TABLE OF CONTENTS
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ABSTRACT

PROCESS
During the research and concept development phase, the author investigated topics around the issue of motorsport. Research areas included: core values of motorsport fans, AI in offroad vehicles, future target groups Gen Z and Gen Alpha, alternative energies, and benchmark races like Rally Dakar and Roborace. After the broad research, the design ideation took place, starting with several package proposals and initial sketches. Based on those sketches, the author was able to guide the Maya mock-up modeling process where the final design direction was shaped.

INSPIRATION
In this modern age, interest in cars is waning and motorsport faces its biggest threat yet. Television numbers are down and its fan base is aging, leading us to wonder: Is there a way to bring back the excitement about motorsport and cars in general? Throughout history, numerous innovations have trickled down from the race track to production cars, thus there is a need to keep this culture alive. Especially in the new era of autonomous driving, we will require a competitive arena to challenge and improve this future technology. And with the rising climate challenges on our planet, motorsports, especially, needs to be a leader in green and efficient energy technology.

RESULTS
Peking to Paris Rally 2030: a new motorsport series, showcasing the combined strength of human and artificial intelligence under the harshest conditions on the planet. This technology offers new opportunities in racing. Given the advance of intelligent high-performance driving systems, an endurance rally can be even more extreme than it is today. Higher speeds, jumps, twists, and turns across the most diverse terrain will grant the spectator an extraordinary experience. With the use of VR and 3D video capturing drones, rally fans can follow their favorite team -up close and on demand from the start to finish line. The high-performance technology surrounded by the distinctive shape unifies rationality and emotionality into one cohesive design.
INTRODUCTION

INITIAL THOUGHTS

In the next one or two decades, there will be a massive change of the world, due to emerging technologies like Robotics, Artificial Intelligence (AI), Machine Learning, Virtual Reality (VR), and Augmented Reality (AR). Many scientists, entrepreneurs, and academics have started to envision their impact on society. We can say that we are facing a new technological era, which will transform our lifestyle.

In the past, humans have always been critical of new technologies. It is in human nature to be suspicious or even afraid of changes and unexperienced things. In the context of artificial intelligence, comes autonomous driving. Many people are afraid to leave the control of a vehicle completely to a machine. Added to this are the elimination of active driving pleasure and the decline of traditional car ownership, thus car enthusiasts would consider autonomous driving as boring.

Working as an intern at Volkswagen, the author became acquainted with rally motorsport by designing the new livery of the WRX Volkswagen Polo R Supercar. Fascinated by high-performance rally cars, the author began to follow a few races. It became clear, that most rally competitions nowadays are very traditional. The fanbase consists primarily of so-called ‘Petrol Heads’ or ‘Gear Heads’. There are several opportunities to apply emerging technologies and innovations to this sport, in order to make it more future-oriented, safer, more sustainable and to attract a broader target group. It will form the perfect testing ground for new technologies and open the door for new innovations to be implemented in subsequent production cars.

With this thesis, it is the author’s mission to bring rally motorsport into the digital age by creating a progressive rally experience, which demonstrates the safety and the technological advance to the public, to ultimately make them believe in a prosperous future of transportation. This new experience is designed to push forward the development of artificial intelligence, through competition and reduce the skepticism about autonomous driving. Furthermore, it should sustain the existence of motorsport by inspiring and fascinating future generations about cars.

Finally, it will revolutionize the way spectators follow the race, through VR and AR. In this way, the spectators can witness the team effort of the rally up close, from the comfort of their own home.
PROCESS

This chapter begins with research, to help reinforce the thesis concept and identify new opportunities. The author briefly describes the issues, that motorsport series are facing nowadays and the key elements, which make this sport attractive to spectators. Here will be shown the possibilities of how motorsport could attract new generations and create better ways to involve them in the event.

In continuation, the potential of artificial intelligence and human intelligence will be discussed - an unbeatable combination that will also gain a foothold in motorsport. Examples are given of how car companies are already developing AI-driven off-road concepts.

To better understand future generations, a section is dedicated to Generation Z and Alpha. Furthermore, the question is asked which drivetrain technology will prevail in the future and what the respective advantages and disadvantages are, followed by a benchmarking with the topics Rally Dakar and Roborace.

The remainder of the research describes the history, brand philosophy and design language of the Hyundai brand.
“It’s going to be interesting to see how society deals with artificial intelligence, but it will definitely be cool.”

COLIN ANGLE
MOTORSPORT

ORIGIN OF MOTORSPORT
In order to understand why we have motorsport competitions today, it is important to look into the past and investigate the origin of motor racing.

Virtually all organisms experience competition within their own species and humans are no exception. That’s one reason historians believe sports were created in the first place - to pit men against each other and identify the most dominant individuals. In other words, competition seems to be in our nature. So when the first car was invented in 1886, it was only a matter of time before owners got an inkling to race each other. 1894 marked the world’s first competitive motor race - ‘The Paris-Rouen race’, which was organized by the Parisian daily newspaper ‘Le Petit Journal’ (Andrews, 2014). The route covered a total distance of 127km and the fastest car had only 3hp of power under its hood. At that time, people were very skeptical of this new creation by German inventor Carl Benz. Thus the purpose of the race was not only to bring attention to the newspaper, but also to build the public’s confidence in the ‘horseless carriage’.

This exhibition inspired other countries to stage similar events and sparked a series of races all over the world. Today, we would consider this type of race a ‘rally’. The first race, where they used the term ‘rally’, was the famous Rally Monte Carlo in 1911 (Monty Carlo Rally, 2019). While racing began as a hobby for the more privileged people in society, car manufacturers started to recognize the potential that participation in racing events could bring to their companies.

RELEVANCE
There are several reasons to mention, why motorsport has remained relevant and why car manufacturers have continued to take part in them. Motorsport provides an opportunity for automakers to not only showcase their cars and outshine their rivals, but also to test current and future technologies in a competitive arena. Throughout motorsport history, innovations in areas such as aerodynamic efficiency, handling, and engine performance have trickled down from the stars of the racetrack to the vehicles we all drive. A prime example is Formula 1, the most popular car race in the world. Due to its popularity, Formula 1 has become an R&D powerhouse and provided a number of innovations such as steel disk
brakes, new tire technologies, KERS, and carbon fiber (Edelstein, 2019). Nowadays, new technical regulations by the FIA intend to make engines more sustainable, efficient, smaller and quieter. These efforts to make race cars more sustainable will be important in the future, given the climate changes and the spread of ecological awareness.

CULTURE

Besides the technological innovation that motorsport offers, there is the enthusiasm shared by a broad community of fans who travel from country to country to be on site when their favorite team competes. This experience is invaluable for fans and should not be overlooked. Motor races are international events where people from different cultures come together to build bonds and escape their everyday lives. An endurance rally covers a route through different countries and figuratively connects them. Having a rally that started in Asia, passed through Russia and ended in central Europe would be a great demonstration of solidarity. Especially in times where the political trend of European countries is more of isolation. The recent refugee crisis and Brexit have shown us lack of unity within Europe. The Russia-Ukraine conflict and the general fear and suspicion by European countries about the rising power of China are other examples of global discord. Setting aside political tensions, people can still set an example for us to learn about new cultures, celebrate our differences, and work together instead of against each other.
A SPORT IN TRANSITION

A DWINDLING FANBASE
When it comes to organization and performance, car racing has never been better. “The cars are more sophisticated than they’ve ever been. The drivers are fitter and better trained. Competition is fiercer.” (Lerner, 2017). And yet the fanbase is fading away and television numbers are declining. For decades motor racing has catered to gear and petrol heads. However, this target group is aging and it seems that millennials care more about owning the latest smartphone than about having a driver’s license. In addition, the sport has become more remote and drivers are disconnected from the audience, so confined by the vehicles and constantly surrounded by a team of engineers and technicians. There is hardly any chance for fans to get a glimpse behind the scenes.

With time and a number of fatal accidents, race cars have become safer, which is, in general, a good thing, however, it brings the side effect of weakening racing’s appeal. The Nissan Deltawing designer Ben Bowlby pointed out that “nowadays drivers are so buried in the car that you can’t see what they’re doing. You can’t see their faces. You can’t see anything. It looks too easy. We need racing to look impressive.” (Lerner, 2017)

MILLENNIAL MENTALITY
The issue of dropping fan numbers in motorsport is rooted in the new generations’ lack of interest in cars. Since its inception, the car has been a status symbol and the ultimate expression of freedom, individuality, and confidence. Is owning a car still as desirable for young people, as it once was? According to research from RethinkX, an independent trend research and analysis organization, the number of young people owning a license has been steadily dropping for the past 30 years. From almost half of all US 16 year-olds having a driver’s license, in 2016 it became less than a quarter. Nowadays there are plenty of
alternatives to get from point A to point B, such as Uber, carpooling services, car sharing, public transport, etc. These services give the opportunity to stay mobile even without a driver’s license. Besides, it’s very convenient and more economical for a few spontaneous trips. “Cars are increasingly seen as a utilitarian means to an end, and the romance has been sucked out of driving.” (Lerner, 2017). Car owners had a stronger connection to their vehicle in the past because they could repair it on their own. Today’s cars are so complex, that even some mechanics are only certified to repair cars made by one or two different brands.

Through motorsport, there will be a chance to bring back the emotional connection between people and cars. However, motorsport needs to be re-invented to fit into the 21st century. Through research, the author will show what can be changed to attract a broader target group. In order to re-evaluate and improve the formula behind motorsports and rally, in particular, it’s important to know what makes it attractive to fans.

**ATTRACTION TO THE SPORT**

In 2016, business researchers of the Technische Universität Braunschweig wanted to find out what the key elements for motorsport fans were. Thus, they made an online survey interviewing 310 participants from Germany and England. It turned out, that fan-intimacy, technology leadership, and emotionality are the three most important values for motorsport fans (Woisetschläger & Lucas, 2016). Other aspects like the extent of risk, the glamour, and ecological sustainability were less important.

Further, they compared the brand perception of four significant race series: Formula 1, Formula E, DTM, and WRC. While Formula 1 and Formula E are leading in the technology leadership field, the fan-intimacy is definitely lacking. In the case of Formula E, technological innovation along with the sustainability aspect have to be marketed more deliberately. This will help to attract new target groups and improve the fan involvement.
THE FUTURE OF SPECTATORSHIP

BROADCASTING
It’s no easy task to attract a younger audience in a world where people have less time and shorter attention spans. Besides, it is the nature of motorsport, that most of the races are quite long (Formula 1, Rally Dakar, 24 Hours of Le Mans). Despite that, there must be a way to keep viewers interested, without changing the entire concept of the sport. What younger viewers are looking for is a short content time, which could be a 30-minute cut of the race or a 5-minute summary. In the modern world, consumers are very used to on-demand services (Powell, 2017). Motorsport fans need to be able to access the footage anytime and anywhere via their smart devices. A live-streaming service combined with virtual reality would be a perfect remote experience to bring fans closer to the race track, by supplying real-time 3D footage.

SPECTATOR PARTICIPATION
The best way to connect people to a sport is by enabling them to practice it in their free time. In that way, fans can identify with the professionals and picture themselves on the field or track. Sports like soccer or basketball, we can all practice with low-cost at home. With motorsport, it’s another dimension. Therefore, there is a need to use new technology to access the racecar on a virtual level. VR cameras would give fans a firsthand view of the cockpit, demonstrating the atmosphere of the race. Another level could be sitting in a race simulator at home or at the actual event, as Roborace did with their immersive VR simulator at the 2018 Goodwood Festival of Speed. Getting so close to the race car and enjoying the event from the car or driver’s perspective would be something truly spectacular.

ESPORTS & SIM RACING
For enthusiasts, who want to participate in motor racing, but cannot afford to because of the high costs, there is an affordable alternative - ‘sim racing’. It is a serious business with a constantly growing community. What makes it so thrilling is their big events with huge prizes and millions of followers. In only its second year, F1 Esport managed to draw an audience of around four million people over TV and video streaming platforms like Twitch. At the final day of CES 2017 in Vegas, Formula E organized an Esports competition - the ‘Visa Vegas eRace’, with a prize pool of 1 million dollars. The winner received 200k and even the 30th place took home 20k (Smith, 2017).
“... perception is far more than the recognition of members of already-established categories — it involves the spontaneous manufacture of new categories at arbitrary levels of abstraction.”

MIKHAIL BONGARD
MAN PLUS MACHINE

AUGMENTED INTELLIGENCE
Today artificial intelligence is the basis for so many mainstream technologies like medical diagnosis, speech recognition, and self-driving cars. But AI is commonly perceived by the public as something unfamiliar and at times scary - listening in on our conversations, piloting our aircrafts, and threatening to take our jobs. There’s even the widespread notion that AI will replace human labor entirely.

But seldom do we discuss the vulnerabilities of AI and the ways in which humans remain superior to their computer counterparts. AI is essentially raw computing power, but it lacks creativity, and at the moment, the ability to adapt. While it outperforms humans in certain tasks like matching patterns, it’s restricted to the patterns we teach it and has a limited capacity to learn more than a few.

Humans, on the other hand, are able to learn an unlimited number of patterns and recall whichever ones are necessary for the situation they find themselves in. It’s actually through millions of years of evolution, that we’re able to do this.

Recognizing the unique strengths of both artificial and human intelligence, many are now embracing an alternative concept called ‘augmented intelligence’ (AI²) which focuses on ways in which AI can advance human capabilities, instead of replacing them.

“Augmented intelligence overrides the critical problem of AI adoption: that the systems are reactive, not proactive.” (Petersson, 2018)

AI² IN VEHICLES
There are already existing technologies in cars, like The Eye, which exploit this notion of augmented intelligence. The Eye is basically a camera positioned on a vehicle, which communicates with other cars in the vicinity to form a grid of information. The Eye doesn’t control the vehicle but rather “assists the primary, human operator by detecting objects and behavior patterns to recognize when a driver is breaking from normal patterns and driving dangerously” (Petersson, 2018).

The same thinking could be applied to vehicles traveling outside of normal road conditions, say
on varying terrain in unpredictable weather. Just as The Eye uses cameras to detect obstacles and unusual driving behavior, a more complex artificial perception system could gather data about the terrain ahead and alert the driver to off-road challenges. That is exactly what major brands like Ford and Land Rover are planning.

At the end of 2017, Ford was awarded a patent for an off-road autonomous driving system. The system would rely on a medley of cameras, radar, ultrasonic sensors, height sensors, LIDAR, topographic maps, rain, and road-condition detectors to help determine surface characteristics of the ground it traverses. The system could help determine the likelihood of a rollover or loss of traction and act accordingly. For example, the vehicle would have the ability to control variables such as “active suspension, body mounts, differentials, and individual wheel position” (Ramsey, 2017).

Land Rover is following the same line of thinking with its latest project, Cortex -using a sensor array, which they refer to as “5D” perception (Edelstein, 2018). This heightened sense of perception may become the norm for self-driving cars, as we can’t always rely on good weather conditions and clear signage. Some speculate the marketability of an autonomous off-road vehicle, pointing out that the whole thrill of off-roading is the challenge it presents to drivers. This could easily be solved by creating semi-autonomous off-roaders to appeal to less skilled drivers who still seek adventure.

**FUTURE GENERATIONS**

**GENERATION Z**

Generation Z, also known as ‘The Sharing Generation’, ‘iGen’ and the ‘Born Digital’, are approximately born between 1995 and 2010. Thus, it is the next generation after the Millennials or Generation Y (Barnes & Noble College, 2016).

Their confident use of technology is one of the main characteristics of Gen Z. Being raised with tablets and smartphones, they are keen to use wearable technology and online gadgets to stay connected all the time. Watching cable TV is a thing of the past: Gen Z prefers streaming services like Netflix or Amazon Prime, but in general, they are spending 10% less time watching TV than millennials.

They are used to storing their private data and study materials in cloud services in order to share assignments with colleagues and teachers. Instead of notebooks, Gen Z prefers to bring tablets to school in order to do online research.

This techy background makes them more open-minded and optimistic towards artificial intelligence and job automation. Growing up after 9/11 and the resulting Great Recession, they are aware of sudden changes in the world, which brings up concerns about world peace, environment, economy, etc (Vision Critical, 2019).
GENERATION ALPHA

Generation Alpha are the children of the Millenials and Generation Z, who are born between 2010 and 2025. These children, also born alongside smartphones and tablets, are not afraid of trying new technology and cannot imagine life without it (Pasquarelli & Schultz 2019). Because parents of Gen Alpha have a high tech literacy, they will be quick to adopt things like AI, trusting it enough to chaffeur their children around and even diagnose their medical conditions (Fourtané, 2018).

Gen Alpha is comfortable using voice interfaces, like Google Home and Alexa. Some even speculate that by 2028, smartphones will become obsolete. Gen Alphas will no longer scroll or type into a small screen, they will simply speak to their digital assistant, an AI-powered bot.

When it comes to mobility, this generation will have drastically different habits than its predecessors. Gen Alphas see no use in having a driver’s license, and by the 2020s shared means of transportation will be cheaper, cleaner and more sustainable. “This generation doesn’t care about horsepower or tire sizes, but is more interested in ease of use, purpose, and experiences.” (Schlereth, 2019)
SUSTAINABILITY

ALTERNATIVE DRIVETRAINS
Given the existing climate in transportation design, it’s quite apparent that mobility is on the verge of change. Emerging trends like autonomous driving, connected vehicles, collaborative consumption (e.g., car sharing) and new materials via 3D printing will drastically change the shape of modern vehicles and the way we travel (Jordan, 2015).

Alternative powertrains are a hot topic, due to people’s increased awareness of environmental challenges and air-pollution of big cities. There have also been political events like the Paris Agreement COP21, which aims to keep the increase in global average temperature below 2°C and to reach net zero emission by 2050. In recent years, many car manufacturers released numerous zero-emission show-cars, some of which have already gone into production.

In order to accomplish the ambitious goals of the Paris Agreement, car companies face many challenges. In 2018, the German government already initiated bans of high emission combustion engines in large cities like Hamburg, Frankfurt, and Stuttgart in order to combat local air pollution (Steitz & Wollrab, 2018). In recent years we have seen many improvements in vehicles with alternative drives. Initial weaknesses and difficulties with the technology have been resolved thus far. With a range of up to 613 km, electric vehicles have proven their suitability for everyday use and are now recognized by the masses (Lambert, 2016). While the future of alternative propulsion is promising, the lack of refueling infrastructure remains a problem.

So far, there are still far too few electric charging stations worldwide. It seems that Tesla is the only automaker dedicated to developing an electric charging station network. Another disadvantage is the long charging time, which ranges from 30 minutes to 12 hours (PodPoint, 2019).

A new, eco-friendly endurance rally series, extending across Eurasia could motivate automakers with well-known energy suppliers to expand the charging network and promote alternative energy. This would be possible if the renewable energy companies functioned as primary sponsors, providing the competitors with green energy.
FUEL CELLS

For years, Japanese and Korean car brands have been reliant on the fuel cell as the prime candidate for alternative drivetrains. In early March 2018, twelve Japanese companies entered into a joint venture called Japan H2 Mobility (JHyM), working together to make their hydrogen propulsion technology competitive. Among those twelve are Japan's largest automakers: Toyota, Nissan, and Honda (Manthey, 2018).

Their primary goal is to expand the hydrogen fueling station network across Japan and bring 40,000 hydrogen cars to Japanese roads by 2020. By 2025, there are expected to be 200,000 FCEVs and 800,000 just five years later (Murai, 2018). In addition, they expect that in the future hydrogen will be produced from water in an environmentally friendly manner via electrolysis, rather than split off from gas as before. Toyota and Honda already have hydrogen-powered vehicles on the market and are considered trailblazers for the technology.

Nevertheless, significant gains cannot be achieved in the short term. Especially for petrol station operators, the hydrogen business is not worthwhile due to low demand and high maintenance costs. However, this should change with the help of financial investors and state subsidies. Market researchers at Frost & Sullivan expect that Asian companies will dominate the market in the future: "Governments of Asian countries such as China, Japan, and Korea are more willing to subsidize fuel-cell vehicles than battery-powered electric vehicles," says Anjan Hemanth Kumar, Mobility Program Manager at Frost & Sullivan. China aims to install 3,000 hydrogen filling stations by 2030 (Frost & Sullivan, 2018).

The Koreans are also putting hydrogen to the test. As early as 2013, Hyundai produced the ix35 Fuel Cell (fourth generation), the first commercially mass-produced hydrogen fuel cell vehicle in the world. In Brussels, the vehicle received the 'Car of the Future' award. With the 2-tank hydrogen storage system, it has a range of about 594 km and a rating of 134 hp (Wikipedia, 2018). Thus, the Hyundai brand is also considered one of the pioneers in the field of alternative drive systems.

During the release ceremony, Kim Eok-jo, vice president of Hyundai Motor, said, “I expect that the world’s first-ever mass-production of fuel cell electric vehicles will help us bring in a new era of eco-friendly cars faster than originally forecasted,” and went on to say, “Going forward, based on strong development competitiveness, we will continuously make efforts to transform ourselves into a leader in technology and production in the field of eco-friendly cars, which is a future growth engine.” (Matthew, 2013) By 2025, Hyundai plans to introduce around 18 eco vehicles in the global market.

At CES 2018, Hyundai introduced “Nexo”, the successor to the ix35 FCEV (Hyundai Media, 2018). In contrast to its predecessor, this vehicle was built completely on a new, hydrogen-propelled platform. This allowed for lighter construction, a more powerful engine (163 hp) and an impressive range of 756 km. That's the largest range of all vehicles of its kind on the market.
THE DAKAR RALLY

ORIGIN OF DAKAR
The Dakar Rally is one of the most fascinating motorsports on the planet. Due to its harsh and versatile terrain, unexpected things can occur at any turn. Small mistakes by the rally team can cause disastrous breakdowns and even disqualification. Admiring the team effort of the competitors and the remarkable footage of vehicles drifting through desert dunes, this rally became one of the main inspirations for the author’s thesis topic. In order to get a better understanding of how it became so popular and why car manufacturers decided to participate, the author began researching the roots of the Dakar Rally.

The Dakar Rally was conceptualized in 1977 when rally enthusiast and idealist Thierry Sabine got lost with his motorbike in the Ténéré desert during the Abidjan-Nice Rally. After spending three days and nights in one of the most remote places on earth, he was finally rescued by race organizers during an extensive helicopter search. Inspired by the vast desert, he had a vision of the most challenging, risky and legendary race, which would outshine all other races at the time (The Dakar’s History, 2010).

Upon his return to France, he wanted to share his experience and fascination with the enormity of the desert with as many riders as possible. Sabine came up with a route totaling ca. 10,000 km, starting from Europe passing through the African countries of Algeria, Niger, Mali, Upper Vota, and finishing in the Senegalese capital of Dakar. The slogan of the inaugural Dakar Rally between 1978-1979 was: “A challenge for those who go. A dream for those who stay behind.” (The Story of the First Dakar Rally, 2015).

Due to his talent as an organizer, Sabine gathered 182 competitors to participate in the Rally, starting from Paris. However, only 74 vehicles survived the long trip to Dakar. The rigorous course -consisting of desert dunes, mountain passes, mud, and gravel-tested the all-around ability of the vehicles and their drivers. Contenders must prepare themselves and their cars against tests of “performance, driving techniques, navigation ability, part supply systems, vehicle repair ability, mental strength, physical strength, and experience.” (Toyota Motor Corporation, 2013). Many famous names from other motorsports were attracted by the extreme conditions of the rally, which quickly elevated
its popularity. Consequently, in 1982 more than twice as many competitors participated, than at the inaugural event.

**VARIETY OF VEHICLES**

In addition to the brutality of the course, the variety of vehicle categories makes the Dakar Rally so unique and interesting. In fact, vehicles with weights ranging from approximately 175 kg up to 10 tons are represented. At present, there are four major competitive groups:

- **MOTO**: 2-wheeled vehicles/motorcycles
- **Quads**: 4-wheeled buggies, etc.
- **Auto**: 4-wheeled vehicles
- **Camion**: trucks

(Toyota Motor Corporation, 2013).

Within these categories, the vehicles are also distinguished between production class (non-converted commercial vehicles) and super production class (converted commercial vehicles and racing vehicles) (Toyota Motor Corporation, 2013). Car companies use the rally’s harsh terrain as a platform to test their technologies and to demonstrate the vehicle’s quality, durability, and reliability. In the history of the Dakar Rally, many renowned car manufacturers like Volkswagen, Citroen, Peugeot, Porsche, Mitsubishi, Nissan, BMW, Renault, Toyota, MINI, Ford, etc. have participated. Most of them achieved great success.
ROBORACE

AUTONOMOUS RACING
Roborace is the first autonomous driving racing series in history, launched in November 2015. The creator of the idea was the Russian businessman, Denis Sverdlov. Originally he had the idea to develop just an autonomous overtaking mode for the Formula E, activated at the touch of a button. However, Sverdlov went one step further and considered a new racing series where racing teams develop AIs and compete against each other (Burgess, 2018). All teams compete with the same vehicle, which is why the coding is simply crucial for victory. With the Roborace series, the organizers wanted to demonstrate autonomous and electrically powered vehicles (with a top speed of up to 300kph) to show viewers how safe this technology already is. For Sverdlov and his team, motorsport is the best platform to advance the autonomous driving technology. Roborace’s deputy CEO Rod Chong said:

“Look through the history of the automobile; so many new technologies first appeared on the race track. If the breakthrough didn’t happen at the track, it was popularized and developed in competition.” (Gitlin, 2018)

ADVANCE THROUGH COMPETITION
For the first racing season, the ‘Season Alpha’, it was planned that the teams would compete against each other, completely driverless, using the Robocar designed by Daniel Simon. But this has now changed - there is a new vehicle for the Season Alpha, the DevBot 2.0, a LMP3 race car with electric drive, AI technology and various sensors, radars, cameras, etc. (Gitlin, 2018). In this race car now sits a driver during the entire race, who is also partially in control of the steering wheel. According to the CEO and the winner of Formula E, Lucas di Grassi, racing needs a ‘human component’.

“We realized that humans are very much part of the storyline of autonomous driving technology. The machines need to learn from humans. What’s it like to take a ride in one as a passenger? These cars have to learn how to fit into a human world. Human and AI cars will share the road.” -Rod Chong, CEO of deputy (Gitlin, 2018)

In the course of the Berlin ePrix, last year, Formula E hosted a Roborace ‘time attack’ competition in which humans and machines competed together.
The goal was to show how technological progress grows through interaction with humans - in other words, the machine learns from man. The AI was programmed, developed and tested by a student team. One team came from the Technical University of Munich (TUM) and the other from the University of Pisa. The goal was to find out how student programmed AI performs against human drivers. The first lap was the human driver and the second lap the AI. Thereafter, the times were measured and compared. The driver of TUM, Errolson Hugh (founder and designer of ACRONYM), described his experience in the vehicle as follows: “You’re fused to the car; it’s like wanting to be a cyborg” and achieved a lap time of 91.54 seconds (Gitlin, 2018). The AI of the TU Munich was only about a tenth of a second slower. Hugh’s conclusion at the end of the day was:

“It’s a more positive way to look at the whole autonomous driving thing,” he said. “It’s not a case of either-or; there will be AI, there will be humans. The only real way to understand the ramifications of that, which are going to be massive, is to get out in front of them, and this was an extremely eye-opening way to do that. Everyone who was there thought the same way.” (Gitlin, 2018).
THE BRAND

BRAND HISTORY
Hyundai is a Korean car manufacturer with its headquarters in Seoul. The word ‘Hyundai’ translated means ‘modernity’. The company’s roots go back to 1947 when Chung Ju-Yung founded the Hyundai Engineering and Construction company (Levine, 2015). However, the car brand was founded in 1967. The first car, the Cortina, was released one year later and was a collaboration project with the Ford Motor Company. Chung realized the potential the automotive industry offers and wanted to develop his own car. Thus, he hired George Turnbull, former director of Austin Morris. With the design by Italdesign, the first Korean mass-produced car was released in 1975 - the Hyundai Pony (Levine, 2015). Ten years later, the one-millionth Pony was sold, which makes it the cornerstone for the company.

Today, the Hyundai Motor Company is the fifth largest car manufacturer in the world (Destination Autogroup, 2013). It consists of the brands Hyundai, Kia, and the luxury brand Genesis. Worldwide, the company has four international R&D centers, in Germany, Japan, India, and the USA.

BRAND IDENTITY
The brand slogan of Hyundai is ‘New Thinking, New Possibilities’ and stands for the company’s mission to create and encourage new thinking to develop innovative products and exceed the customer’s needs, by providing new experiences (Rudenko, 2011).

The brand direction of Hyundai is called ‘Modern Premium’. It is not about luxury, it is rather to exceed expectations of the customer, by offering exceptional performance and elegant design at a reasonable price (Rudenko, 2011). By doing so, the company wants to reach all people and not just the select few.

DESIGN PHILOSOPHY
The new design philosophy is defined as ‘Sensuous Sportiness’ (Siler, 2018). With the Geneva Motor Show in 2018, Hyundai releases the ‘Le Fil Rouge’ concept, which is the first of its new design direction. Translated the name means ‘common thread’ and implies the bridge between Hyundai’s past, present and future designs (Siler, 2018). The focus was to enhance the emotion and desirability of the cars, combined with a sporty character, by creating harmony between the proportions, architecture, styling, and technology.
“Our goal is to build a beloved brand by creating vehicles with heightened emotional value to reshape the landscape of car design. This is the foundation of our concept,” said Sang-yup Lee, Head of Hyundai Styling (Cha, 2018).

Very characteristic of the exterior design is the interplay between the very organic car volume and the sharp edges. This creates a contrast between hard and soft, which eventually builds harmony.

“Our motorsports vehicles will spearhead the N Brand at the apex of the brand’s hierarchy. Not to mention that the valuable experience and technology derived from our success in motorsports will cascade down to all the future N products.” (Hyundai, Media Center, 2018)
GOALS & WISHES

ANALYSIS
We are heading towards a new age - the Augmented Age. This era starts with the introduction of artificial intelligence and sees it become part of our everyday lives. AI will help us to think, to produce things more precisely and efficiently, and to relate to a world that goes far beyond our natural senses. However, many fear this future, yet the author is convinced that humans cannot be replaced. Therefore, it is important to promote the combination of AI and HI, the so-called ‘Augmented Intelligence’. When we look at the automotive industry, it becomes clear that autonomous driving is about to happen. However, the first autonomous production vehicles will initially be very limited. These vehicles will only be able to drive on highways and in city traffic. For off-road use, further development is needed. Even in the field of alternative drive technologies, there is still a lot of development necessary, especially in the infrastructure. After extensive research, the author comes to the conclusion that for off-road vehicles, the hydrogen drive is best suited. It is particularly suitable for larger vehicles with long range, as it is not susceptible to temperature fluctuations and can be refueled quickly.

GOALS
The primary goal of this thesis is to create a new Endurance Rally series for the year 2030, which uses the combination of human and artificial intelligence to maneuver the vehicle through the most diverse and challenging terrain. This concept takes autonomous driving to a new level and promotes the development of fuel cell technology and, in general, the use of renewable energy in motorsport. By perfecting the AI it will be possible to set new standards in speed, off-road capabilities, jumps, and efficiency.
Furthermore, the audience should be offered an immersive experience - unlimited access to the vehicle and team via VR live stream. In this way, future generations will want to participate in this sport.

The focus of the design lies in the exterior. It is important to design something unique and unprecedented, as motorsport fans attach great importance to the appearance of racing cars. In order to create a holistic design, it is necessary to include technical aspects and details that can convince the observer of the vehicle’s function.

WISHES
Throughout the entire thesis development, the author had some wishes which he wants to achieve. One of these wishes was a broad ideation phase in Maya, to generate as many ideas as possible and then narrow them down one-by-one. In previous projects, it always felt like there was never enough time for exploration.

During the author’s student career, there was never a chance to build a detailed and refined physical scale model. It means a great deal to have model-making support from Hyundai and to realize the personal design in a real exhibition model. This requires a well-refined CAD model, which the author wants to create in ALIAS, together with professional modelers. This helps to learn to communicate with other people about a design they are not familiar with. Having familiarity with building one’s own models by hand, the author believes it is very important to learn how to supervise an ALIAS model, executed by professional 3D modelers.
IDEATION

RACE SUMMARY, INSPIRATION, PACKAGE, SKETCHES, MODEL MAKING

The following pages will first describe how the endurance rally and the rally team are structured. This is important to get an overview of what requirements the vehicle has to meet.

With this background knowledge, several package variants were designed, which show different architectural concepts. Furthermore, the required technical components of the vehicle are listed. This forms the basis for the sketch phase, where various design characters were generated, using hand sketches and Maya mock-ups. These mock-ups were refined in Photoshop and served as the foundation of the Alias modeling process. The main body and wheels were modeled in Alias, however the remaining details and the 3D terrain podium, in Maya.

At the end of this section, the physical model building process is briefly shown.
THE RACE

11 COUNTRIES, 11 STAGES.
This spread shows the entire route of the race. The competitors have to master 11 stages while traversing 11 countries. There will be stages mostly during the day, however, some of the stages are during the night. This will add an additional challenge for the AI and the rally team.

Approximately half of the route consists of desert or dry steppes, the other half is divided into tarmac, mountain passes, urban areas, and even water. Some of the famous spots are the Gobi desert, Taklamakan desert, Caspian Sea, Black Sea, Transylvanian Alps, the Alps, culminating at the final destination - Paris.
COMPETITIVE GROUPS
There are three different vehicle groups competing against each other. They can either win the overall race or win within their group. Not only speed is important, but also good efficiency, great teamwork, and popularity are awarded extra points. The author believes in the combination of human and AI and decided to follow this direction.

I
TRADITIONAL
A combination of driver and co-driver [navigator], like we know it from the Dakar Rally.

II
MIXED
A striking combination of the human mind teaming up with an AI steering the car. Scientists claim that the synergy of human and AI will be a very successful formula.

III
ROBO
For the geeks, a very extreme category, where the car is completely driverless. It is probably less about speed and more about who is going to make it to Paris.

"PAIRING AI WITH A HUMAN CREATES A NEW DECISION-MAKING MODEL IN WHICH AI OFFERS NEW FACTS AND OPTIONS, BUT THE HEAD REMAINS HUMAN, AS DOES THE HEART"
-SVETLANA SICULAR, RESEARCH VICE PRESIDENT AT GARTNER

RALLY TEAM
This graph shows the organization of the rally team. In the car, there are the human and the AI. The drones, which are equipped with 360 cameras, are flying ahead of the car and sending the video footage to the rally team.
The idea was to visualize all the different driving modes, the vehicle has to be capable of. Therefore, the tires and suspension play an important role.

**INITIAL PACKAGE**

The initial package consists of all technical components. Since it is a fairly complex vehicle, it was helpful to start there. It helped to create an architecture, keeping technical components constantly in mind. Since the vehicle is autonomous, there will be many radars, lidars, and cameras mounted on the exterior.
First ideation round, creating a design based on the chosen architectures, required components, and design inspirations. After a review with the supervisors, three favorite design directions (marked with a ‘+’) were chosen. They were selected based on the following criteria: autonomous, robust, off-road and unconventional.
After experimenting with a lot of different architectures, it was necessary to choose one which reflected the conditions of such an extreme journey. The ‘Leaning Forward’ concept puts the occupant in a very dynamic seating position. It would fit the high-speed approach, however, it makes it look like the person is actively steering the vehicle. The ‘Capsule’ design makes a lot of sense because of safety reasons. It protects the person entirely, while the ‘Roofless Construction’ gives the person more freedom and better sight. Additionally, it strongly linked to the first Peking to Paris vehicles, back in 1907.

After the first sketching round, the author decided to build quick Maya mock-ups, to test the generated designs in 3D. Re-building the first models, based on the initial sketches, turned out to be a powerful tool to create entirely different and iconic designs. After a few reviews, these five characters were shortlisted. The first one, the ‘Bison’ is the only proposal without a roof. The other designs are fully closed, to give a very robust character.
After a presentation with the entire Hyundai design team, a poll took place to get an idea of which design characters were favored. The ‘Bull’ and the ‘Beetle’ received the most votes. Since the author shared this opinion, he selected the two designs to develop further. It turned out that both proposals were extremely promising. The arguments in favor of the ‘Bull’ were that it looks super dynamic and unique, due to the two horns which shape the front fenders. However, the ‘Beetle’ looks very robust and robotic. Both would be capable of driving thousands of kilometers through harsh terrain. After reflecting and talking to many friends, tutors, and colleagues, the author came to the decision to proceed with the ‘Bull’ design, simply because of its novel and confident presence, coupled with its practicality and distinctive asymmetry.
With the chosen design, there was a need for a bigger window, to have a desirable experience for the person sitting inside. Since the occupant is not driving, there must be perfect visibility of the surroundings.
To make the experience more extreme for the occupant, the author tested the open architecture through sketching and modeling. It turned out, that having the human more exposed with maximum visibility, while still providing safety, added a big portion of excitement. This will attract spectators to follow the race and make them dream about sitting in this car one day.
The inner circle of the Korean flag shows two halves - the red half represents positive cosmic forces, while the blue one represents the negative ones. Together they build balance in the universe. Derived from this symbolism, the car is divided into two halves - the human and the AI. Where the human stands for warmth and emotions, the AI rather stands for cold and rationality.
With the chosen design, there was a lot of refinement necessary, to achieve the desired proportion in Alias. Therefore, many orthographic side view line drawings were made. These were the basis for model development. Further, the Maya mock-up model and the perspective sketches helped to communicate the design to the Alias modelers.
The airless tire is capable of transforming itself, through pneumatics, into four different modes: mountain, water, desert, and tarmac. This design builds a bridge to the trigrams on the Korean flag. They symbolize harmony and movement and individually represent heaven, sun, moon, and earth. The idea was that if a mode is activated, the section with its symbol lights up. In that way, spectators can see the mode in which the tire is set.
Since the car has many functions, there are many details shown on the exterior—especially on the AI side. Computer parts require a lot of cooling, especially in warm climates. Therefore, the design accommodates several air intakes and outlets, to generate sufficient airflow. Besides cooling, the AI needs a lot of sensors, lidars, radars, and cameras. These make up the perception system and have to be mounted around the vehicle.
MODEL MAKING

The main body of the car was milled out of Ureol in two parts so that it was possible to make it hollow inside.

The 3D terrain podium was milled out of foam. All the other 49 components were 3D printed. In order to assemble all parts together, pins and holes were added on the components’ data.
THE TOP DOG

Introducing the ‘Top Dog’, the team leader and master of the AI. He/she is responsible for training the AI, thus excellent driving skills and programming skills are required. During the race, the Top Dog decides which way to go and how risky the car should drive. At any time, he/she is able to take over control of the vehicle. When something unexpected happens, eg. a breakdown or system collapse, human creativity is needed to solve these type of unforeseen issues.

The Top Dog also acts as a role model for fans, since he/she is the one leading the team and being inside the car during this exciting race. It must be thrilling, racing with high speed on diverse terrain and not having control for the most part.
Imagine an endurance rally where you can follow your favorite team from within the vehicle, from just outside the vehicle, and from the air. The ‘Peking to Paris’ concept offers fans the possibility to watch the race with VR glasses, through the most beautiful and remote places on earth. This image also demonstrates how the Top Dog can see fans with Augmented Reality with his/her glasses. This builds a bridge between Top Dog and fans.
FINAL DESIGN

TOP DOG SIDE
This side houses the cockpit and is characterized by continuous organic lines with soft surfaces. This design language symbolizes humanity and expresses a certain warmth. It was also important to place the N logo at this spot, as the Top Dog represents the brand.
AI SIDE

This side houses the artificial intelligence with its technical components. Here you will find the combination of soft and hard surfaces. At the area, where the components of the AI are, we recognize a polygonal design language. This symbolizes technology and expresses a certain coldness.
DESSERT RACE

This is how the race could look, starting in the Gobi desert of China. The first three stages will only be desert. The hydrogen tank should carry enough fuel for one stage. Extra fueling means deduction of points since efficiency is one major category of the rally. After each stage, the vehicle gets refueled by publicly provided renewable energy.
THE TEAM DRONES

Every team is equipped with several drones: some of them fly ahead and provide the AI with scanned data of the upcoming terrain. In that way, the AI always keeps updated and the team can spontaneously decide to alter the route. The other drones are equipped with 360° cameras to film the race car continuously. The 3D footage will be live streamed back to the fans at home.
AUGMENTED REALITY

With AR, fans can transform their living room into a rally scene and share their experience together with friends and family.

Photo 25 - (Backplates) Pereira and Valt

PEKING TO PARIS - 63
SOCIAL MEDIA
The more fans are rooting for a team, the more points a rally team gets during the race. In this way, rally teams are even more motivated to stay connected to their fans, because they are the ones who keep this sport alive.
Photo 26 - (Backplates) Karemame and Valt

PEKING TO PARIS - 65
FINAL MODEL

1:5 SCALE MODEL
These photos were taken at the Arts Campus in Umeå, during the degree show. The complete model is shown, mounted on the terrain podium in an actively suspended position. It was very important for the author to achieve this so the viewer can easily picture the car driving in nature.
The author had a very positive start to the thesis project, boosted by the trust and respect earned from colleagues at the collaborating company, Hyundai. With that trust, the author even managed to convince design managers to support the project with a physical model—a huge personal accomplishment, given the effort and expense it would entail.

With the author’s interest in racing and desire to design for off-road usage, concept exploration came easy and it wasn’t long before several ideas were on the table.

Diving deep into research, a clearer vision of the concept began forming. This brought confidence and composure to the author, who had preoccupations about discovering a convincing topic to satisfy both the requirements of the degree program as well as personal ambitions. With this momentum, the author soon began with initial ideation. Although a bit ahead of the UID schedule, this pace was necessary to allow adequate time for feedback from colleagues and planning for the scale model. As car enthusiasts, Hyundai designers want to see something surprising and extraordinary. That’s why broad exploration in Maya was quite important. It showed a breadth of ideas and really allowed the author to diverge.

One challenge, however, was to clarify and polish the concept behind the design. This endeavor, to develop a new rally series for 2030, was quite daunting, and brought many open questions. It was a struggle to develop convincing arguments against all the skepticism and criticism about AI in off-road racing. Another challenge was to incorporate ‘design for sustainability’. Given the school’s general emphasis on green design, the author put a lot of effort into adapting the concept to be more eco-friendly. This meant less focus on selling the fundamental idea of AI in racing.

The other challenge was, to bring AI into rally motorsport—a type of racing, that has existed for decades without major change. Watching autonomous racecars just didn’t sound exciting enough to people. Thus the research gateway was quite an eye-opener. There, glimpses of the design were presented to a jury, who showed obvious signs of doubt. The critique was that the architecture resembled a driving fortress. The occupant was not seen well enough from the outside and it seemed to lack an explicit connection to the fans.

‘It looks too easy’, ‘too safe’, and ‘make it sexier’ were typical remarks during the review. This motivated the author to push the boundaries even further, focusing on the roofless solution, which was ultimately the right choice.

In preparation for the final scale model, the author chose to receive Alias support. This meant learning how to properly supervise the CAD model. Due to the tight schedule, Alias modeling began quite early—leaving no time to prepare final sketches, which prompted a multitude of questions about the design. The unconventional architecture of the vehicle made it difficult to set proper proportions in Alias. But, thanks to the great support of Hyundai,
it worked out very well.

Eventually, it paid off to start early, as the model was fairly complex, with many details and asymmetry. The data preparation for the milling process took longer than expected too. The difficulty was the mix of printed and milled parts and the sheer number of small parts. This meant a great deal of sanding as well.

The author’s mood during the whole development could be compared with a share price fluctuation. Day-by-day, it flipped from one extreme to the other. One day, optimism about the design and the next - just plain doubt. The absolute low point was when the author suffered a severe ankle injury during a hiking excursion. An entire week marked by swelling, pain, and several doctor visits didn’t help during the final month of the project. But the show went on. The author accepted the unforeseen circumstances and tried to find a balance between recovery and work.

Overall, the author feels a high level of satisfaction with the project, although unable to fulfill some initial wishes (e.g. an animation). Nevertheless, the Peking to Paris rally is an inspiring concept and an exciting design. It, hopefully, paves the way for the existence of rally motorsport in the future and provokes questions around reestablishing the romance between people and cars.

The intention was to be as courageous as possible, because students tend to focus too much on trying to get a job, restricting themselves and attempting to please design bosses with a similar formula. Instead, students should be encouraged to dare something; trial and error - that’s the way of true improvement.
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A DWINDLING FANBASE

MILLENNIAL MENTALITY

ATTRACTION TO THE SPORT

BROADCASTING
**ESPORTS & SIM RACING**


**AUGMENTED INTELLIGENCE**


**AI² IN VEHICLES**


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AUTONOMOUS RACING; ADVANCE THROUGH COMPETITION


BRAND HISTORY


BRAND HISTORY

DESIGN PHILOSOPHY

REFERENCES

IMAGERY

COVER PAGE

TABLE OF CONTENTS

ABSTRACT

INTRODUCTION

PROCESS


Photo 1: Benavides, V. (2017, August 05). One in A Million [Photograph found in 4 Yawkey Way Ext, Boston, United States]. Retrieved from https://unsplash.com/photos/W6NGECt_yE4

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IMAGERY


RESULT


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APPENDIX

MASTER THESIS TIMETABLE

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