmission (AMR, also called Freechoice) from Magneti Marelli is an electro-hydraulic mechanism for automating manual transmission which derives from Formula 1. It combines comfort of use with a reduction in consumption, and can be applied to any transmission, with production costs that are consequently lower compared to traditional automatic transmissions.

AMT is based on an electronic control unit and a hydraulic system that supervise the use of the clutch and the gear shifting, allowing the driver to change gear without using the clutch, either sequentially or fully automatically.

The device from Magneti Marelli operates on the manual transmission of a car in the same way as the driver would: it opens and closes the clutch, engages and disengages the gears and, when necessary, it also controls the choice of transmission (automatic or sequential mode for changing gear). These three control movements are ensured by three specific hydraulic actuators, controlled by hydraulic electro-valves.

Just like manual transmission system, gear has to be selected by the driver only depending on his selection, one has to change the gears, but without operating the clutch lever. In this case (AMT), an electronically controlled system is used to identify when the driver changes the gear, an electrically operated) power operated) system depresses the clutch automatically when the gear is changed.

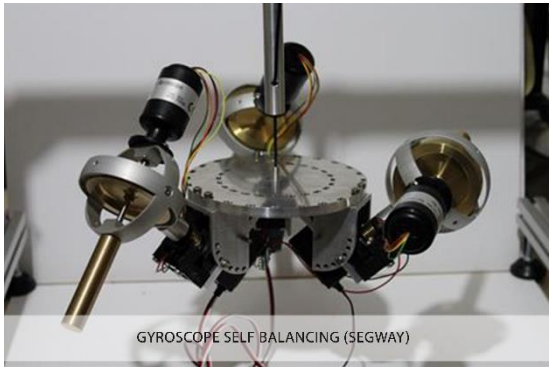
3.7.2. DUAL CLUTCH TRANSMISSION (DCT)


DUAL CLUTCH TRANSMISSION

These are a step ahead of AMT in terms of mechanism and performance. They are generally equally or I some cases even more expensive than the traditional automatic

transmission, but they are really good in terms of efficiency as well as performance. These use two clutches, instead of one, which connect with even and odd number of gears. When the car speed changes, the transmission system (controlled by a microprocessor unit), selects a gear (depending on multiple factors, such as load, speed, driver's throttle input and output). After selecting the gear, the system automatically engages that gear in almost no time as it has two clutches, so one cutch is dis-engaged and the other is engaged.

3.7.3. GYROSCOPE SELF BALANCING



GYROSCOPE SELF BALANCING (SEGWAY)

Gyros installed in vehicles or even personal mobility device such as the Segway and Lit Motors C-1, can tilt forward and backward.

When the vehicle is tilted in a direction, the gyro system generates a powerful torque that pushes the vehicle on the opposite direction.

To function better, two gyros are located, take the case of C-1. The computerized stability control module changes the tilt to keep the vehicle balanced. The vehicle remains level when driving straight or standing still, and leans at an angle when making turns. Thereby controlling the way, a vehicle manoeuvres.

3.7.4. HONDA SELF BALANCING MOTORCYCLE

HONDA SELF BALANCING MOTORCYCLE

This is newest invention happening. Unveiled by Honda Two wheelers at the Consumer Electronics Show in Las Vegas, Honda calles it "Riding Assist Technology" which could assist riders in balancing bikes in the difficult low speed range below 3mph.

It is not however clearly explained how it works, but certain articles and video demonstration showcases use of a fairly powerful steer actuator. Another shows use of an electric drive, as with a touch of a button, the motorcycle self-balancing itself follows the owner walking ahead of it.

3.7.5. HUMAN MACHINE INTERFACE

HMI is the acronym for Human Machine Interface, and can be designed as just that; an interface between the user and the machine. An HMI is considered an interface; a very broad term that can include MP3 players, industrial computers, household appliances, and office equipment.

However, an HMI is much more specific to manufacturing and process control systems. An HMI provides a visual representation of a control system and provides real time data acquisition. An HMI can increase productivity by having a centralized control center that is extremely user-friendly.

3.7.6. PARALLELOGRAM MOTORCYCLE STEERING LINKAGE

Developed by Yamaha Motors Co., this setup is used in their product Tricity, which is a reverse trike.

PARALLELOGRAM LINK FRONT STEERING

It employs two wheels at the front and one at the back. To enable the front two wheel to lean as well as turn, it involves a parallelogram linkages that constructs the steering system. Coupled with Cantilevered Telescopic Suspensions, the steering features natural handling characteristics and good cushioning performance.

3.7.7. VOLVO PEDESTRIAN SAFETY AIRBAG

Developed in the mid-2000s, the pedestrian safety airbag contributes in certain frontal collisions to alleviating the collision of the pedestrian with the car. It is fit under

the bonnet near the windscreen. In an unfortunate event of certain frontal collisions with a pedestrian, the sensors in the front bumper react and the airbag inflates if required, based on the force of the impact. The sensors are active at a speed of approx. 20-50 km/h and an ambient temperature between -20 and +70 deg. C

As can be seen from the image, if the airbag gets deployed, the rear part of the bonnet is raised and locked in that position. The sensors are designed to detect a collision with an object that has similar properties to those of the human leg.

4. ENVIRONMENT

1. Preventing deterioration of environment
2. Environment as source of inspiration
3. Renewal of environment

4.1. PREVENTING DETERIORATION OF ENVIRONMENT

4.1.1. TESLA Inc.

Tesla, founded in 2003 by Martin Eberhard and Marc Tarpenning, although the copany also considers Elon Musk, JB Straubel, and Ian Wright amongst its co-founders. The company specializes in electric cars, Lithium-ion battery energy storage and their SolarCity subsidiary resedential solar panels.

Tesla first gained widespread attention following its production of the Tesla Roadster, the first electric sports car, in 2008.

The company's second vehicle, the Modes S, an electric luxury sedan, debuted in 2012, is now the world's bestselling plug-in electric car for over two years now.

Tesla aims at eventually offering electric cars at prices affordable to the average consumers.

4.1.2. FARADAY FUTURE

Faraday Future is an American start-up technology company focused on the development of intelligent electric vehicles. Faraday Future was established in April 2014 and is headquartered in Los Angeles, California, US.

Although still in its development stage, the firm recently showcased its autonomous electric powered cross-over vehicle FF91. Prior to that, back in year 2016 January, showcased their first car, a sports car named FF ZERO1, but did not announce production schedules.

4.1.3. TORK MOTORCYCLES

A Pune, India, based electric motorcycle firm,, recently announced its foray into mainstream two-wheeler segment in India.

Tork T6X, notably India's first electric performance motorcycle.

It will be available to the consumers in the year 2017, starting April month.

It is one of the very new and very few notable electric motorcycle manufacturer which is grabbing the attention og enthusiasts as well as general public consumers.

4.1.4. ZERO MOORCYCLE

Zero Motorcycles Inc. is an American manufacturer of electric motorcycles. Formerly called Electricross, it was started in 2006 by Neal Saiki, a former NASA engineer, in Santa Cruz, California. The company is now located nearby in Scotts Valley.

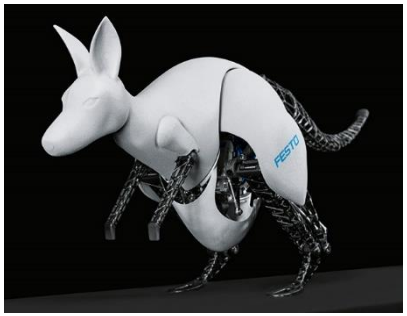
4.2. ENVIRONMENT AS SOURCE OF INSPIRATION

4.2.1. BIONICS

Bionics is the application of biological methods and systems found in nature (or environment as per se) to the study and design of engineering systems and modern technology.

It has had a widespread use in the field of design and innovations.

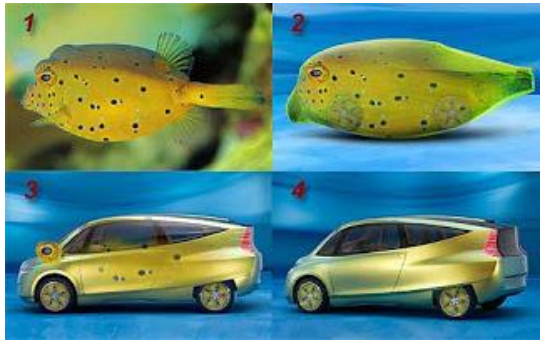
In robotics, bionics and biometrics are used to apply the way animals move to the design of robots.



BionicKangaroo was based on the movements and physiology of Kangaroo.

Nanostructures and physical mechanisms that produce the shining color of butterfly wings were reproduced in silico by Greg Parker, professor of Electronics and Computer Science at the University of Southampton and research student Luca Plattner in the field of photonics, which is electronics using photons as the information carrier instead of electrons.

4.2.2. Mercedes-Benz Bionic Car



First introduced in 2005 at the DaimlerChrysler Innovation Symposium in Washington D. C. The Bionic car was modelled after a type of fish, the yellow boxfish, *Ostracion cubicus,* as seen in the image here. It has 80% lower nitrogen oxide emissions with its selective catalytic reduction technology.

4.3. RENEWAL OF ENVIRONMENT

4.3.1. USE OF ALTERNATIVE ENERGY SOURCE TO PETROLEUM PRODUCT

Use of unconventional source of power source, such as Bio gas, for the Bio Bus in the UK, use of electric powered able lines for local train commutes in cities like Mumbai, Delhi, and inventions of electric powertrain automobiles such as Tesla, Faraday Future, LeEco, Lucid Air, and Indian firm Tork Motorcycles, environment of the planet earth has witnessed a ray of new renewal methods in the past decade and a half years of duration.

5. MAPPING OF DESIGN DRIVERS (CONCLUSION)

After looking at the above advancements in all the three factors and its sub categories, it was found that many of the factors, even though they originate at a different need of level of intentions, but they fall in multiple categories sharing attributes to one another despite being different.

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