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Internet of Things (IoT) in Smart Cars

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Abstract

This paper explains how connected cars, along with billions of other devices and services, can connect to the Internet of Things (IoT). The Internet of Things (IoT) is a topic of information technology that is still in its development. The subject of linked vehicles is currently dominating the conversation in recent Internet of Things research, making it one of the most important areas of discussion.We are utilizing smart features and IOT concepts to build up this application. In order to support the achievement of automotive informationization, this article continues the analysis and study on the connected subject of vehicle manufacturing "IOT" and lists relevant content. Technological advancements in the auto and autonomous vehicle industries have skyrocketed. The number of driven cars has increased, and with it have the safety problems associated with them. Accidental deaths and serious injuries have increased dramatically. The provision of suitable safety features in vehicles has become a requirement. In this paper we discuss about Smart Car's features with interior design and how better decisions can be made by connected cars sharing information. As a result, the use of these smart cars may effectively manage road traffic control. Road accidents, which frequently happen as a result of traffic congestion, might be greatly minimized, if not entirely avoided, by vehicle-to-vehicle communication. This paper focuses on several distinct applications of the Internet of Things, including connected cars, IoT-based predictive maintenance, infotainment systems, Fleet Management and Telematics in vehicles also. As a result of this in-depth examination, various applications of the internet of things (IoT) in the automobile industry will be better understood. In addition, the information presented in this paper can be used as a foundation for further developing the current adoption of the Internet of Things in Smart Cars.

Declaration

This thesis is composed of our original work, and contains no material previously published or written by another person except where due reference has been made in the text. We have clearly stated the contribution of others to our thesis as a whole, including statistical assistance, survey design, data analysis, significant technical procedures, professional editorial advice, financial support and any other original research work used or reported in our thesis. The content of our thesis is the result of work we have carried out since the commencement of Thesis.

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Approval

This thesis titled ”IoT Based Smart Car” has been submitted to the following respected member of the board of examiners of the Faculty of Science and Technology impartial fulfillment of the requirements for the degree of Bachelor of Science in Computer Science and Engineering on dated and has been accepted satisfactory.

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Chapter 1

Introduction

When we thought of a car in previous years, we thought of a personal or rented vehicle used solely for transportation. Nowadays, cars are becoming increasingly capable of giving entertainment, information, and aid to drivers both during travel and in the event of an emergency. These are just a handful of the modern-day services accessible when purchasing a vehicle. Nevertheless, the automobile is transitioning from a good to a service. In fact, individuals can choose not to own a car and instead use it just when they need it through car sharing or other services such as carpooling. This is one example of how the car is shifting from being a product to a service.

The term ”Smart automobiles” refers to a system in which the vehicle itself possesses its own intelligence in order to provide passengers with an improved driving experience. This type of technology is sometimes referred to as ”autonomous driving.” It is possible to separate the computer system into a primary driving computer and auxiliary computer systems. The primary function of the first one is to provide the driver with a source of information regarding the condition of the vehicle as well as the surroundings that are immediately surrounding it. It is linked to a computer that is capable of navigating around obstacles through the use of an Ethernet network, and it communicates warnings and directions to drivers in order to assist them in avoiding collisions. There has been a substantial breakthrough made in this sector’s technological development, particularly in the field of driver less vehicles, which has seen great progress. In this circumstance, the number of vehicles being driven is also increasing, which simultaneously generates concerns about safety as well as unease. Accidents and injuries that ultimately result in death are also getting more common as each passing day goes by.

The innovative features of the modern smart car are numerous. In a network setting, its cutting-edge features shine through, including autonomous detection and driving as well as speed limiters that set themselves. The role of intelligence tools in daily life and industrial production has expanded as automatic control, computer technology, and information technology have progressed. [26]. Smart cars are being created and improved at a rapid rate around the world, coupled with computer, network, and

communication technologies, as they play a significant role in Intelligent Vehicle Highway Systems [27]. The traditional approach to designing a smart car relies on the acquisition of photoelectric signals, and the requirement for CCD image processing on the surrounding environment is increased. Smart vehicles are vulnerable to interference [28].

1.1 Smart Car

The automobile industry and the Internet of Things can operate hand in hand, and a smart car that incorporates state-of-the-art electronics and system-driven artificial intelligence is a perfect illustration of this. Devices connected to the Internet of Things are employed in the smart automobile for both routine maintenance and for sending alerts to drivers. In this instance, IoT-based smart management services can be supplied since the physical infrastructures of parking lots are linked to information and communication technologies.

A linked car and a self-driving car hybrid, the smart car can be recognized. In addition to being able to drive itself, it can also share its network with other passengers and, thanks to an Internet connection, make its data accessible to devices that are inside or far away [29]. It will soon be possible to put ”the old metal box on four wheels” out of your mind since the cars of the near future will be smarter and capable of doing things that were previously unimaginable. Due to new technology, cars will no longer just be vehicles for getting around; they will also make driving easier and increase road safety. First, the automobile can do all required safety procedures and keep an eye on the condition of the roads the entire trip, but not in exceptionally poor weather. In contrast, in all but the most extreme cases, the second scenario only requires the driver to signal the system's start and destination. In addition, the Internet of Things (IoT), which has now had an effect on every aspect of day-to-day life, includes the connected smart car as one of its components. In point of fact, smart cars are able to contact the repair shop if something in the engine is behaving abnormally, notify emergency services in the event of an accident, and notify the tire dealer if a tire is punctured in addition to giving drivers access, typically through a smartphone, to information about the state of the car, its location, and technical data. Smart cars are also able to give drivers access to information about the car's location.

A smart automobile is a highly computerized vehicle that possesses an open recruitment platform, accessible computing, and a straightforward human-computer interface [30]. Because they are the most common and well-liked method of transportation, smart cars have quickly become an integral component of people's day-to-day lives, as well as a fundamental requirement. As a result, the manner in which people live in every region of the world has been profoundly altered. The extensive use of motor vehicles has resulted in a number of risks, including ones related to road safety and pollution, despite the fact that these modes of transportation offer a number of benefits, including on-demand mobility, ease of use, and even comfort. As a result of the many different ways in which automobiles have impacted every aspect of society over the course of several decades, cutting-edge technologies that improve driving assistance and safety have been incorporated into increasingly sophisticated automobiles. In this article, we present

a more sophisticated version of the smart car, one that is not only able to keep its occupants safe in the event of an accident but also provides the necessary level of comfort. Features such as GPS Modules, emergency buttons, MQ-3 Ethanol, temperature sensors, GSM Modules, rain-sensing car wipers, 3D gestures, solar power, and so on are employed to lower the likelihood of accidents and increase user safety.

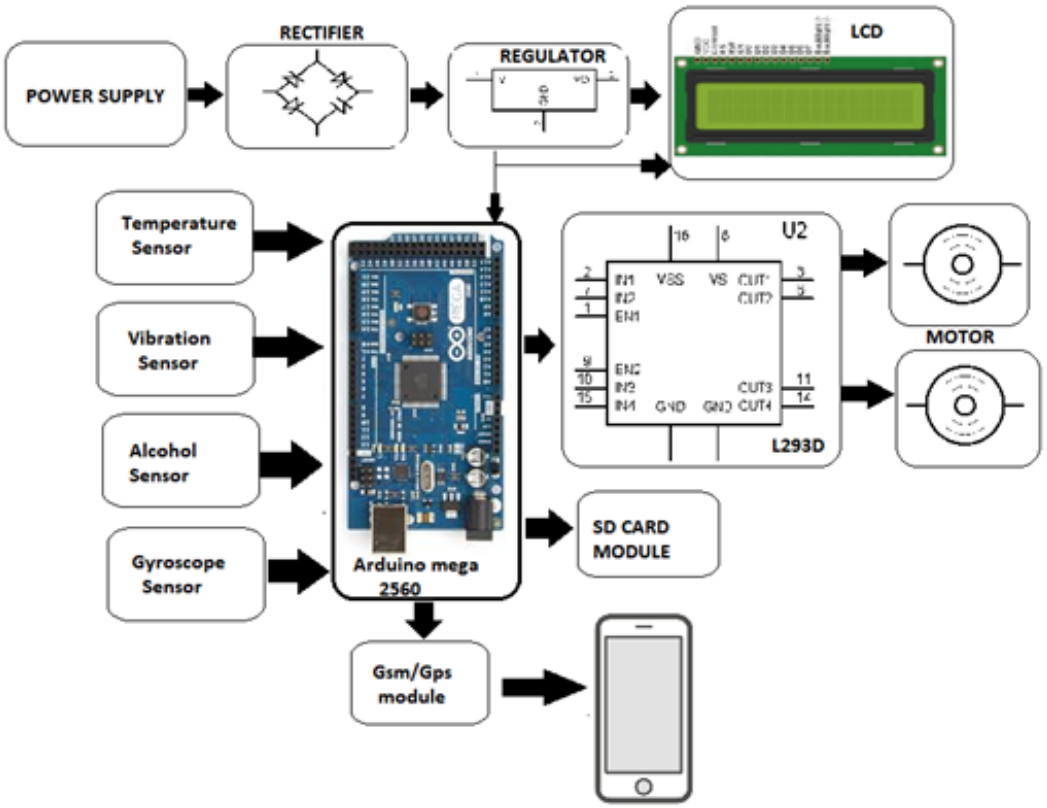

Figure 1.1: Internet of Things (IoT) in Smart Cars [1]

1.2 Internet of Things (IoT)

The Internet of Things (IoT) is a novel technology paradigm that views the world as a network of interconnected equipment and objects. It is also known as the Internet of Everything and the Industrial Internet. As one of the most promising areas of future technology, the Internet of Things (IoT) has caught the attention of many companies. The paradigm of information technology is undergoing a significant transition as a result of the Internet of Things (IoT). ”Internet of Things” is a phrase that is usually shortened as ”IoT.” This phrase is formed by combining the words ”Internet” and ”Things” together. The Internet connects billions of people all over the world by utilizing a common Internet protocol suite known as TCP/IP. This allows for the Internet to function as a global network of interconnected computer networks. It is a network that connects other networks and is comprised of millions of different types of networks, including public, private, academic, commercial, and government networks. These networks are linked together by a variety of networking technologies, including wired, wireless, and optical. The scope of these networks might range from the neighborhood to the entire world. When it comes to

Things, they can be any object or person that is distinguishable from one another from the outside world. Everyday objects include not only the electronic devices that we frequently interact with and use, but also technologically advanced products such as equipment and gadgets, in addition to ”things” that we do not typically consider to be electronic at all, such as food, clothing, and furniture. In other words, everyday objects include everything from food to clothing to furniture. In addition to this, they consist of things like components, parts, and equipment, goods, and specialized objects, in addition to landmarks, monuments, and works of art. People, animals (such as cows, calves, dogs, pigeons, and rabbits), plants (such as mango trees, jasmine, and banyans), and nonliving goods are all examples of things that can be both alive and nonliving (chair, fridge, tube light, curtain, plate, and so on). At this moment, anything that can be found within this material or physical universe can be considered to be an actual thing.

The Internet of Things makes it possible for data to be transmitted over a network without the need for any kind of human contact (IoT). Users are able to upload data to the cloud and make use of wireless technology that is not prohibitively expensive thanks to the Internet of Things. Because of the internet of things, the user can keep their privacy intact. The Internet of Things (IoT) might be said to have begun with the development of products that could connect a variety of different electronic devices to one another. These gadgets can be monitored or controlled by computers through the use of the Internet. Parking problems lead to increased levels of pollutants in the air and traffic congestion on the roads. In today’s environment, it can be difficult for individuals to locate available parking spots.A recent research indicates that by 2035, there will be more than 1.6 billion cars on the road. Over a million barrels of oil are wasted every day around the world. So, the key to minimizing fuel waste levels is a smart parking system. the solution to the problems being raised. remedy for the problems being raised. With the help of smart parking solutions, drivers can save time and energy when searching for parking spots, as well as money and the environment by driving less. It uses sensing devices to collect data, which is then processed and analyzed. There will be more than 1.6 billion cars on the road by 2035, according to a recent study. More than a million barrels of oil are consumed daily. Therefore, a smart parking system is essential for reducing fuel waste. clarification of the questions raised. By utilizing smart parking solutions, drivers can save time and energy spent circling for a parking spot, as well as reduce their carbon footprint. It uses sensors to collect data, which is then analyzed and processed. It can also be used to penalise drivers for unintentional traffic violations, allowing cities greater command over traffic and boosting their standing in the eyes of the public. Many people, for instance, become confused and wonder where they parked, or even try to check that their car is safely parked during the day, a problem that occurs in nearly every large garage. This system improves computer science since it may be used to create more efficient parking structures that reduce traffic and the likelihood of accidents (whether through smart braking or some other means). It was consequently developed with these considerations in mind.

An expansion of the Internet Services revolution can be seen in the advent of a new Internet revolution known as the Internet of Things (IoT). The Internet of Things (IoT) can be characterized in a lot of different ways, and it encompasses a wide variety of areas of day-to-day life, including as homes, cities,

automobiles, and roads, in addition to devices that monitor people's activities and use the information gained to provide push services. Electronics, software, sensors, network connections, and various other components make up this system, which enables the aforementioned things to collect and share data. Over the past fifteen to twenty years, machine-to-machine control (M2M), which is sometimes referred to as machine-to-machine communication (M2M), has been steadily growing in popularity among engineers and researchers. The control and communication provided by M2M is considered to be an essential component of the IoT. The Internet of Things was initially founded on the Radio Frequency Identification (RFID) technology. The RFID microchip tag is capable of using wireless communication to keep track of any things and communicate identification information as well as position data to a reader. The Internet Protocol (IP) addresses that are embedded in the sensors or computer systems allow for the unique identification of each thing or object that is part of an IoT-based system. Additionally, these things or objects are able to communicate with one another and share information about themselves by utilizing the existing infrastructure of the Internet [31]. In other terms, the Internet of Objects (IoT) refers to a network or networks that connect people, processes, and things by making use of traditional Internet Protocol (IP) technologies in order to establish a new cyber-physical system. It is best to think of the Industrial Internet of Things (IIoT), which is also known as the Industrial Internet of Things, as a subset of the greater Internet of Things. The primary purpose of these connections is to produce and maintain tangible items for sale on the market. The literature has provided a comprehensive analysis of the benefits that the Internet of Things can bring to industrial organizations and facilities that are responsible for the production of resources. According to the author's understanding, the implementation realities of Industrial Internet of Things (IoT) technologies, as well as its various components and decision points, have not received a lot of attention. The prospective uses of Internet of Things manufacturing in business models, data gathering and processing, and decision making based on models have been addressed in basic terms [32]. To communicate the corporate values from an industrial perspective, an innovative IoT-based cloud platform is developed. A case study was used to illustrate the methodology behind the process of deriving value from things that are linked to the Internet of Things cloud. Numerous well-known and cutting-edge Internet of Things solutions, such as waste management, air quality monitoring, smart agriculture, etc., have been examined from the perspectives of sophisticated technology and the industrial market. where a search was conducted using the keywords "Internet of Things" and "Industry 4.0" in the Web of Science databases. An extensive survey report on the implications, possibilities, advantages, and threats of IoT is presented at the World Economic Forum.Participants at the forum arrived to the conclusion that the Industrial Internet of Things is, in point of fact, a revolutionary technology that will usher in a new wave of disruptive businesses that have the ability to make automated judgments and respond instantaneously. The Internet of Things (IoT), which enables real-time monitoring and tracking of all things in healthcare systems, including people, equipment, and pharmaceuticals, also presents new prospects for the healthcare business. People, equipment, and medications all fall under this category.The Internet of Things is also very important for the transportation and logistics industries. These industries have the ability to do real-time product monitoring throughout the entirety of the supply chain by deploying RFID tags or sensors. IoT can improve communication between surface and

underground miners, track mine locations, and evaluate safety precautions in the mining industry [33]. The primary advantages of IoT include an increase in employee productivity and a decrease in labor costs, efficient management of operations, improved utilization of assets and resources, cost-effective operation, improved work safety, thorough marketing and business development, improved customer service and retention, improved business opportunities, and a more dependable company image, among other advantages.

1.3 Components of IoT

Major components of IoT are:

1. Connected smart devices and sensors
2. Data Cloud
3. User Interface
4. Secured Network Interconnection/Gateway
5. Data Analytics

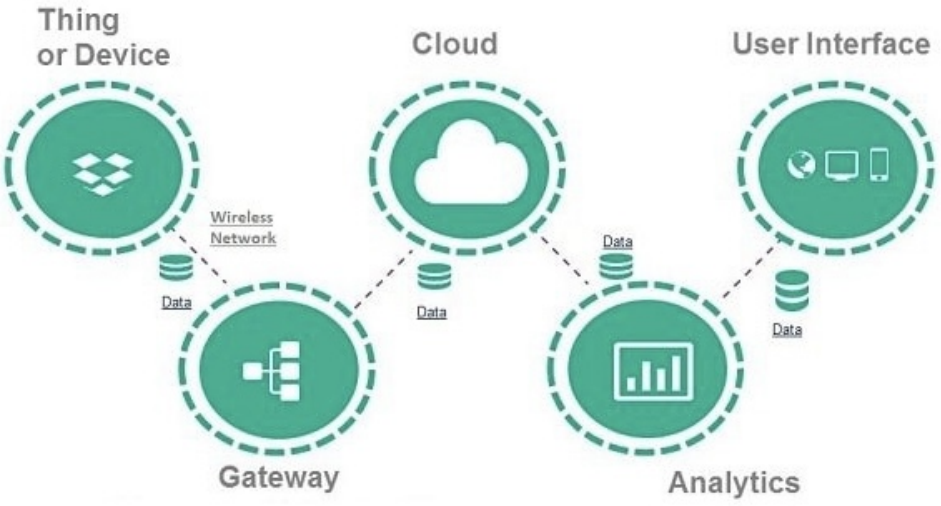

Figure 1.2: Major Components of Internet of Things [2]

1.4 Application of IoT in Smart Cars

Semi-autonomous vehicles are automobiles that make some decisions on their own while the driver is still partially in charge of how the vehicle is driven. This helps to reduce the amount of physical labor that is required of the driver, which in turn helps to reduce the number of accidents that occur. IoT technologies, together with a range of proximity sensors and cameras, are currently being incorporated into autos in an effort to erase the chance of driver error and to make operating a vehicle more joyful and risk-free. This integration is already taking place.

Autonomous vehicles, often known as self-driving cars, have proven to be one of the transportation

industry's most fascinating innovations thus far. With the help of IoT technology, self-driving cars are today a cutting-edge reality, but just a few decades ago, they were nothing more than a distant pipe dream. Autonomous vehicles are able to navigate roads in a secure manner by sensing their environment and requiring very little to no input from a human driver. However, in order to gather information about their surroundings, self-driving vehicles make use of a variety of sensors. A self-driving car, for instance, might utilize acoustic, ultrasonic, radar, LiDAR (light detection and ranging), camera, and GPS sensors in order to collect data about its environment and then base its mobility choices on that data. This shows that Internet of Things (IoT) sensors are essential for the operation of self-driving cars. The Internet of Things makes it possible for sensors to be installed in autonomous vehicles so that they may continuously collect environmental data in real time and communicate it to a central hub or the cloud. The data is analyzed by the system in a matter of seconds, which enables the self-driving cars to react appropriately to the information that has been provided. This demonstrates that the Internet of Things is what connects the sensor network for self-driving cars and makes it feasible for them to function as they were designed in the figure 1.3.

Figure 1.3: Smart car in IoT device [3]

The primary objective of this project is to develop a prototype of a smart car system that is capable of providing real-time location data. When the vehicle detects an accident, it notifies the police station and, for the convenience of the driver, it also features a feature that allows him or her to activate an alarm. passenger protection and safety. An interactive link between cabin monitoring and a user and a car, in which the user can ask about the temperature, humidity, and other variables remotely inside the vehicle. The sending of a text message to the GSM module that is now present The GSM module in the car establishes a connection to the Arduino, which then retrieves and transmits readings from sensors

that are attached to it. It responds to the user by sending them a text message. The safety of the driver is an essential component of automobiles, which is why several nations have made its inclusion obligatory. A key contributor to fatalities is both careless driving and a prolonged delay in patients receiving first treatment. The number of inexperienced drivers who drive recklessly is rising, and this trend is expected to continue. Criminal acts such as harassment and cab robberies As more and more individuals begin to use them, contemporary taxi services have grown in popularity. Some examples of these features are a system to track driver weariness, an alert that notifies the driver of their current GPS location and the nearest hospital, an automatic emergency braking mechanism, smart airbags, and GPS. used currently in some ultra-luxury settings It is not meant to serve as a template for cheap cars. For the sake of everyone within, it's crucial that the car be equipped with readily available safety features. To that end, the project's goal is to design and implement smart vehicle technologies that reduce operational costs without sacrificing effectiveness. The primary goal of this project is to demonstrate the ease with which a wide variety of sensors can be integrated into the Arduino or any micro controller system, as well as the ease with which data can be transmitted to and from the system using technologies like GSM and GPS, and the ease with which desired actions can be carried out using the actuators connected to the system.To show off our thinking and provide a research baseline in this emerging area of the IoT, we built a simple prototype. We believe our concepts can be scaled and deployed in real time with the recent advancements in the capacity to process vast volumes of data from sensors, as well as communication technologies like 5G. We outline the associated earlier work for such an issue and make the scripts available to the research community for future development, afterward, the Experimental Design is outlined where we'll be describing our unconventional methods [34]. The topic is brought to a close in the final section with a conclusion and some recommendations for the future.

The illustration depicts our concept for an upgraded version of the Smart Car, which. It has features such as a GPS Module, panic button, MQ-3 Ethanol, temperature sensor, GSM Module, rain-sensing car wiper, 3D gestures, solar power, and so on. In this context, a solar car refers to a solar vehicle, which is an automobile that may be driven on public roads or racetracks. Another feature is that there is a panic button, and whenever a passenger experiences discomfort for whatever reason, they can push the button to send an SMS that triggers an alarm message. This occurs whenever the button is pressed. MQ-3 ethanol is the standard for determining how much alcohol is present in the breath of a driver. The rain sensor's primary function is to identify instances of precipitation so that it can establish a connection with the Arduino.

1.5 Chapter Summary

In this chapter we discussed about what is Internet of things and its impact on smart car, application of IoT in Smart cars, benefit of IoT in everyday life and connected cars.A connected car is a vehicle that incorporates state-of-the-art electronics and system-driven artificial intelligence. Devices connected to the Internet of Things are employed in the smart automobile for both routine maintenance and for sending alerts to drivers. Car sharing and other services such as carpooling are examples of how the car

is shifting from a product to a service. Project aims to develop a prototype of a smart car system that is capable of providing real-time location data. Internet of Things (IoT) sensors are essential for the operation of self-driving cars. Sensors can collect environmental data in real time and communicate it to a central hub or the cloud. We believe our concepts can be scaled and deployed in real time with the capacity to process vast volumes of data from sensors, as well as communication technologies like 5G. We outline the associated earlier work for such an issue and make the scripts available to the research community for future development.

Chapter 2

Literature Review

The first step in the process of formulating our thesis was to acquire a comprehensive understanding of the primary issues, in addition to the theories and forecasts that had already been put up. This phase of the process lasted for a while. The analysis of the papers is the first step in achieving a comprehensive grasp of the academic literature that relates to the topic, which is something that we want to investigate in greater detail. By analyzing the existing body of work, one reduces the likelihood of making assumptions that have been disproven in the past. This not only increases the validity and dependability of the theories, but it also improves their plausibility. In actuality, scientific research is a process of enlarging our knowledge that is based on submitting new theories that are accepted as long as they do not contradict earlier study findings. It is true that the method cannot guarantee that the truth has been discovered because any idea that has already been established can be disproven by a new theory or experiment, but it can guarantee a steady increase in knowledge because every idea that is disproven is still replaced by one that is better and more effective at explaining the phenomenon. This body of work was written as a result of these and other contributing elements, and it took into account the most current advancements that have been made in the corpus of scholarly literature. The literature on the Smart Car was initially looked at in order to get a better understanding of how far along the research process has come in this particular area. We paid particular attention to understanding the concerns that were either better addressed or, on the other hand, ignored from the many academic papers that were analyzed in order to investigate the key areas and only look into the research areas that required more attention and investigation. In order to do this, We was able to focus my attention on the research areas that needed more attention and investigation. Because of this, it was very simple to identify any gaps in the research about the Smart Car. The second objective was to investigate possible advances in the near future that may be made in this area that would be beneficial not only to the participants but also to the user in the end. In this particular instance, secondary sources and primary research from the relevant fields were frequently merged. The research for this analysis was gleaned from a wide range of journals as well as papers delivered at various conferences. Due to the enormous number of journals that publish articles concerning this field of research, a search of the relevant literature was carried out using the search engines and electronic

databases listed below. Some of the key words that were utilized in the process of carrying out this study include internet of things, smart vehicle, internet of things-based smart car, smart car nowadays, smart car technology, automotive industry, benefit of smart car, etc.

The Internet of Things has had a huge impact on the automobile industry, and as a result, the entire concept of a car is currently being rethought. This is happening because of the connectivity that the Internet of Things provides. People want their vehicles to be able to control themselves and engage with them more effectively, in addition to having the capability of driving themselves. Because they are the most common and well-liked type of transportation, smart cars have quickly become an integral and essential component of people's day-to-day lives. As a result, the manner in which people live in every region of the world has been profoundly altered. The extensive use of automobiles has resulted in risks, such as those related to road safety and pollution, despite the fact that these modes of transportation offer benefits such as on-demand mobility, convenience, and comfort. Over the past few decades, innovative intelligent technology has been introduced to smart cars for the purpose of enhancing driving assistance and safety. This is due to the fact that automobiles have had various affects on every facet of society, as illustrated in Figure 2.1.

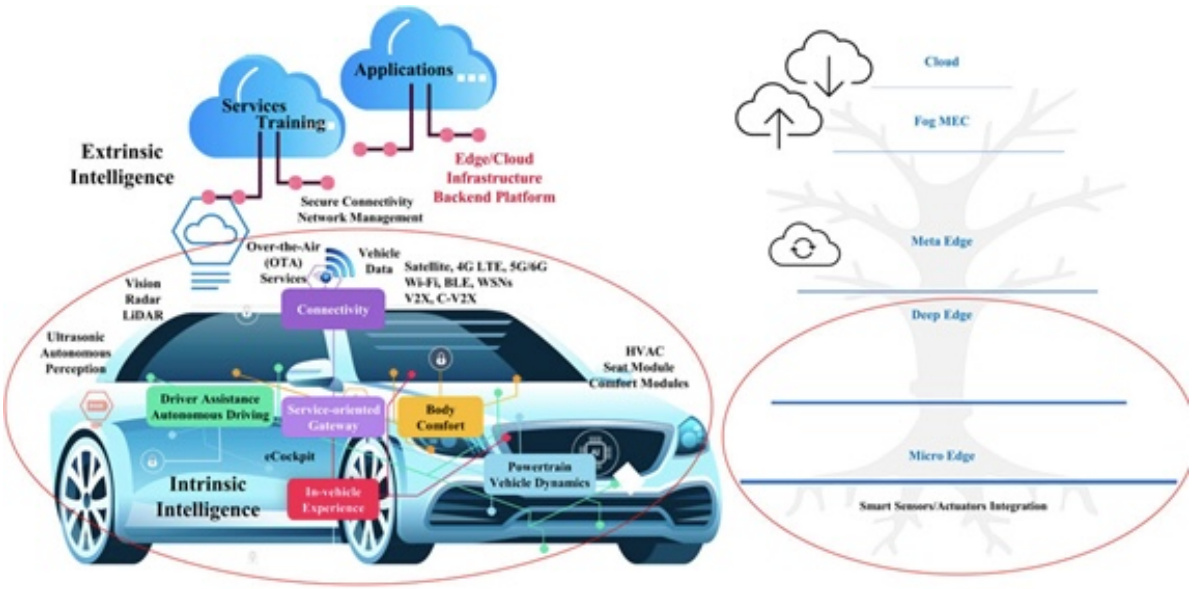

Figure 2.1: Intrinsic Intelligence and Extrinsic Intelligence of smart cars [4]

According to the IoT (Internet of Things) computational paradigm, every tangible thing has the potential to connect to the internet and be given a distinct identifier among other electronic gadgets. In reference to both the functions, such as data exchange and remote control, that are included, and the real-world items that are utilized. A few examples of this would be people, machines, sensors, electrical equipment, collections, and anything else that may be considered equipment. They are all outfitted with in-built sensors and maintain a constant connection to both local and worldwide networks .The Internet of Things provides the opportunity to automate, improve, and simplify a variety of processes while also

resolving a number of challenges. There are numerous processes that take place on a daily basis.

František DuchoËa et al [27] presents Intelligent vehicles as the robotic applications . In the article's main body, they are given an explanation of what an intelligent car is and how its automated features work.In this paper they described Full-autonomous cars are not likely to be used in regular traffic, mostly because of legal issues. So, these vehicles only use advanced control systems that help the driver. • Keeping cars from hitting each other when reversing for example, with a multi-camera system. Here they used ultrasonic sensors to make parallel parking easy. The driver pulls up to a parking spot and stops. he or she presses a button on the dashboard, which turns on the ultrasonic sensors to measure and find a good place to park .Then the system did asks the driver if they want the system to help them park. The system takes over and drives the car into the spot without you having to do anything. Still, the driver shifts the transmission and uses the gas and brake pedals based on the system's instructions . A driver interface shows and/or tells the driver about the It tells you how to drive based on how close you are to other cars, objects, and people . Here they described some advanced assistance control systems were designed for robots. Intelligent vehicles are robots. Intelligent vehicle applications require: Vehicle state (position, kinematics, dynamics Environment awareness. Driver/passenger state awareness , Vehicle-roadside infrastructure communication,Satellite and digital maps.

MassimoBertozzi et al. [28] explores the most widely used strategies for tackling the difficult challenge of autonomous driving.The motivations that led to the development of vision-based intelligent cars are discussed in Section 2 of this paper, along with an illustration of the needs for such vehicles and the particularities that distinguish them. The report comes to a conclusion with Section 4, which discusses the authors' ideas on the development of intelligent vehicles and reviews the most popular ways to autonomous road following that have been established anywhere in the globe. After analyzing the most promising experimental solutions and prototypes made throughout the world employing AI approaches to perceive the state of the environment through the use of artificial vision, they came to the following conclusion: Functionalities associated with automatic driving can be attained by operating on both infrastructures and automobiles. Either option may or may not be optimal for a given set of circumstances, depending on the details of the task at hand. Those forms of mobility, such as public transportation and industrial robotics, which are dependent on repeated and prescheduled routes may profit from improvements made to the road infrastructure. These improvements may also benefit motorists.

Shih-Chia Huang et al. [30] suggested that an advanced Smart Car demonstration platform be developed. This platform should have a windshield display that is see-through and a variety of motion sensors. Drivers would use this platform to interact with augmented reality versions of various car-related applications. Drivers have the ability to personalize their Smart Cars, which are similar to smartphones, through the free download of software that are designed specifically for use in cars. In addition, three possible applications that are relevant to cars and are related to computer vision are being researched and integrated into our platform to further enhance the safety of driving. Both the first and

second car-specific applications have the goal of improving the driver's field of vision. They do this by converting low-visibility scenes that were captured during inclement weather or nighttime driving conditions, respectively, into high-visibility scenes and displaying them on a display that is superimposed over the car's transparent windshield. In addition, we investigate strategies for tracking pedestrians that combine the information from numerous driving recorders into a mobile surveillance network. Among these techniques is a proposed framework that we have developed as the third application that is suitable for cars. The Smart Car has the ability to boost the safety of driving situations during the day and night, as well as during inclement weather, thanks to the car-appropriate applications that are embedded within the vehicle.

Abhirup Khanna and Rishi Anand [35] presents IoT based Smart Parking System . Here they mainly described A mobile application that is connected to the cloud serves as the foundation for the intelligent parking system that we suggest be put into place. A user of the system can get real-time information on the availability of parking places thanks to the system. The remaining portions of the paper are structured as follows: In Section II, we will discuss the variables that are responsible for Cloud-IoT. In the third section, they will discuss the most recent advancements in intelligent parking systems. The operation of the system as well as its implementation are discussed in Section IV. In order to demonstrate how their system operates at each step, from determining whether or not a parking spot is available to successfully parking a vehicle in a vacant spot, they carried out an experiment to simulate these processes.

Fabio Arena et al. [36] give an overview of the current status of smart automobiles as well as their potential in the future, taking into account the technological, transport, and social aspects. In this paper, an analysis is carried out concerning the methods that can be used to make a smart car that is generic, the potential developments that could take place in the following decades, the qualities of 5G, ADAS (advanced driver assistance systems), and the power sources. Other topics that are analyzed include: the approaches that can be used to make a generic smart car and the possible developments that could take place in the upcoming decades. The 5G network has the potential to assist in the protection of vulnerable road users, including pedestrians (due to their presence on a crossing), bicycles, and motorists (the presence of a connected bicycle on the road). For example, if a person is getting ready to cross the street, a device on the side of the road that is connected to the mobile network and has a camera that is able to detect the action will send an alarm message to any connected vehicles that are nearby. Communication from the infrastructure to the vehicle (also known as I2V) is taking place here. The 5G specifications can also make it easier for vehicles to share live streaming video with one another in real time. This will increase the driver's field of vision in situations with low visibility and help to reduce the risk of collisions, particularly during the phase of the trip when vehicles are passing one another.The identification of traffic signs can detect a variety of different types of restrictions, including those that ban access and overtaking. The speed restrictions that are marked not only on the road sides but also on trestle gates or in the vicinity of construction sites are captured by a video camera that is mounted on the inside of the windshield (in correspondence with the internal rearview mirror). Both the display on the instrument panel and the display on the screen for the infotainment system will show the results of a

comparison between the data taken by the camera and the information provided by the navigation system. Access and overtaking are both prohibited (including by signs signaling termination), in addition to other cautions. The camera, which is used for the detection of traffic signs, gives manufacturers the ability to integrate a broad variety of driver assistance systems, which in turn improves the safety of the vehicle.

PS SRAVANI et al. [37] developed a system for the structure of the car park that may be installed, for the purpose of screening vehicles and managing parking services. Operations based on morphology were utilized in the development of the algorithm. ORC, which stands for optical character recognition, is utilized in the process of reading the license plates of vehicles that are entering the garage. Document image recognition software was made available as part of the offering (DIR). DIR is one of the most effective methods that makes use of a database to establish a connection between the plates in question and the photographs that have been stored. Recommended A system for the recognition of license plate numbers on motor vehicles Image that is created with MATLAB, along with its projection The use of edge detection partitions and image preprocessing are both necessary steps in the creation of characters. Developed and put into operation a recognition system based on the NPR algorithm, which is a powerful real-time online technology. Developed and put into operation a recognition system based on the NPR algorithm, which is a powerful real-time online technology. A progression that has been very well planned. Methods that are based on morphological operations require, as their first step, that the placement of the plate in the figure be determined, followed by the correction of the diagonal. carries out operations related to the alphabetic and numeric splitting procedure Character. Pattern equivalence is the mechanism that underpins the recognition process.

Abhishek Das et al. [38] presents Embedded System and Internet of Things Capabilities Used in Smart Car Features In this article, they developed a car using a number of unique characteristics in an efficient manner. Here They make use of a panic button, GSM module, MQ3 alcohol, and Rain Sensing Automatic Wiper, among other things. Tracking with a GPS System Let's go over the reasons why they chose to implement these features. The panic button is there for the safety of the passengers. When a passenger presses the button, an alarm message is sent out via SMS and is raised whenever that passenger experiences fear or discomfort as a result of particular circumstances. There is potential for several panic buttons to be installed in various locations throughout the car and then connected to the Arduino. The MQ-3 Ethanol Sensor is helpful in identifying drivers who have been drinking. The MQ-3 Ethanol Sensor is attached to the steering wheel of the vehicle or the seat belt of the driver seat in order for it to be able to monitor the amount of alcohol that is present in the breath of the driver. If it is determined that it is higher than the restrictions that have been established, then the Arduino tells the GSM to send an alarm for the same thing to the driver's specified safety number (such as a home number). Other possible measures include not starting the engine of the vehicle until the proportion of alcohol in the blood has dropped. When an individual uses tobacco, whatever ethanol that is in their breath is converted to acetic acid when they exhale. At the cathode, oxygen absorbed from the surrounding air is decreased. The oxidation of ethyl alcohol is the total reaction that takes place. After measuring the charge flow created by this reaction and calculating the resistance, the Arduino will estimate the various degrees of

drunkenness that have occurred. Automatic Windshield Wiper That Detects Rain In currently available vehicles, the windshield wipers are operated manually by the driver. This function can be found in some luxury vehicles; but, due to the high expense of implementing it, it has not yet been incorporated into standard automobiles. This project proposes a more cost-effective version of it, which consists of a rain-drop sensor similar to the one shown in Figure 8 that is connected to the microcontroller, which in this instance is Arduino. The Arduino receives a signal indicating whether or not rain has been detected from the rain sensor. After receiving this signal, the Arduino will process it in order to carry out the specified operation. The rain sensor is made up of nickel tracks, and when water droplets make their way in between the tracks and connect them, the circuit is completed and the sensor is able to pick up on the presence of rain. The raindrop sensor module has a low cost as well as a high level of accuracy for detecting raindrops. The sensitivity of the sensor can be adjusted by spinning the screw that is located on the board. This location does utilize GPS Tracking. A high-performance GPS receiver that makes use of u-blox 6 positioning engines. In a compact size measuring only 160 x 122 x 24 centimeters, this receiver is both adaptable and economical, and it provides a wide variety of possibilities for establishing connectivity. Because of its small architecture as well as the power and memory options that it provides, NEO-6m modules are ideal for low-cost systems with limited space. Because it possesses an acquisition engine, as well as 2 million effective correlators, and because it is capable of making massive parallel frequency searches, it is able to locate a satellite in a relatively short amount of time. A Time to First Fix of about one to two seconds is provided by this 50-channel u-blox 6 positioning engine. These receivers have great navigation performance even when put in extremely challenging locations as a result of the anti-jamming technology and Eeprom for storing settings that are included in the design. The SIM900A modem from SIMCOM is a Dual Band GSM/ GPRS based modem that is used in the construction of the SIM900A modem. It operates on the 900 MHz and 1800 MHz frequencies. The SIM900A is able to automatically search for these two bands. Through the use of the AT command, the baud rate can be adjusted from 1200 to 115200. This is a complete GSM module that comes in an SMT type and was developed with a very strong single-chip CPU that integrates an AMR926EJ-S core. As a result, you will be able to take advantage of solutions that are both compact and economical.

Qiuleji et al. [39] present the Intelligent Vehicle Driven by Laser Control In this article, they mostly discussed the idea behind, and their experience designing, a self-directed smart car module that was based on the chip XS128 that was manufactured by the Freecale firm.The design of this car primarily incorporates a number of modules, the most important of which are the control processing chip MC9S12XS128MAL, the laser sensor module, the servo drive module, the motor drive module, and the speed sensors. The power supply is a Ni-cd battery with 2000mAh and 7.2V. The motor drive is made up of two different BTS7960 components. And Omron's speed sensors utilize their brand's exclusive photoelectric encoder technology. Additionally, a laser sensor schematic was utilized by them. The launching circuit and the receiving circuit are the primary components of the laser sensor diagram. First, the emission part, which passes through the modulated tube, will output the frequency of 180 kHz. This is the frequency that will then drive the emission tube after the amplification transistor, which is

what caused the emission tube to emit 650 nm light by the frequency of 180 khz.

Rustam Rakhimov Igorevich and Dugki Min* [40] present use Case Analysis of Big Data for Smart Cars In this section, they described how the Smart Car uses the MQTT protocol to communicate with the IoT Server in order to send the sensor and video data that it generates. Once the sensor and video data have been transferred to the IoT Server, it is then saved in HDFS so that it can undergo additional processing, and the final processed data are stored in MongoDB. Through the widely used REST web interface, the owner of a Smart Car has access to a variety of services and recommendations made available by the IoT Server. In this work, we present an integration of Big Data and the architecture of a Dynamic Reconfigurable Internet of Things Framework. This use case example exhibits the infrastructure of the interaction between an IoT Gateway and an IoT Server so that services can be provided for Smart Cars. IoT Server Architecture incorporates a NoSQL database for storing the sensor and video data that is generated by cars.

S.Architects [5] presents the usage of automobiles as part of a larger system for predictive maintenance, vehicle connectivity, fleet management, etc., the term ”Automotive IoT” is often used to describe the incorporation of various components, such as sensors, gadgets, clouds, and apps. IoT embedded solutions have made vehicles ”almost as smart as a computer.” The widespread interest in autonomous vehicles is only one example of the many technological advances made possible by the Internet of Things for the manufacturing sector. It’s a huge foundation upon which to build new IT capabilities. Depending on your tastes, a car can play a selection of podcasts for you to listen to on the road. It will drop you off at your destination and find a parking lot on its own. After finishing up, you’ll simply use your smartphone to call your automobile to where you are and drive back home.It might sound far-fetched at first, but it’s closer than you think. With the continued growth of the Internet of Things in the automobile industry, all of this will become a reality. The IoT is already deeply implanted in vehicles, and by the end of 2020, there will have been 470 million such endpoints, generating 389 billion in global income. With a projected CAGR of 16.4 percentage between 2018 and 2025, the automotive IoT market is poised to become a 541.73 billion industry by 2025, proving the trend’s explosive growth potential.

ttnews article [41] presents autonomous vehicles are the future, and they may soon render everyone in a car or truck nothing more than a passenger. ”Smart” technology is gradually being integrated into automobiles and trucks, and this trend will only accelerate in the near future.Taking the human driver, the automobile’s weak link, out of the equation, smart automobiles will supposedly make the roads immensely safer, according to experts.Professional services firm KPMG predicted in a June analysis on the effects of autonomous vehicles on the insurance market that the number of accidents would drop by 90 percentage by 2050.Researchers believe this is possible because the computer ”brain” controlling autonomous automobiles and trucks may be trained to make better decisions than humans can. Human error accounts for 94 percentage of all car accidents that occur today.

Matthew David [42] presents these days a car is a necessity. A LOT. In her book Carjacked: The

Culture of the Automobile and Its Effect on Our Lives, Anne Lutz Fernandez claims that the typical American spends more than 18 hours a week in their vehicle. There's a lot of driving involved there. Surely the platform of the future will need to be mobile, right? Vehicles with high levels of intelligence.In the media nowadays, we see connected cars. These "smart" vehicles have been around for a while. Long-distance travel necessitates the use of a global positioning system (GPS), which has been around for over a decade, just as diagnostic data that evaluates the health of your vehicle has been around for over a decade and iPods have been plugged into cigarette lighters for over a decade. Next-generation "smart" automobiles are now in sight.It's not easy to bring a culture around to the idea of change. "Culture will eat strategy for lunch," as Peter Drucker put it. There is little point in having a technically brilliant solution if consumers don't understand the implications for their own life. Microsoft pioneered the widespread use of tablets, wearables, streaming audio, and touch interfaces. Microsoft's Surface table, SPOT watch, Zune music service, and Windows XP for tablets are all fantastic concepts that nobody needs.The time for smart cars has come. Consider. How frequently do you hook your cell phone up to your car stereo? Although I now make my home in the United States, my love for London radio shows remains undimmed. While I'm driving, I listen to British radio on my phone.It makes logical to have smarter cars. Disconnect my phone from my automobile. There has to be BBC Radio for cars.The second part deals with connectivity. Smartphones, with their continual connection to the internet, aid in their success. You do mindless things like opening emails, starting Pandora, and logging into Facebook. Connectivity is essential for autonomous vehicles.Another problem is traveling with a large group of people in your car. To what extent would you say that you use carpooling? While driving, they might want to utilize a tablet (like streaming Dora the Explorer to your three-year-old in the back seat). A 4G/LTE data connection must be established, and the car's Wi-Fi system must relay that data to each passenger. This is not difficult to accomplish at 65 miles per hour on the freeway.The next thing your vehicle has to pick up is the ability to talk to others like it. Waze, which is now integrated with Google Maps, enables communication between drivers (vehicles report when the car is stuck in traffic and reports the data back to Google Maps so that you can get alternative directions). Soon, cars will be able to talk to each other. The advantages are enormous, as vehicles will be able to detect each other across lanes to prevent collisions. The use of autonomous vehicles is on the rise.The radios in smart cars are a first step. Check the status of your vehicle by hooking up to its diagnostics system. Manufacturers of automobiles increasingly provide customer service in the form of maintenance prediction systems. It's more cost-effective to perform preventative maintenance than emergency repairs.The third part of the linked car — the technology — is already on the market.There has always been a need for more technological features in automobiles. This year saw the introduction of both Apple CarPlay and the Android-based Open Automotive Alliance from Google.Distractions while driving pose a significant challenge for this technology. Texting while driving now poses a greater danger than drinking and driving. The safety of drivers and passengers is the top priority for any automobile technology.

2.1 Chapter Summary

In this chapter we discussed about the fundamental issues, hypotheses, and projections led to our thesis. Analyzing past research reduces assumptions. Studying potential improvements for participants and users was the goal. Relevant articles in this section describe safety and traffic solutions that make use of a variety of sensors that are enabled by artificial intelligence, ideas for autonomous roads and prototypes that make use of AI techniques,the enhanced Smart Car that was proposed featured a display that was embedded in the windshield and other motion sensors, the development of a smart parking system, the current status and future perspectives of smart cars and information regarding the internet of things.

Chapter 3

Internet of Things in Automotive Industry

3.1 Automotive Industry

The inclusion of elements such as sensors, gadgets, clouds, and applications into vehicles and their utilization as a complex system for fleet management, predictive maintenance, and other activities is referred to as ”Automotive IOT.” Because of inbuilt IoT technology, modern automobiles have been described as having ”near-artificial intelligence.” Because of the Internet of Things, manufacturers now have the ability to implement a wide variety of enhancements, including self-driving cars, which are currently one of the most discussed topics in the business. It is a significant platform for broadening the range of possibilities in information technology.

Imagine that when you leave the house one day, your vehicle is already waiting for you in the driveway, having been called from the garage because it is aware that you have a ride planned for today, in line with the calendar that you keep. This will give you a realistic idea of the potential of automotive IOT. A car will stream some podcasts that you've chosen while you're driving. When you get there, it will drop you off and go off by itself to find a parking space. After finishing your tasks, you may just click on your smartphone to have your automobile arrive where you are standing and drive home.One industry where the Internet of Things has been quite beneficial for both car manufacturers and consumers are the automotive sector. The benefits of using the Internet of Things in the automobile manufacturing process are as follows:

1. Reducing risk of possible dangers and financial damage.
2. Increased workplace safety and equipment theft monitoring.
3. Mobile app access to automotive information (recent vehicle models allow you to start the engine, check the fuel level, and even locate your car in a parking lot with just a single click).
4. The ability to get predictive analytics about a car's condition, which allows you to cut costs and improve driving safety.

5. Enhanced in-car infotainment, etc.

Figure 3.1: Automotive Industry Infrastructure [5]

It is imperative that the fact that self-driving cars are the wave of the future in the automobile industry be brought to people's attention. These autos offer drivers and passengers an increased level of comfort while maintaining a high level of safety on the road. Because of the combination of various Internet of Things devices in automobiles, including cameras, sensors, radars, inertial measurement units (IMU), and so on, there are a lot of prospects for the development of the Internet of Things for automobiles.

The development of autonomous vehicles (AV) combined with the application of IOT will have a positive impact on the environment. The new Robo Taxi service, for instance, has already been publicized by Tesla. Each Tesla owner will be able to use the app to add their vehicle to Robotaxi's service and specify certain times when they are willing to let others use it. In addition to providing an opportunity for automobile owners to cover their maintenance costs, this will help to reduce the number of cars on the road and air pollution. The Society of Automotive Engineers established a grading system for automated driving (SAE). To find out more about it, look through the ensuing infographic.

IOT has a big impact on the overall car concept, which is currently being actively reviewed in the automotive industry. This is because of the impact that IOT has. People want their autos to have a comprehensive software platform that is capable of self-driving and that makes it easier to control and engage with the vehicle. The Internet of Things presents automakers with opportunities to improve not only their production processes but also the components found within their automobiles. One of the popular topics these days is car maintenance, which contributes to fuel economy, car safety, as well as in-vehicle electronic entertainment, because driving in today's world is shifting from being a stressful management of the road to being an interesting journey for drivers [43].

The automobile industry has been around for a while and has developed since then, but the huge shift from human-driven to autonomous vehicles that is currently occurring will have a long-lasting impact on society. Since they can link to cellphones, offer emergency roadside help, record real-time traffic alerts,

and perform other similar functions, today's vehicles are already connected and have been for some time. However, this tendency will change. Actually, in the automobile sector, the term "Internet of Things" refers to a complex network of gadgets (such as sensors, cameras, and GPS trackers) that are linked to the cloud and offer real-time data. With the help of this information, vehicle manufacturing procedures may be improved, and transportation systems can be managed more effectively. By enabling predictive maintenance, direct vehicle-to-vehicle communication, artificial intelligence-powered driving assistance, and other cutting-edge features, IoT solutions turn vehicles into intelligent modes of transportation that improve road safety and driving efficiency for both individuals and businesses. Implementing IOT in the auto sector has the potential to automate production processes, reduce the likelihood of human mistake, and enhance quality control.

The automotive industry is one of the many sectors that has been significantly influenced by technology in recent years. As new technologies emerge, existing ones find new uses and applications in the process of designing and manufacturing automobiles. In general, the application of technology provides consumers and the automotive industry with benefits; yet, technology application can also have negatives or express an obvious lack of acceptability from consumers. It is realistic to predict that the automobile sector will follow suit, particularly in terms of how electronic technologies are utilized, given the constant evolution of technology. This is particularly true in terms of how electronic technologies are used. Therefore, the fledgling environment of new technologies in the automotive sector has important repercussions for successfully undertaking market research and realizing the correct implementation of that research. Specifically, this is because of the following: Particularly in view of the possible advantages and disadvantages that could be brought about by technological advancements, the automotive industry has placed an increased emphasis on the importance of safety. There have been developments in technology concepts that have made it possible for car manufacturers to capitalize on the concept of consumer safety, a strategy that is frequently an essential component in the process of recruiting customers [44]. The development and application of technology in the automobile industry has always been driven in large part by the creation and implementation of features that increase vehicle safety. This has been the case for as long as the industry has existed. Despite the fact that components such as airbags and anti-lock brake systems may no longer be regarded as ground-breaking ideas, new technologies continue to address even the most unremarkable aspects of the functionality of automobiles. This is the case even though these technologies have been around for quite some time.

3.2 Applications of IOT in automotive software development

The Internet of Things, known as IoT, is a term that refers to a network of devices that are able to connect with one another over the internet. This makes it possible for highly developed automotive technology, such as electrical components, actuators, and sensors, to communicate with one another and with other online-connected vehicles. IoT solutions have a lot to offer automobiles and will likely have an infinite number of applications as technology advances. The already available WiFi capabilities, engine performance measurements, and climate control systems are merely the tip of the iceberg. In light

of this, the following are four ways in which the Internet of Things (IoT) technology is shaping the future of the automotive sector [45].

Because of the Internet of Things and other preseason technologies, the whole automotive industry is currently going through a period of transition. The progression of this business has led to the production of cutting-edge automobiles that are connected to the internet and can drive themselves. Through its utilization, auto maintenance and inspection capabilities have been enhanced, and new entertainment channels have been made available. A fleet management system that is powered by the Internet of Things has been developed with the assistance of long-distance data transfer made feasible by automotive telematics [32].Every day, more Internet of Things applications are being developed for use in the automotive industry. The advancement of technology related to the Internet of Things will result in the introduction of increasingly complex automotive use cases, which will result in a fundamental shift in the way that we interact with our vehicles.

3.3 Connected cars

Cars that are connected to the Internet of Things can facilitate the rapid transfer of critical data, which can improve overall traffic safety by enhancing communication. Smart cars can forecast and avoid accidents and warn drivers of approaching emergency vehicles by sharing position, speed, and dynamics information when they are connected to one another [46]. Connectivity between vehicles and other networks allows for the communication of information to drivers regarding things such as traffic lights, accidents, and weather forecasts. This not only improves the flow of traffic, but it also makes the roads safer and provides drivers with the information they need to select routes and evaluate the state of the roads. Connected automobiles offer rapid data transmission and increase drivers' reaction times by virtue of their greater ability to link to other vehicles. Vehicle data is being transported all over the world and is interacting with local infrastructure, people, and devices in a variety of ways, including:

3.3.1 Vehicle to Vehicle (V2V)

A vehicle-to-vehicle, or V2V, link enables vehicles in close proximity to communicate and share data with one another. The vast majority of the data consists of information that pertains to location, speed, and dynamics. Because of the technology that underpins V2V communication, automobiles have the ability to both receive and send directional messages. This provides them with a "awareness" of other surrounding vehicles in every direction. Vehicles that are equipped with the appropriate software can make use of the messages sent by surrounding vehicles in order to identify potential collision hazards as they arise. After then, the device is able to warn drivers by a mix of audible, tactile, and visual alarms, or through any one of them individually. It is possible for drivers to take preventative measures in response to these indications in order to avoid collisions. These V2V communication messages can detect risks that are hidden by weather, environment, or traffic and have a range of more than 300 meters. The present accident avoidance systems, which employ radars and cameras to identify potential collisions, are extended and improved via V2V communication. With the use of this new technology, drivers can

prevent collisions altogether rather than just surviving them. The V2V communication system might be used by a wide variety of vehicles, including motorcycles, automobiles, lorries, and buses. It is possible that in the not too distant future, walkers and cyclists alike will employ V2V communication technology in order to improve their visibility to motorists. In addition, there are technical measures that can be used to prevent automobile monitoring and system tampering. Furthermore, the information about the vehicle that is provided does not identify the driver or the vehicle. The performance of vehicle safety systems can be improved via V2V communication technology, which could save lives.

3.3.2 Vehicle to infrastructure (V2I)

A V2I connection is the term used to describe a network that consists of cars and road infrastructures. V2I technology makes it feasible for information to be transferred between vehicles and the road infrastructure in both directions through the use of wireless communication. The primary objective of this mode of communication is to make it possible for safety applications to be implemented, such as the prevention of automobile collisions brought on by a variety of factors including hazardous road conditions, inclement weather, road construction on the side of the road, or malfunctioning traffic lights. The driver is provided with notifications regarding potential hazards like as traffic jams, accidents, sharp curves, and appropriate speeds. The technology known as vehicle-to-infrastructure, or V2I, connects automobiles, infrastructures, and passengers in a reliable network framework. Within this framework, all parties can communicate and share information regarding the weather, road conditions, traffic conditions, traffic jams, sharp curves, and even accidents. This network provides a Non-Line of Sight operation with a range of up to 100 meters and functions with great accuracy in situations where there is major traffic bottleneck, poor weather, or potential dangers. Prioritizing public transportation when approaching a traffic light is possible. For autonomous cars to be able to accurately predict the status of approaching traffic lights, V2I is essential. V2I assists autonomous vehicles in terms of mobility and safety by allowing the infrastructure to alert drivers to upcoming dangers and by enhancing traffic flow.

3.3.3 Vehicle to pedestrians (V2P)

According to the Vehicle to Pedestrian network, a pedestrian and a car are able to speak with one another directly. Bicyclists are an example of another potentially susceptible road user group that might be brought under the V2P umbrella. Signals will be broadcast to these pedestrians if they are in close proximity to an automobile. The signs alert drivers to the presence of approaching pedestrians, and they also alert pedestrians to the presence of cars in the area. When considered from the point of view of pedestrians, the conventional warnings or safety messages may provide exhaustive information regarding the vehicle. It offers information about the speed of the approaching car as well as its location and direction. In-vehicle technologies have been developed with the intention of determining the sources of traffic that are not caused by automobiles. This strategy can serve as a warning to motorists who may have ignored blind spots or failed to account for the possibility of an accident. The possibility exists if one makes use of modern technology, such as GPS tracking for vehicle fleets. Telemetry data can be captured either through the dashboard cameras or by recorders brought in from the outside. To guarantee

that all passengers always buckle up, sensors can be added to the seat belts. When people are nearing the bus, the Pedestrian in Signalized Pedestrian paths warning application alerts the bus driver. Additionally, while approaching a signalized intersection, it warns them when pedestrians are in the crosswalk.

3.3.4 Vehicle to network (V2N)

The goal of vehicle to network is to send data between the management system and the vehicles. High-bandwidth, low-latency, and very reliable network infrastructure enable this process. Broadcast alerts about accidents or traffic jams further down the road can be received by cars, paving the path for autonomous driving in the age of mobility. The objective is to increase road safety by offering extensive recommendations regarding actual route updates and improving car connectivity. Data centers are incorporated into the systems that link vehicles to networks to provide reliable access and consistent communication. It's possible that the car will link to high-latency cellular networks and the cloud in order to acquire continuous broadcast notifications on the latest traffic and road upgrades. For example, well-known smartphone applications such as Waze and Google Maps collect data on the current traffic situation in order to assist drivers on their journey. The V2N network also allows for the communication of vehicles with one another. However accurate the information on traffic updates and navigation may be provided by third-party applications, their technology has its limitations. Vehicles can rely on the good judgment of others to provide direction for an often unexpected phenomena on the road. Automobiles are able to make direct contact with one another in order to exchange information regarding their location, speed, and general status. Useful and informative technologies such as left turn assist (LTA) and intersection movement assist (IMA) make it possible for vehicles to communicate with one another directly. These technologies, along with others like them, contribute to an overall increase in the safety of roads. People in cars have the ability to talk to drivers of other vehicles as they move through intersections or make left turns so that they can alert those drivers to the likelihood of an accident occurring. Concurrently, the Vehicle to Network systems can also trigger pedestrian devices, which are also referred to as V2P, to avoid any potential collisions that may take place. Signals are sent by V2N to road infrastructures such as traffic lights so that they can be programmed to change at regular intervals. For instance, it modifies the rate at which the signal changes in accordance with the specified times of the day or when vehicles drive over sensors embedded in the roadway.

3.3.5 Car-Device (V2D)

Vehicle-to-device The V2D communication protocol is a subclass of the V2X protocol that enables automobiles to interact with any smart device via Bluetooth. Apple Car Play and Google Android Auto are two platforms that enable mobile devices such as smartphones, tablets, and wearables to communicate with the infotainment system in a vehicle.

3.3.6 Vehicle to Cloud Whitepaper (V2C)

V2C data sharing uses V2N access to broadband cellular mobile networks. This technology's uses:

1. OTA (OVER-THE-AIR) upgrades car software.
2. DSRC (Dedicated short-range communication) redundancy.
3. Remote diagnostics.
4. Cloud-connected household appliances communicate bidirectionally (IOT).
5. Digital assistant bidirectional communication.

V2C may soon be crucial to shared mobility. Car sharing might automatically modify seat position, mirrors, radio stations, and more based on drivers' cloud-stored preferences.

3.3.7 Vehicle-to-Grid (V2G)

Communication between plug-in hybrid vehicles (PHEV), battery electric vehicles (BEV), and hydrogen fuel cell vehicles (HFCEV) and the smart grid is known as vehicle-to-grid, or V2G for short. This relatively new form of V2X technology promotes the electrification of transportation by exchanging data in both directions between the vehicles and the smart grid. Connectivity between vehicles and grids will facilitate load balancing on the next-generation electric grid and lead to decreased monthly power bills.

3.3.8 IoT Based Predictive Maintenance

When an automobile is manufactured with Internet of Things capabilities, the integrated sensors collect data on the operation of individual components and upload it to the cloud. These data are processed there by predictive analytics, which then identify the chance of failure, evaluate the health of specific parts, and analyze their overall condition. After that, the driver is notified of any faults and provided information regarding prospective service and repairs to the vehicle. Customers in the commercial and industrial sectors can take advantage of predictive maintenance, which can be used, for example, to monitor fleet performance or to improve the user experience for individual owners. A real-time view of the condition and dependability of industrial machinery requires data collecting from a range of the system's sensors. As a result, predictive maintenance is a very complicated process to perform. This plan for servicing is prepared over the course of four distinct stages:

1. The system's various sensors being used to collect data.
2. Processing of data.
3. Identification and prognosis of faults.
4. Making a decision regarding the maintenance plan.

3.3.9 Autonomous vehicles

The development of autonomous vehicles is gaining traction in the automobile industry as artificial intelligence (AI) and automation technology continues to grow. These so-called "intelligent" automobiles help drivers with duties such as driving, braking, parking, and changing lanes, making them useful for

both professional drivers and commuters. The elimination of human mistake on the road is one of the primary benefits that will result from integrating IoT solutions like these into newly designed vehicles.

3.3.10 Shared Mobility

As a consequence of linked autos, new types of business models have come into existence. These models place an emphasis on shared mobility as an alternative to the conventional ownership of vehicles. As a direct consequence of this, the ownership of underutilized automobiles is discouraged, and mobility as a service (MaaS) is made possible. These solutions fulfill the requirements of a municipality or a business without the need to purchase extra vehicles, thereby reducing fleet wait times and the pollution caused by gasoline or diesel vehicles [32].

3.3.11 Self driving/ Driver-less Car

A vehicle that is designed to sense its surroundings and drive without any assistance from a human operator is referred to as an autonomous automobile, self-driving car, or driver-less car. Because of the ongoing progress made in self-driving cars, the network communication between the vehicle and the surrounding environment is expected to improve, resulting in an entirely new kind of driving experience. Once the destination has been selected, the IoT-powered self-driving car is able to operate under its own direction and communicates with both its surroundings and the traffic that is already there [28]. Drivers of self-driving cars will have the luxury of being able to use their mobile phones, laptops, and other electronic devices without the slightest bit of anxiety.

3.3.12 Fleet Management and Telematics in vehicles

The Internet of Things adds new and sophisticated capabilities to fleet management, which in turn makes the process more cost-effective and reduces the need for human processes. The Internet of Things sensors that are built into vehicles capture data in real time about a variety of factors, including the vehicle's speed, location, load, fuel consumption, and driver behavior. utilizing IOT analytics systems to extract useful information from these datasets. Monitor the driving patterns of their personnel, check the performance of their vehicles, and implement preventative maintenance to reduce the likelihood of disruptions to their business. The availability of in-car Wi-Fi capabilities that are enabled by 4G LTE connections has made it possible for Internet of Things-based autos to incorporate telematics functions. The process of transmitting digital information over great distances in a decentralized manner is referred to as "telematics." If a person owns a car and uses vehicular telematics, they are able to keep a bird's eye view of their vehicle even while they are in a remote place. By implementing a dashboard that is compatible with smartphones, car owners can have unwavering confidence in the constancy of their vehicle's security, ability to conduct surveillance, and overall safety. An application running on a mobile device collects data from external sensors and cameras that monitor the state of the car and communicate their findings. These sensors and cameras are located outside the vehicle. The telematics system and the real-time warning system will sound an alarm on the owner's smartphone if an unauthorized individual

makes an aggressive attempt to enter the vehicle without the proper access credentials. In the event of a critical situation, the Internet of Things–enabled smart car will immediately make contact with the relevant authorities, such as an ambulance or a fire department.

3.3.13 Infotainment systems

A wide range of services can be accessed through infotainment control systems in vehicles that are made possible by the internet of things (IoT), including music streaming, navigation, voice assistance, hands-free calling, and more. Cloud-based services provided by Volvo, some of which include an upgraded navigation system with 3D maps, free map updates, an ability to remotely submit destination directions, etc.Wi-Fi capabilities have also been responsible for the development of intelligent entertainment systems, in addition to other aspects of smart cars. The owners can connect their smartphone to a variety of components in their vehicle, such as the music system and the GPS, and control those components from a distance. At the moment, there are a number of applications, both built-in and third-party, that may be utilized by a person in order to connect their vehicle with their mobile device. The accessibility of voice commands within these applications enables a person to play their preferred music, stream a video, or answer calls without even moving a finger. The onboard navigation and extensive information about neighboring gas stations, restaurants, and other sites of interest may be accessed using the GPS and GNSS system that is integrated into the infotainment systems.The software is able to operate a variety of different aspects of the computer in a BMW, including the vehicle's information, entertainment, navigation, communication, and media controls. Additionally, it is able to easily integrate with the internet connection on a phone.

3.4 Chapter Summary

In this chapter, we have presented the knowledge that is already available in the Automotive Industry, which will give a realistic sense of the possibilities of automotive IOT. This chapter discusses the lessons that were learned regarding the benefits of utilizing the Internet of Things in the manufacturing of automobiles, its impact on the overall car concept, and the applications of IOT in the development of automotive software and connected cars, which can improve overall traffic safety by enhancing communication. After that, it discusses an important factor that should be taken into consideration during the development of automobile software: Vehicle to Vehicle (V2V), Vehicle to Infrastructure (V2I), Vehicle to Pedestrians (V2P), Vehicle to Network (V2N), Car-Device (V2D), Vehicle to Cloud White paper (V2C), and Vehicle-to-Grid (V2G) . The chapter that preceded after this Internet of Things-based predictive maintenance, autonomous vehicles, shared mobility, fleet management and telematics in vehicles, information and entertainment systems, and driver-less cars.

Chapter 4

Smart Car Features

The automotive industry is experiencing rapid technological advancement, and the general level of sophistication of automobiles now in use is growing daily. On the other hand, the safety of both the riders and the cars is an important consideration. Every vehicle needs to have proper safety measures taken. The purpose of this article is to provide new safety features for vehicles that also allow access to the vehicle's locations in real time. The first version of our product will have components such as an accident detection and alarm system, an alert for drunk drivers, a passenger safety button, and automatic airbag triggering. This prototype was created using a combination of different kinds of modules and sensors in addition to hardware. These include an acceleration meter (ADXL335) sensor to identify accidents, a Buzzer alcohol sensor to determine whether or not the driver is intoxicated, GPS and GSM modules to locate the car's location and to send an alert notification or message to the authority that is closest to the car [47].

4.1 Head-Up Display

A head-up display (as shown in Figure 4.1), often known as a HUD, projects information exactly where it is needed to be seen, in the user's direct line of sight. It is not necessary for drivers to look down at the instrument cluster or at the secondary display in order to obtain vital information such as the current speed, the presence of any warning signals, and the indicator arrows for navigation. Head-up displays allow you to do both of these things at once: keep up with your information feed and maintain your eyes on the road ahead. The windshield display can be customized to show any information of your choosing. It's helpful for multitasking because you can quickly check your speed and heading.

4.2 Raspbeery Pi Dual Dash Camera

If you have ever had the misfortune of being involved in a car accident, you are well aware of how terrifying and expensive the experience can be. Dash cams are a wonderful investment for safety since

Figure 4.1: Hud-up display [6]

they allow drivers to prepare ahead and protect themselves, which is why it's always advisable to protect yourself and plan ahead in the figure 4.2.

Figure 4.2: Raspberry-pi-Dual Dash Camera [7]

Dash cams are just one example of how developments in technology have simplified our driving experiences and made our lives overall much easier. The term "dual-lens dash cam" refers to a camera that may record the scene in front of the vehicle as well as other viewpoints from the vehicle, such as

those to the side or behind the driver. This equipment is ideal for capturing clear footage of accidents and other situations on the road in a more comprehensive way. It also has other applications. Drivers are able to view what is going on outside of their vehicles thanks to the use of dual-lens cameras, which can either assist them avoid accidents or provide a more well-rounded decision-making process in the event that an accident does occur. Here are some considerations to make when deciding whether or not a dash camera with two lenses is right for you.

4.3 Raspberry pi navigation System

The Global Positioning System (GPS) in a car's navigation system can use satellites to determine where the vehicle currently is. The system will make use of data from the cellular network in the event that GPS data is unavailable. Additionally, the system is able to retrieve data from other linked devices and provide up-to-date information regarding vehicular traffic and accidents in the figure 4.3

Figure 4.3: Raspberry-pi-Dual Navigation System [8]

4.4 Vehicular Communication System

Computer networks known as vehicular communication systems consist of communicating nodes located in vehicles and roadside units. These nodes share information with one another, including safety warnings

and traffic data, as part of the network. They have the potential to be useful in reducing the occurrence of accidents and alleviating congestion in the figure 4.4

Figure 4.4: Vehicular Communation System [9]

4.5 System of 3D Gesture

An interactive sensor that recognizes and tracks 3D gestures in motion, the robot 3D gesture sensor includes both of these features. The rotation and movement directions that can be detected by this gesture sensor are clockwise and counterclockwise, respectively in the figure 4.5
The design of the gesture sensor is based on the GestIC® technology that is protected by a patent held by Microchip. This sensor makes use of electric near field sensing technology and features a 3D gesture input sensing system as well as an advanced 3D signal processing unit. The accurate detecting range is between 0 and 10 centimeters. A variety of interactive applications could benefit from the use of this gesture sensor.

4.6 Gesture Control

The interpretation of human gestures through the use of computer algorithms is the core focus of the field of gesture control, which is studied in both computer science and language technology. Users are able to engage with and control a system without having direct physical touch because gesture control devices have the ability to recognize and interpret movements of the human body. Gestures can begin from any motion or state in the body, but the hand is the most common location from which they emerge.

Figure 4.5: System of 3D Gesture [10]

4.7 Camera systems (2D/3D)

The camera serves as an input for many different gesture control applications. There are, in point of fact, already a number of solutions available on the market that make use of the cameras found on smartphones in order to construct mobile apps with gesture control features.In the real of automobiles, BMW has been at the forefront of innovation by incorporating gesture control into some of their most recent models. Their method enables drivers to control certain aspects of the navigation system (IDrive) by making hand gestures that are recorded by a three-dimensional camera. The camera, which is integrated into the roof lining, examines the space in front of the dashboard in order to identify any gestures that are being made. Depending on the apparatus, a variety of different functions can be carried out in the figure 4.6

4.8 Vision Using Computers

Algorithms in computer vision technology designed to function as a whole system have to be reliable and effective. computing and processing sensor data into a usable form, be it numerical or symbolic. The Smart Car's central processing unit is based on this methodology.

4.9 System for the Advanced Assistance of Drivers (ADAS)

ADAS automate car systems for safety and improved driving. Technologies that warn drivers of possible issues prevent crashes. Even to avoid collisions by introducing protections of the vehicle.Adaptive features may reveal driver blind spot, closing vehicle sensing, auto adjust lighting, adaptive cruise control, automate braking, traffic weather warnings.ADAS makes drivers feel protected in life-threatening situations.

Figure 4.6: 360 Degree IOT Based Smart Car [11]

4.10 Smart Breaking System

The loss of life due to a traffic accident is one of the worst possible outcomes that can occur on the road. Human error, such as a driver's slow reaction time, is a major contributor to these mishaps. When the driver realizes he or she is about to crash, they often feel anxious and fail to use the brakes with the necessary amount of force, leading to a collision.

To keep passengers and drivers safe in situations where human monitoring is compromised, vehicles are equipped with collision avoidance systems that automatically apply the brakes when the calculated time to impact (tc) drops below a certain threshold (tr).

Using data from ultrasonic and hall effect sensors, this system will keep a running tally of how long it took for a collision to occur based on the relative speeds and distances of the cars involved.When vehicles are perpendicular to one another, this system can still function efficiently. If your car already has an Antilock Braking Technology (ABS), this system will cooperate with it to provide you even more command when you need to brake.

4.11 Solar Powered Car

Solar-powered automobiles, much like solar-powered houses, transform the sun's rays into usable electricity to power their onboard propulsion systems. This electricity provides fuel for the battery, which in turn powers the motor of the vehicle. Some solar-powered automobiles bypass the use of batteries altogether and send the electricity from the panels directly to an electric motor. Solar cars created by the University of Michigan, the Massachusetts Institute of Technology (MIT), and the University of California, Berkeley are three excellent examples of the most recent solar-powered automobiles.
Connected solar power vehicle Solar cars derive their power from the sun by utilizing photovoltaic cells, which convert sunlight into usable electricity. Solar panels are made up of a variety of components known as photovoltaic cells. These cells are responsible for converting the energy from the sun into electricity. They are composed of light-absorbing semiconductors, which are typically constructed of silicon. The energy from the sun liberates electrons trapped in semiconductors, which results in the production of an electron flow. This flow results in the generation of electricity, which in turn fuels both the battery and the specialized motor in solar automobiles.

4.11.1 Connect a solar panel to a car

It's feasible that you could leave the automobile linked to a battery maintainer if it were parked at your house; however, this is not practical when you are away from a mains socket. Fortunately, there is an alternative: a solar panel that has a connector that can be hooked into the diagnostic port of the vehicle On-Board Diagnostics (OBD).Solar automobiles offer a number of important advantages. Their solar panels are designed to operate quietly, so that they do not contribute to the noise pollution that is already present on the road. In contrast to gasoline engines, solar panels do not contribute to the emission of greenhouse gases. Most importantly, solar energy does not cost anything, it is readily available, and it enables drivers of solar cars to be completely independent from their reliance on foreign oil in the figure 4.7

4.12 Enhancing and protecting in-car functioning with Long-Term Evolution (LTE)

At the moment, connected automobiles in some countries make use of the 4G LTE connectivity, which provides quicker internet connections and ensures a smoother user experience. However, the future of the Internet of Things is 5G, which is the 5G version of LTE.
While BMW was among the first automakers to reveal LTE integration in their vehicles (2012), many others, like Audi and Vauxhall (GM), have subsequently released automobiles that make use of this technology.The proliferation of smartphones was a major factor in the development of LTE. Automakers were unable to guarantee a risk-free user experience as more passengers relied on mobile devices for navigation and entertainment.
According to official statistics, around 6,400 people lost their lives and 25 percrntage of all accidents

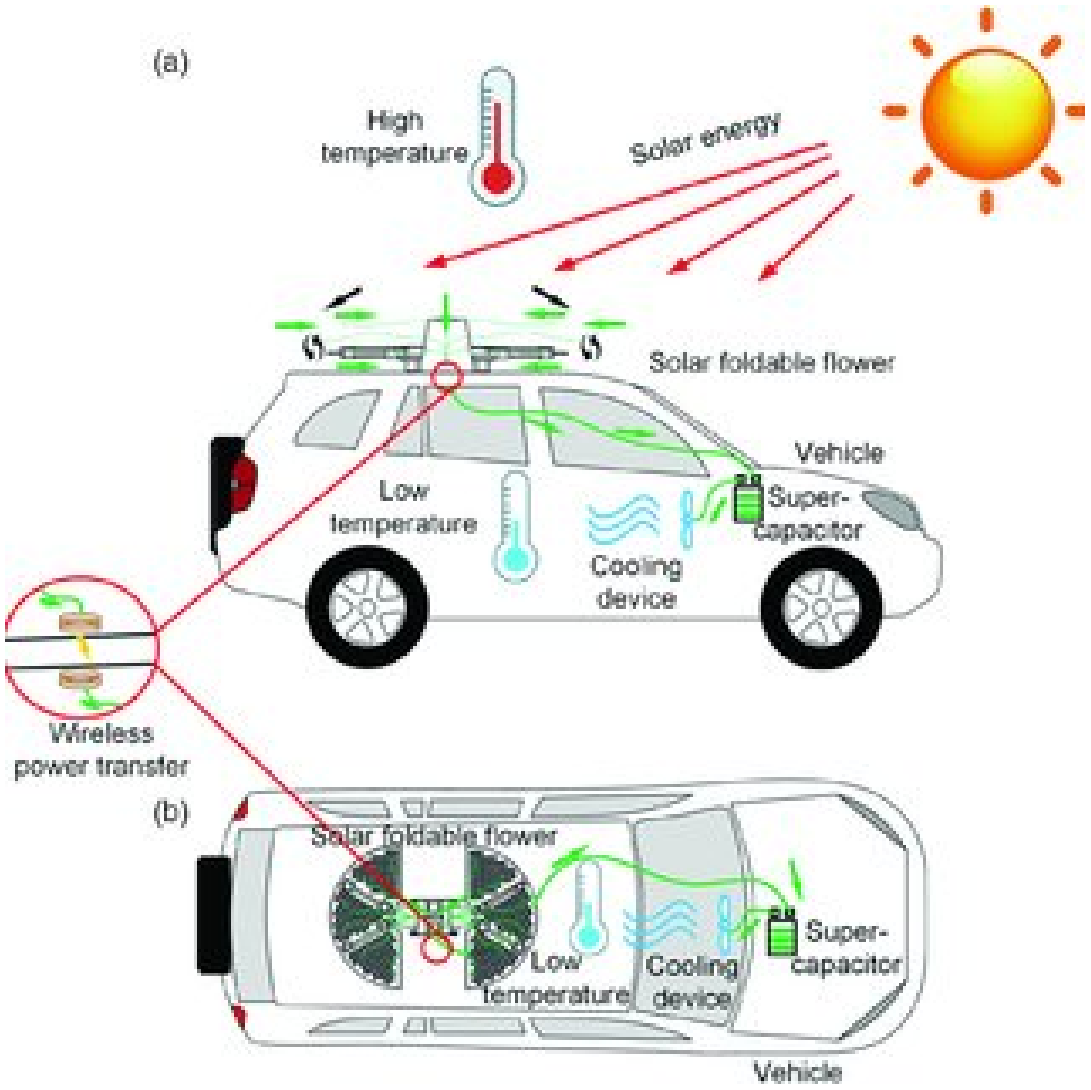

Figure 4.7: IOT Based Smart Solar Panel Car [12]

occurred due to driver distraction in 2012.Also, it's important to remember that if you want to let wireless communications into your automobile, you'll need to take precautions to make sure that your connection is safe and hardened against hacks and other forms of cyberattack.

4.13 Unit of Hydraulic Braking

The hydraulic braking system includes a control unit, a master cylinder, a slave cylinder, hoses, brakes (either drum or disc), and the brakes themselves. The hydraulic braking unit has a cylinder filled with an incompressible fluid that is used to provide pressure to the wheels with minimal effort.

4.14 Detection, Prevention, and Emergency Resolution of Road Accidents in Bangladesh

Accidents that occur on Bangladesh's roads have become a major source of concern in recent years. Some folks might not be able to reach a hospital in a timely manner in the event of an accident. Because

there is a lack of a fast method of conveying information to the necessary authorities and there is a shortage of ambulances, the authors have presented a solution that is based on the Internet of Things (IoT) that can avoid, detect, and handle emergency situations. The most important contribution that can be made by this research is a lower overall accident rate. In the technology that is being proposed, an automobile will come to a halt approximately 30 centimeters in front of any obstruction. A determination is made by the system as to whether or not the motorist has drunk alcohol. If the sensor determines that alcohol is present, the driver won't be able to start the vehicle even if they try. The driver's level of alertness is checked on a continuous basis by the sleep sensor. The architecture of the system cuts down on the amount of time that must pass between the occurrence of an accident in a particular location and the conclusion reached by Internet Street line regarding the quickest route to the nearest hospital. When an accident occurs for reasons that are unknown, the server will send an sms alert to the owner containing location.

4.15 Annual fatalities caused by drunk driving

Even though the number of deaths caused by drunk driving has been going down in recent years, it still claims the lives of over 10,000 people annually. A tendency that is also slowly continuing to reduce over time is the number of alcohol-related road fatalities, which currently account for slightly under 30 percent of all traffic fatalities that occur each year. The table that follows provides a breakdown of the total number of road fatalities as well as the number of traffic fatalities that were caused by alcohol between the years of 2016 and 2019 In the figure 4.8

Year	Total traffic fatalities	Alcohol-related traffic fatalities	% of fatalities from alcohol
2019	36,096	10,142	28%
2018	36,560	10,511	29%
2017	37,473	10,908	29%
2016	37,806	10,967	29%

Figure 4.8: Annual fatalities caused by drunk IOT Based Smart Car

4.16 Smart Vehicle Security and Safety System that is Powered by the Internet of Things (IOT)

The Internet of Things (IOT) is simplifying all facets of human life in a variety of ways. It is impossible to fully comprehend the applications that it provides. The Internet of Things (IOT) is more of a concept than a physical thing; it is an idea that involves connecting all kinds of tools, gadgets, and other apparatuses to one another through the use of the internet. Information technology and network technology are all utilized here. In order to produce the intended outcome and make people's life easier, multiple tracking and sensing devices are coupled together. The Internet of Things has a number of potential applications, including intelligent cars and their ability to improve safety and security, navigation, and fuel consumption efficiency [48].

This project offers a potential method to achieve the targeted result of reducing the number of precious human lives lost as a result of vehicular accidents. Within the framework of the proposed system, we are developing and putting into operation a system that not only prevents accidents but also responds appropriately. A panic button has been installed in such a location that, when pressed by a passenger who is experiencing fear and discomfort as a result of particular circumstances, an alert message is raised in the form of an SMS message. There is potential for several panic buttons to be installed in various locations throughout the car. Because of this, the officer who is sitting in the car is able to comprehend the passenger's predicament and assist him in finding a solution to his issue in the figure 4.9

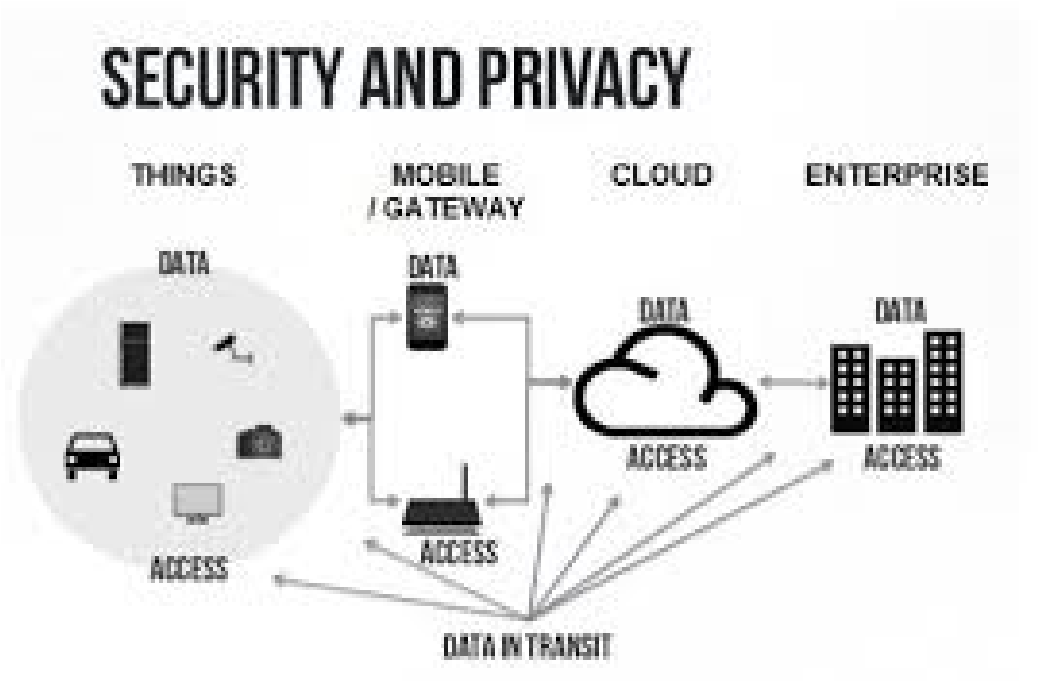

Figure 4.9: Security and Safety IOT Based Smart Car [13]

4.17 Preventing Drunk Driving

In the system that is being suggested, a MQ-3 Ethanol will be attached to the seat belt of the driver's seat or the steering wheel of the vehicle in order to be able to monitor the amount of alcohol that is present in the breath of the driver. If it is determined to be higher than the restrictions that have been specified, then the Arduino tells the GSM to send a warning about it to the driver's predefined safety number. Other possible measures include not starting the engine of the vehicle until the proportion of alcohol in the blood has dropped.

When an individual uses tobacco, whatever ethanol that is in their breath is converted to acetic acid when they exhale. At the cathode, oxygen absorbed from the surrounding air is decreased. The oxidation of ethyl alcohol is the total reaction that takes place. After measuring the charge flow created by this reaction and calculating the resistance, the Arduino will estimate the various degrees of drunkenness that have occurred in the figure 4.10

Figure 4.10: Caught Drink Driving on IOT Based Smart Car [14]

4.18 Rain Sensing Automatic Wiper

The windshield wipers of today's vehicles must be operated manually by the driver. Newer models incorporate rain-sensing technology.This function can be found in some luxury vehicles, but due to the high expense of implementing it, it has not yet been incorporated into standard automobiles in the figure 4.11

Figure 4.11: Rain Sensing Wipers on IOT Based Smart Car [15]

It is proposed in this project that a cost-effective version of it be used, and it will feature a rain-drop sensor that will be connected to the microcontroller. The sensor receives a signal indicating whether or not rain has been detected from the rain sensor.The rain sensor is made up of nickel tracks, and when water droplets make their way in between the tracks and connect them, the circuit is completed and the sensor is able to pick up on the presence of rain. The raindrop sensor module has a low cost as well as a high level of accuracy for detecting raindrops. [49].

4.19 Drive Modes

The three driving modes simplify both typical and less typical driving situations, making full use of the vehicle's potential for versatility. Choose between Eco, Normal, and Sport to allow the car to fully adapt to your driving needs, whether you are commuting through the city or driving through the countryside.

4.20 Chapter Summary

Currently there are many types of smart cars in the world, but we have added many features to create a smart car including Head of Display, Dual Dash Camera, Raspberry-pi-Navigation System, Vehicular Communication System , Advanced Braking System ,Solar Panel Solar Power, 3D gestures,3D-Camera systems,Vision Using Computers,ADAS (Advanced Assistance of Drivers),Long Term Evolution (LTE),Buzzers,(MQ-3) senensors , Rain sensor Automatic wiper etc.These features are definitely needed to make a smart car and if these features do not work properly, it cannot be claimed as a smart car. The main function of these features in a smart car is to easily protect the car from many accidents and to save time and make life comfortable.

Chapter 5

Smart Car Interior Designs

Sindelfingen's skilled designers developed an elegant, modern, and emotive environment. The interior has a "dynamic loop" theme. The dashboard, door Centre panels, and seat covers have bold, youthful colors. The stand-alone central touchscreen and product-style spherical air vents are also typical.The interior has a geometric honeycomb pattern like the exterior. Numerous stowage facilities and ambient lighting, often seen in higher segments, enhance the interior's quality.

The designer's emotive sweep, called "Loop," decorates the dashboard and doors. The sculptural dashboard has two sections: A bold, sensuous outer piece that may be covered in fabric, and a big, concave interior section with practical elements. The new smart generation's easygoing and pleasant personality is reflected in the color and material idea, while the equipment lines are unique.

The proxy line has blue upholstery on the console and door center panels and white accent trim. The premier line has black fabric with grey accents. For the passion, orange cloth with black/grey trim is optional. Seat coverings match. Leather seats with grey top stitching are very luxurious (standard for prime). Integral sporty front chairs have aggressive curves. The center dashboard radio or navigation unit can be controlled via the three-spoke steering wheel (optional). Modern infotainment centers hover above dashboards. Thus, the interior represents a young, dynamic, networked generation.

The clever Media-System offers a 7-inch touchscreen with navigation, while the smart Audio-System has varnished surfaces. The ellipsoidal doors fill the dashboard's "loop." The big armrest is comfortable. The integrated loudspeaker and mirror triangle tweeter display the outside honeycomb design.

In the passenger side central tunnel, the three equipment lines have a small drawer that smartly maximizes space. The driver and passenger seat backrests have ruffled pockets. The innovative stowage net on the passenger footwell central console is great for swiftly storing small bottles or magazines. Prime, passion, and proxy lines have ambient illumination. Indirect lighting illuminates the front doors, driver and passenger footwells, and glove compartment. The basic model lacks a glove compartment and

has open storage.

In this chapter, we described about a smart car's interior design as below in figure 5.1

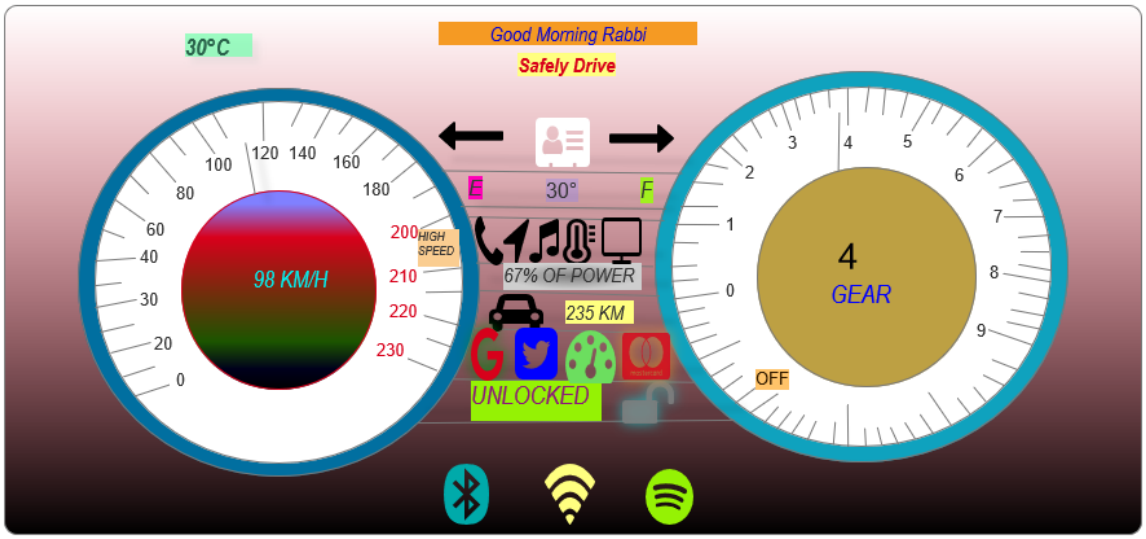

Figure 5.1: Interior design of Smart Car

5.1 IOT Based Smart Car Designing and Components

We have read many papers and used some designing tools in our smart car to complete this paper. We have tried to keep all the components that are needed to make a smart car and if a car is not smart enough, then there may be many types of accidents on the roads and it may harm people. And if the car is totally smart then accidents can be avoided to a large extent and The car can be handled easily.We designed this car while doing the paper in the figure 5.2

5.2 A valid driver's license

In order to keep up with the rapid speed of today's world, we all want to be able to drive fast cars and other vehicles of our own. Because driving carries with it a sense of responsibility, the person who has the privilege of sitting in the driver's seat must be in possession of a valid driver's license citation li2011application. A valid driver's license is a required piece of paper that demonstrates to authorities that an individual is authorized to operate a motor vehicle on a highway or other type of public road. After reviewing the following information, we are confident that you will concur with us that obtaining a driver's license is of the utmost importance: You are now prepared to travel "legally" on the road. When a person achieves the age required to obtain a driving license—17 for a car and 16 to ride a bike—the license legally certifies that the individual has qualified as an efficient driver and is ready to hit the road. The age requirement for a driving license is 17 for a car and 16 to ride a bike.

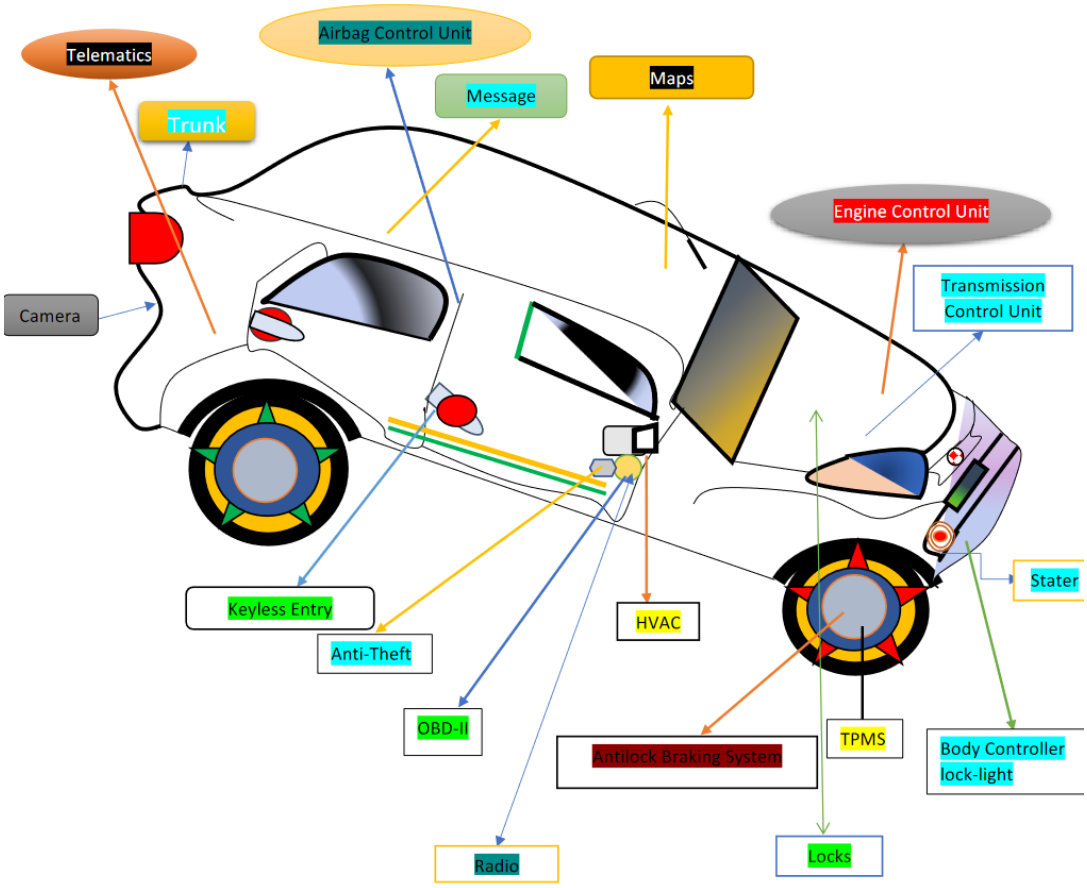

Figure 5.2: IOT-based Smart Car

5.3 Shows awareness of traffic laws

A driver must always respect the laws of the road, no matter where he or she may be. A driver's license is proof that you are aware of and want to abide by traffic laws.

5.4 Independence

Everyone enjoys independence. It would be amazing to drive wherever, anytime. Friends and siblings don't have to drop you. If so, learn to drive and get a license. Driving license Licenses provide formal proof, but they also give drivers pride that they are qualified and less likely to make mistakes than unqualified drivers. To get a license, one must pass the theory and practical tests. [50].

5.5 Upgraded Sensors for Intelligent All-Weather Vehicles

Using sensors like cameras, Light Detection and Ranging (LiDAR), millimeter-wave radar (MWR), and the global navigation satellite system, automated driving in urban environments requires decision making while simultaneously detecting the environment (GNSS). Any form of automated driving on the road will benefit from the capacity to operate in a wide variety of weather conditions. The ability to assess

different traffic situations and navigate safely provides significant obstacles to the widespread use of automated cars. The creation of a reliable recognition system that can work in inclement weather is another significant obstacle. Sun glare, rain, fog, and snow are all examples of potentially dangerous weather conditions that drivers may encounter on the road in the figure 5.3

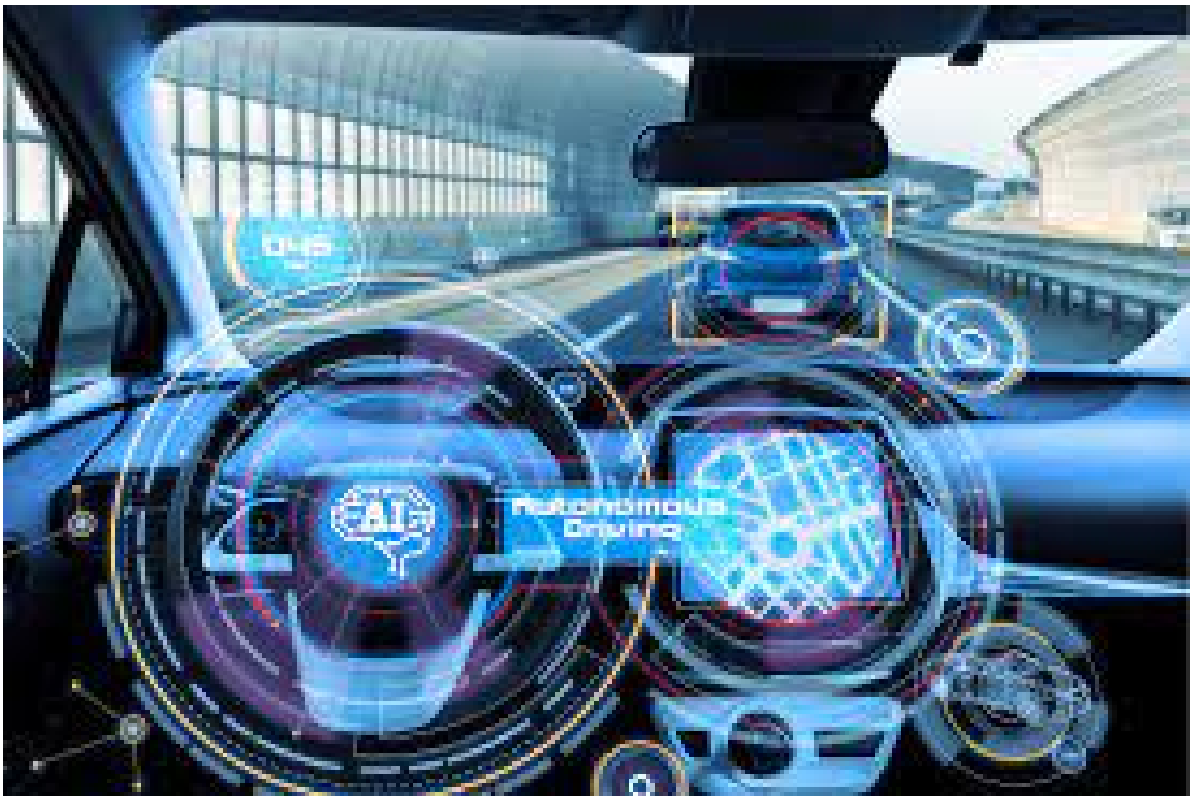

Figure 5.3: Better sensor on Smart Car [16]

5.6 Detection and ranging

Light Detection and Ranging was first created as a surveying tool.The range of an object can be determined by shining an invisible laser beam on it.These sensors can emit up to one million laser pulses per second, giving you a high-resolution, all-around 3D picture of your surroundings. However, dense fog and torrential rain might compromise the performance of LiDAR equipment. It also takes a lot of processing power for LiDAR sensors to convert data from measurements into useful information.LiDAR is more than capable of identifying that there is anything in the road that has to be avoided, but it is unable to tell exactly what it is looking at. The price of a LiDAR sensor can be as much as ten times that of a camera and radar system combined. However, that might alter in the near future. Velodyne released the first three-dimensional LiDAR sensorin the figure 5.4

5.7 Radar/Rfid Systems

Radar systems have a long history of application in land, sea, and airborne vehicles due to their widespread use in aviation, naval, and aerospace industries. The target area is bombarded with radio wave pulses

Figure 5.4: LiDAR sensor on an IOT-based Smart Car [16]

from sensors, which are then reflected back to the sensor. This provides information regarding the speed of the object as well as its location. This technology makes it possible to have driver aid systems in vehicles, such as those that prevent collisions, automatically apply emergency brakes, and adjust the cruise control. Radar sensors are not only sturdy but also relatively inexpensive and resistant to the elements. However, one of its shortcomings is that it has a low resolution. It is just able to locate objects; it cannot recognize or categorize them in the figure 5.5

Figure 5.5: Rfid system on an IOT-based Smart Car [16]

5.8 Ultrasound

These sensors estimate distances by emitting high-frequency sound waves that are undetectable by the human ear. They are frequently utilized in parking assistance systems because of their usefulness. They are able to identify things whatever their color or material, and they provide accurate and precise information regarding distance even during the night and when there is fog. However, the technology can only be utilized at close ranges, while being both proven and cost-effective in the figure 5.6

5.9 Global Positioning System (GPS) tracking

The system uses satellites and devices to locate objects and people. GPS technology was developed in the 1960s for military use and became available to the public in 1983. Since then, it has advanced and expanded. GPS is used for military exercises worldwide and driving directions in the figure 5.7

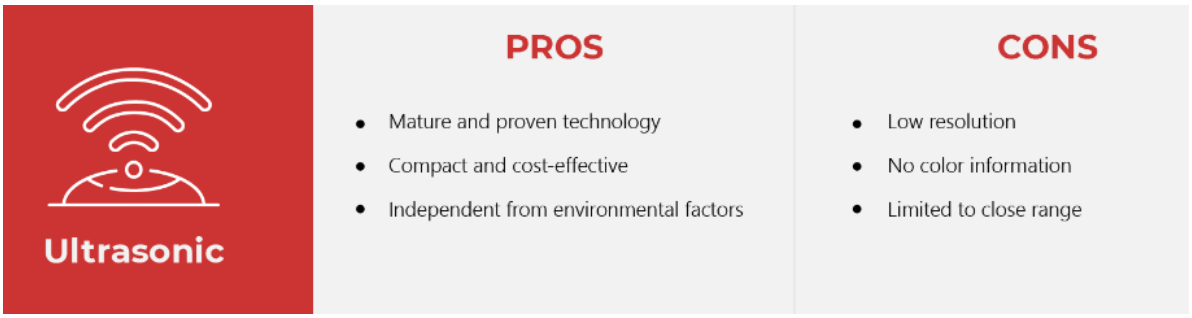

Figure 5.6: Ultrasonic sensor on an IOT-based Smart Car [16]

Figure 5.7: GPS Tracker on an IOT-based Smart Car [17]

5.10 Using Google Maps

Google maps is a web service that delivers in-depth information about geographical locations and locations all over the world. In addition to the standard road maps, there are also interactive panoramic views of the streets in 360 degrees. Aerial and satellite views of many different locales are available on Google Maps. Google Maps provides users with street views in certain cities through the use of images taken from moving vehicles. As a component of the broader Google Maps online application, Google Maps includes a number of different services. A route planner, for instance, provides guidance to motorists, bicyclists, pedestrians, and users of public transportation who are moving from one precise spot to another in the figure 5.8

5.11 eCall 112-based emergency assistance

If your car is involved in a serious collision on the road, the eCall system will immediately place a free emergency call to 112 for you. This feature is standard in all vehicles sold within the EU. You can also manually activate eCall by pressing a button on the screen.

Figure 5.8: Google Maps navigation on an IoT-based Smart Car [18]

5.12 eCall works

eCall works across the EU. If your car gets in a serious collision, the nearest emergency response network will be contacted. Your vehicle's registration and purchase location don't matter. eCall calls the nearest emergency response center by phone and data when engaged. This lets you and your passengers talk to the emergency center operator while automatically sending your position, accident time, vehicle ID, and direction of travel. Emergency services can analyze and manage your situation in the fig 5.9

5.13 Central Processing Unit

Your home audio system may have a CD player, radio tuner, and wires. Due to space constraints, automotive audio systems must be tiny. The head unit, which performs multiple functions, is the key portion of any car's audio system to overcome this limitation. It controls volume and audio sources. Back in the day, there was only AM radio to listen to. However, with the development of technology, FM radio and, more recently, HD radio, have become useful. Users also frequently employ MP3 players, CD players, and DVD players. The convenience of a central head unit allows for quick access to any of these options. The head unit also functions as a remote for your iPod or other media player, and a browser for your flash drive. Bluetooth wireless access simplifies the process of browsing your music library in the

Figure 5.9: eCall button on IOT-based Smart Car [19]

fig 5.10

Figure 5.10: Audio System on Smart Car [20]

5.14 A Smart Car with Bluetooth

Bluetooth is a wireless technology standard that enables connectivity and the exchange of data. Bluetooth is used in smart cars. It is a standard feature on all modern cellphones. You can play your music through the stereo of your vehicle using Bluetooth, and you can even control the tunes straight from the device. You can make hands-free phone conversations on the speakers, which is a significant advance toward improved driving safety. However, this is not the most crucial feature in the figure 5.11

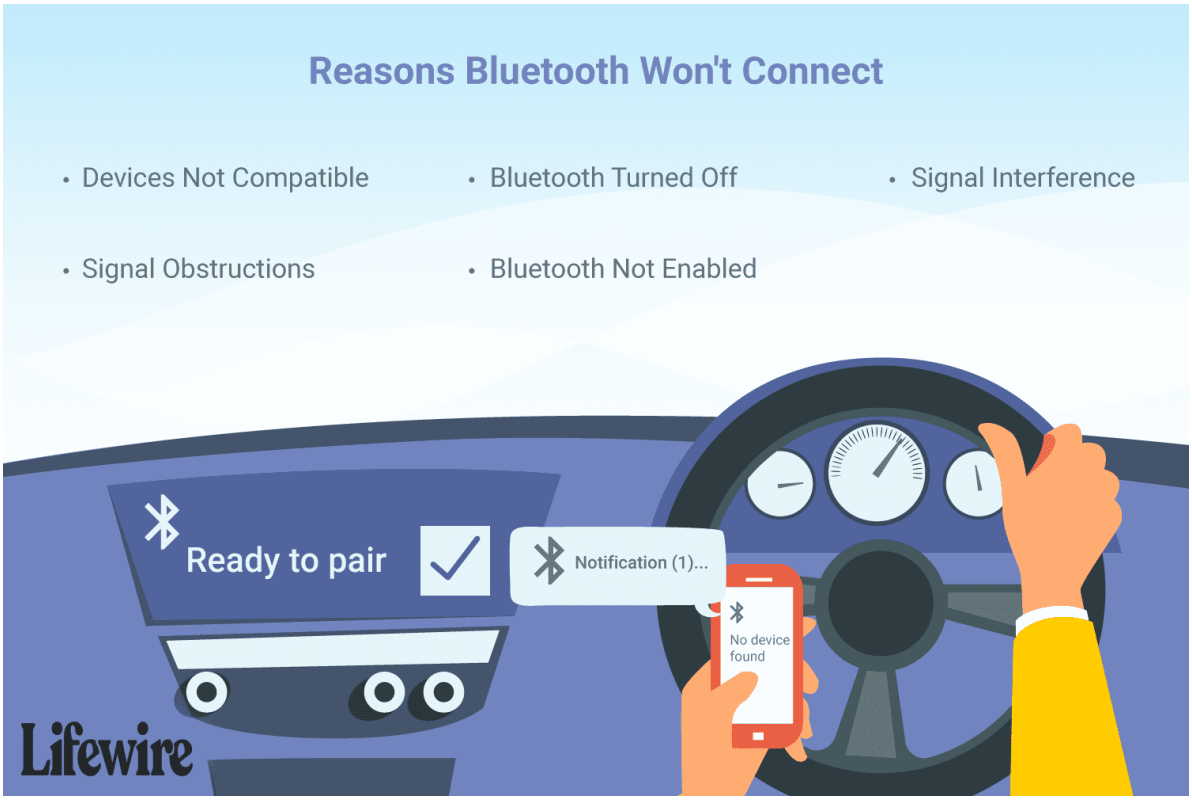

Figure 5.11: Connected Bluetooth on Smart Car [21]

5.15 Join the Bluetooth network

Play Spotify on Bluetooth-enabled car stereos. Learn about Bluetooth.Learn more about how to connect with Bluetooth by doing some research.

1. Switch to: Find the Bluetooth menu by going to the ”settings” section of your stereo, and then selecting the option to pair your device with the stereo.
2. Sync: To synchronize, make sure the Bluetooth feature is turned on in both your mobile device and your stereo.
3. Mode: Play some Spotify after you’ve chosen your vehicle and, if necessary, entered the pairing code (which is most likely included in the user manual of your device).

5.16 Make and Receive Calls

For a good number of years, making and receiving phone calls was the principal usage of Bluetooth in the automobile. In order to host calls coming from your phone, the majority of factory head units and aftermarket stereos employ Bluetooth technology. You can get a Bluetooth car kit if the head unit in your vehicle does not support Bluetooth. This will allow you to add the wireless capabilities that you are searching for. The Hands-Free Profile is the name given to this particular profile (HFP). You are able to make and receive calls, dial numbers using voice commands, and access your address book on the vast majority of phones, head units, and Bluetooth kits that are equipped with HFP in the figure 5.12

Figure 5.12: Receive call-text on IOT-based Smart Car [22]

5.17 Tachometers

Tachometers, also known as revolution counters, are commonly found in automobiles, aircraft, and other types of vehicles. These instruments display the rate at which the crankshaft of the engine rotates and typically feature marks that indicate a safe range of rotation speeds. This might be helpful for the driver in picking the optimum throttle setting as well as gear for the conditions they are traveling in the figure 5.13

5.18 Tachometer sensor

Tachometers and speed transmitters use permanently placed speed sensors to observe a target on the machine's rotating shaft. Proximity, Hall Effect (magnetic), Optical, and Laser sensors exist. Permanent systems use proximity or Hall Effect sensors.

Figure 5.13: Tacho meter on IOT-based Smart Car [23]

5.19 Types of Tachometers

1. Types of Tachometers item In order to measure the RPM of a rotating item, contact tachometers need to be in physical contact with the object.
2. Tachometers that do not require contact. Tachometers that are non-contact are able to perform measurements without having to make physical touch with the thing being measured.
3. Tachometers that use lasers.
4. Tachometers that use light.

5.20 Wi-Fi in the modern smart automobile

Wi-Fi can be obtained in your vehicle using the mobile hotspot feature of your phone, the hotspot that is integrated into your vehicle, a mobile hotspot device, or the public Wi-Fi that is offered in the parking lot of a restaurant or library. If you have internet access in your vehicle, you may stay connected to the outside world and enjoy some entertainment even on extended excursions. While you are driving, having access to emergency services, live traffic updates, satellite radio, and weather predictions is all made possible by having Wi-Fi in your car. Just remember to keep your attention on the road and delegate any Wi-Fi-related activities to passengers.

In the meantime, here is a rundown of the many different ways you can access the internet while driving. The term ”Internet of Things” (IOT) refers to the network of interconnected intelligent devices and sensors that are dispersed throughout the environment and linked together so that they may collect, share, and combine data. Emerging Internet of Things technologies and systems have been created to help people better comprehend how their activities affect the ecosystems around them in many different

ways. Because of the proliferation of wireless radio devices, the pervasiveness of wireless signals, and the rich information that is introduced into wireless signals by human activities, wireless sensing has been predicted to become a prominent solution to the problems posed by the Internet of Things (IOT) applications in the figure 5.14

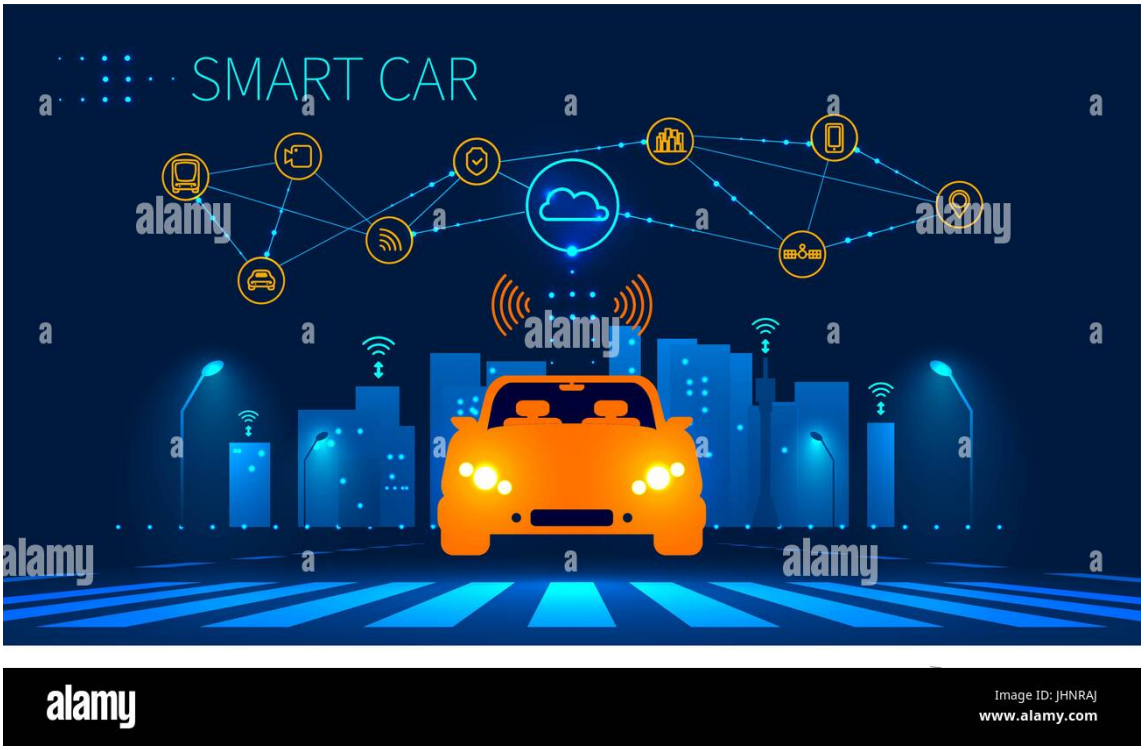

Figure 5.14: Connected Wi-Fi Smart Car [24]

5.21 Vehicle Condition Detection

Monitoring the driver's state of consciousness is always a top priority for autos because of how dangerous driving can be. According to the statistics, the most common cause of automobile collisions is a driver's failure to pay attention behind the wheel as a result of factors such as fatigue, distraction, drowsiness, or stress.

5.22 Link up in the Control Panel

Your car may already be Spotify integrated like on GM cars, or you may have a dashboard that supports Spotify using Android Auto or Apple CarPlay and your car manual should have this information in the fig 5.15

5.23 Chapter Summary

Automation of vehicles, also known as vehicular intelligence, is the application of artificial intelligence to improve or fully automate the control of a vehicle. IOT based Smart Cars equipped with features such as

Figure 5.15: Control Panel [25]

LiDAR sensor,Radar,Ultrasound,GPS Tracker,Bluetooth,Wi-Fi,eCall,Google Maps, automatic activation of high beams, and other similar technologies make it possible for drivers to depend on the vehicle's ability to keep them safe. Aptiv's Smart Vehicle ArchitectureTM (SVATM) is a vehicle-level design philosophy and concept for electrical and electronic systems that reduces the total cost of ownership and enables feature-rich, highly automated automobiles. The SVATM was developed by Aptiv.These features directly connected to the internet have helped to make cars smarter and make people comfortable and convenient to travel.

Chapter 6

Conclusion

IoT in smart cars has a significant impact on the entire car concept, which is currently being actively reconsidered in the automotive industry.Users want their vehicles to have a complete development platform with self-driving capabilities, as well as easier control and engagement. IoT technologies can be used by manufactures to enhance both their production methods and the systems inside their cars. Because driving today is changing for drivers from the stressful management of the road to an entertaining journey, one of the trendiest subjects is car maintenance that adds to economy, car safety, as well as in-vehicle electronics.The rise of linked car technology is due to the wireless connection industry's rapid growth. Fast data transmission between drivers, vehicles, and municipal infrastructure is made possible by connected cars. IoT technology uses real-time data collection to analyze what is happening to a car and its surroundings, recommend the best driving strategies, and provide driving advice. Drivers are able to better manage the highways as a result, increasing their mobility, easing traffic, and cutting down on travel delays.

Smart cars originate from the concept of smart cities. Smart cities are the dream of humanity and it has been going on for the past few years. Through continuous changes in society the concept is created by the reality that technology like the internet Smart Development of Things and Cloud Computing Cities have risen to a different level. Integration of IOT the cloud has led to a new society.In this paper, we include innovative technology and features that has been used to help people so that they feel comfort. The main goal of the vehicle was to reduce time User costs, congestion as well reduction of carbon footprint. Attempts have been made in this case this paper is human quality development and the environment. The main purpose of our effort was to put forward hopes to improve our research ideas by community and eventually scaled and deployed by the Autonomous vehicle industry.

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