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IoT Based E-Parking System using Arduino

[1]Shalini Singh, [2]Kumari Shikha, [3]Shivangi Jha, [4]Shourabh Rathi, [5]Deepak Kumar
[1]Assistant Professor, [2, 3, 4, 5] Student
Computer Science and Engineering, Krishna Engineering College, Ghaziabad
Dr. A.P.J Abdul Kalam Technical University, Lucknow, India
Email - [1]shalini027.singh@gmail.com, [2]shikhayadav.1998@gmail.com, [3]shivangijha89@gmail.com
[4] saurav.98115@gmail.com [5] deepak.kumar@krishnacollege.ac.in

Abstract: *As a part of smart technology in vehicle, Automated valet parking system has become a major attention in society. Automated valet parking system involves parking of cars without a driver parking it will be safer and quicker parking of cars while reducing the chances of accidents while parking with the help of Internet of Things using Arduino. The parking with the help of cart and its management is the main highlight of this research paper. Main focus of this paper is the parking process through the cart, the design of the cart using various IoT ultrasonic sensors and required lifting during parking in the slots. It also shows challenges and security issues .Here we briefly describes each and every level of this model.*

Keywords: *Internet of Things , Sensors , Ultrasonic , Security, Arduino.*

1. INTRODUCTION:

Research paper is based on Automated valet Parking system. In Today's growing population and improvement in living standards of people, car ownership is also trending so does traffic on the roads[1]. The automation is needed for the safety and quickness in parking technology. Other issues faced during parking at a reserved space are incorporated. Minimising the human involvement in parking system, it will be designed in reference to the human urgency. The occupied parking spots are notified reducing the effort to look for empty spots. It will be less accident-prone system for parking[1]. All these have been discussed later with technologies that will help to achieve this idea. The major area of research is ultrasonic sensors and it will work in the motion of the car and elevation of the cart while moving the car into a slot. We are working over a smaller model than the actual parking so there will be small slots and spaces which will differ into reality. In reality ,the automobile industry has been around for quite a time and has grown since then[2], yet the big change currently taking place from human-driven cars to self-driven cars would give a long lasting effect on civilization. Cars are now attached as well as linked since quite time, as it is able to interact with mobile phones, provide wayside backing, record simultaneous traffic signal notifications etc., but the growth is near to shift. Many companies are incorporating the idea to make vehicles that are driverless. The challenge is in implementation on the scale of a city, and then of a country. Many researchers are identifying the practical implementation and scope of the automated system in future. This project bridges the gap of what may come in 30-40 years and today's reality. The production of automated carts is the midway of the current models and fully automated models. The considerable challenge is to accommodate a system that is practical enough for any given space of parking systems. The rest of the paper is organized as follows: Section III includes related work. Background and literature review is provided in Section IV. Section V gives detailed discussion about information regarding sensors and methods used While section VI explained in depth analysis of IoT experimental setup. Section VII points out results, challenges and open research issues. Finally conclusion is defined in Section VIII.

2. RELATED WORK:

Several types of automation in the field of valet parking or related to valet parking using sensors are already present though some related work have been mentioned as. A project under IFAC [3] that deals with the ultrasonic sensor that has been used for the measurement of the distance between the objects and their precision. For measurements [4] radius up to 3m the precision amount was 0.5 percent, for measuring radius up to 6m the precision amount was 0.7 percent and for measurement distance above 6meters the accuracy class was 0.4 percent. The sensitivity of the sensor was related to the spectrum of measurements in all situations. All experiments were carried out roughly under the same conditions (temperature T=23 degree C). Intelligent parking includes the method [5] and the way in which how much space is required towards finding more efficient, appropriate as well as précised predictive parking space impact, IoT advancement is used to design the parking space. Research on the idea of the space required for the purpose of parking [6] has been done in this paper having majorly focused on path planning , path control and parking scene. Automotive parking advancement helps to perform parking operations with safety[7] and quickness using no driver. Mostly removing chances of parking accidents while enhancing the driving comfort. Paper[8] proposes a bright and optimal way of solving the parking space difficulty in small urban towns. IOT[9] based cars used ultrasonic sensors to detect the obstacle to avoid collision. Implanted two at each side and one at the front, ultrasonic sensors are covering a wide range. IR sensors are designed for sensing automobiles [10]. IR sensors may be divided as Proximity sensors. Reasons for using these sensors are the cost, as they are found to be cheap and use less memory in comparison to camera-based sensors. These sensors are more reliable. This reference displays Proximity sensor(IR sensor) efficiency review [10]. Case study, an exam room is configured where the sensors are installed in an area having parking facility available to check empty parking slots, automobiles. The types of detection and precision of detecting varies according to environmental conditions[11] . Good perception of the performance of the sensor as the topic navigates its field of view. The automation is needed for the safety[1] and quickness in parking technologies[7]. And issues such as delay, damage to vehicles during parking within a reserved space are incorporated. Due to these problems, human involvement in the parking system is reduced. The occupied parking spots are notified, reducing the effort to look for empty spots. It will be less accident-prone system for parking. Developing the application devices that can handle modified position feature [12], shows the configuration of the position is part of the limitation and further studies are being carried on to support the project more precisely. Many companies are incorporating the idea to make vehicles that are driverless[9]. The challenge is in implementation on the scale of a city, and then of a country. Many researchers are identifying the practical implementation and scope of the automated system in future. This project bridges the gap of what may come in 30-40 years and today's reality. The production of automated carts is the midway of the current models and fully automated models. IOT based cars used ultrasonic sensors to detect the obstacle to avoid collision. Implanted two at each side and one at the front, ultrasonic sensors are covering a wide range.

There are several injuries which are being faced in the manual parking where many people get injured. A mail sample [13] that Was carried amongst 698 elderly French drivers to recognise their unique requirements and problems that they were facing while parking. Front perpendicular and back parallel operation were the most observed. Improvising smart techniques for parking[14],this is important to anticipate the space in parking areas to the drivers where they can park. A modern architecture that combines the IoT and a statistical algorithm based on a number of operations for automating the estimation of parking spaces available in smart car parks. The relationship between packed suburban car parks and travel behaviour,[15] with a special emphasis on public transit utilisation as well as car ownership regulation. To tackle parking space constraints and risky parking [16]. Good approaches in addition to the ongoing development and extension, solutions are being created, tested and introduced for the more productive use of established parking space. Existing truck parking spaces may be efficiently optimized with the usage of smart distribution channels. Giving enough parking spaces[14] might minimise the destructive movement of traffic and rising density in city roads. Regarding this problem, [17] parking on roads is the key issue frequently faced in urban cities. The practice of on-street parking is prevalent in the commercial areas of AI-Najaf. The results show that reckless parking activity is prevalent in the urban research region on weekdays, weekends and the proposed solutions are to restrict on-road parking and include off-road parking. The related information about how the inclination is being done using the servo motor[18]. The layout for the designing of the model[19], where all the connections are made on Arduino to provide all the connectivity inside the model. Numerous applications of emerging technologies are being used in developed towns making no offering to the environmental sustainability [20] and the tricks to achieve a small amount of contribution to the sustainability of the cities. It is expected[21]that IoT technology[22] can make a breakthrough in industries by connecting information of automation and environmental information obtained by IoT sensors. It will help to improve the living. Updated and advanced technology, [23] with comparatively low cost and rapid response and designing which will provide optimal solution of parking problems.

3. BACKGROUND AND LITERATURE REVIEW:

For understanding what drives those optimal solutions, theories and data given by Research that has been done in the field of valet parking system [6] are understood. This research paper they have explained the idea of how much space required for each car and parking of those cars without the need of a driver, called automated valet parking technology have been touched. Referring to this research paper we have gained about 3 aspects that are Path control, Path planning and parking scene recognition with the help of the ultrasonic sensors and visual sensors. From which we will be using ultrasonic and IR sensors in our research paper. In **Automated valet parking,** the areas covered are modelling of the cart so that it can park the car using ultrasonic sensor for detection of the distances, elevation that will be needed so that car can be slipped into the slot and IR sensor to detect that a car has been parked which is displayed on the entrance with the help of LEDs. So a cart will be bearing a load of average 4009 pounds over it in the real world. We are using a small model for performing the activity. The expectation of this project is to reduce the human involvement in the motor vehicles handling, reducing the possibility of error and hence reducing the average accidents rate and damage to the vehicles themselves. The manual arrangement of the valet system holds users liable to take care of the slip. If the slip is misplaced anyone who gets hold of it can claim the ownership of the car. The provision of getting slips on your devices such as smartphones allows you to have security of ownership. This project is an improved variation of parking projects that show the vacant slots available for the parking. The onus of finding space remains on the user themselves and hence an automated cart is thought of to do all the required decision making. The cart will be automated to ensure space management as to park vehicles that are available nearest as compared to already existing parking systems where cars are parked as the number they are issued serially. It could easily be mentioned that the cars with this automatic system built-in are introduced but the cart is for scenarios where all automatic cars are a clear distant future. The automated system,[24] where the driverless and self-driven facilities into the cars have been a major part to provide better parking experiences. It basically provides 3000 parking slots to people to park their cars manually. The main purpose is to avoid traffic in the market area. The major issue of this MULTILEVEL PARKING not working very much, is time involvement in parking. Automated valet parking, differs here as primarily it automated so once the car is placed over the cart the human work finishes there in the process of parking the car.

- It is advanced and better version then the existing there as the only thing a person has to do is to place their car on cart and then left.
- No issue of finding slots, as it will be performed by the cart.
- Its quicker and time saving.

There will be a cart where the car has to be parked by the user and then the cart will move with the help of servo motors that have been attached with 3 ultrasonic sensors[4] to detect available space[5] in the lot. Once the cart finds an available space it will park the car there. After which the role of IR sensor comes into play. Now the IR sensor will detect a car acting as a hindrance. There will be LEDs connected to it on the SLOTS displaying screen where the available slots have been displayed as OFF LEDs and occupied have been displayed with ON LEDs at the entrance. This will be quicker, safer than manual parking systems. It will be driverless parking. There are many different aspects to work over the field of parking[25].

Figure 1: Noida Sector-18 Multilevel Parking

4. METHODS AND MATERIALS:

The instant notification will help in eventual traffic management. The already existing systems are analysed and a cart was designed that works similar to an automated car. The method is to analyse the space required by the car to be parked. Then the ultrasonic sensors[3], will be used to detect the clear area both along the path of the cart and the actual parking space[4]. The area and angles for the cart to move freely in an efficient way are precisely calculated based on the prototype designed. Using IoT for the automation of the cart,[9] as microcontroller Arduino nano is used. It is established that it is very well suited for the hardware projects. It can easily be powered using a battery pack. Interfacing sensors and other electronic components to Arduino are convenient. These are qualities that come in handy to design the prototype that is required to move across a range of areas. Processor used in the Arduino is from the AVR family Atmega328P.A motor driver is used. Motor driver task is to take a power signal with low current that can drive a motor. The motor used for the cart is 1298 drivers. Driver motor is a high voltage, high current and move induction bear like a stepping motor that is used in this project itself. It can drive 2 DC motors simultaneously which will allow the wheels at the back to be in synchronized movement.

The main function of the cart is to detect paths for presence of obstacles and calculate distance to know if there is enough space for movement. Ultrasonic sensors are used. Ultrasonic sensor[3][4] is a device which determines the distance to a body by means of sound waves produced by ultrasonic[3]. Ultrasonic sensor contains a transmitter to send and receive signals which communicate about the proximity of the body. This will help to calculate the required distances and gaps. This will be provided once the prototype is built so as to make adjustments in the algorithm. Now the next important function of the cart is to take a car to be climbed over it to start parking it. For this IR sensor[10] is used. When the car is taken up on the cart its presence is detected by an IR sensor. Another, very important part of the set-up is the ultrasonic sensor that detects the positioning of other bodies.

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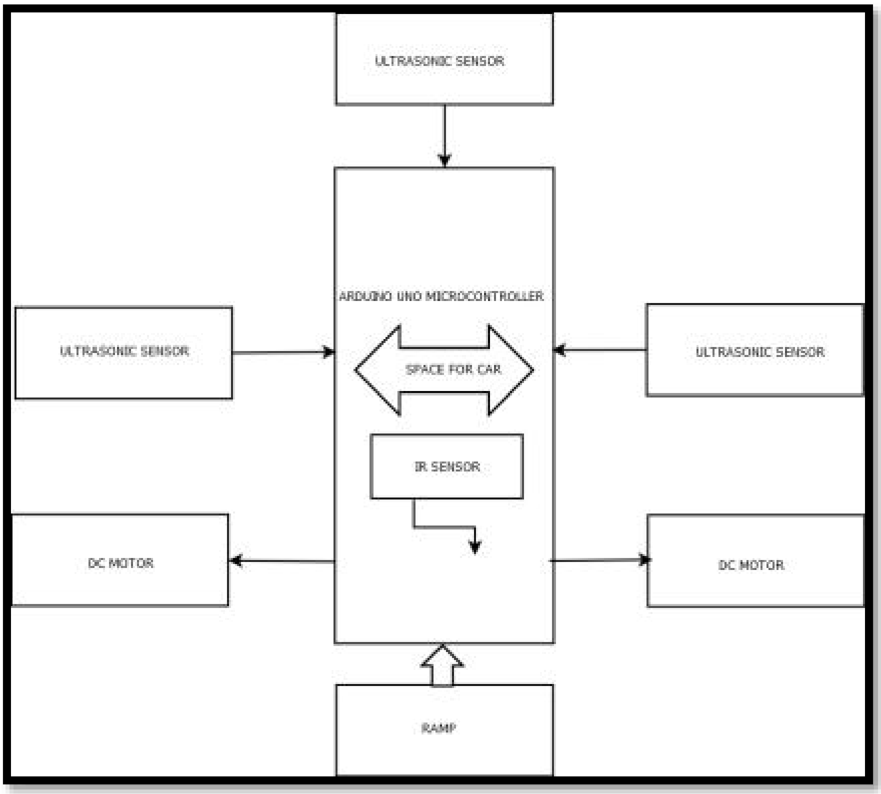

Figure 2: Proposed Model of the Cart

Submarines detected using ultrasound were attempted by Paul Langevin around 1900 as the first application of ultrasound. The usefulness in transmission is in both air and water to detect waves using ultrasound[3]. Research over the automation valet system on ultrasonic was created much early. Now, ultrasonic plays a major role in the evolution of automobile valet parking. During 1989, Derrick and Bernard started studying parking terminologies and wrote his article outcomes in the area of parking. The sensor module consists of an ultrasonic sender, receiver and the controller.

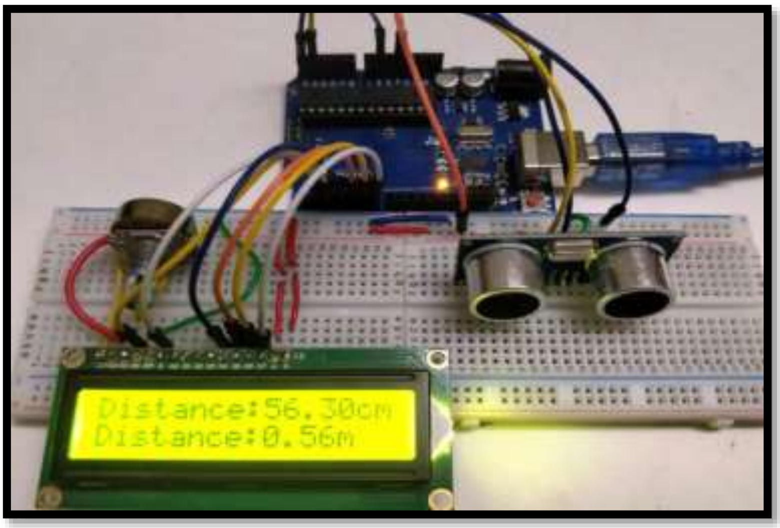

Figure 3: Ultrasonic HC-SR04 sensor measuring distance.

Ultrasonic in an automated valet system will help to measure the accurate distances [3] which we require for the parking of the car in the specified area or slots. To make sure that there is normal opening of doors on both sides of the automobile. Usually the setup aims of having a parking space to get at least width of 75-85 cm more than the vehicle body's width. Time required for acknowledgement is almost for around 0.8s, that further can be minimised when the distance between body and sensors are short[3]. Distance = (Time X Speed(340m/s) in air))/2The time taken to reach the object or car already placed into the slot will be half of the total time taken. The dimension of the slot in the model has been set to 60cm X 40cm. But in reality, the dimensions will differ. PARKING THROUGH CART: Horizontal colliding of the car with the other car during the movement of the cart with the car loaded over it. Breakage of the ramp in the slot. DATA AND ANALYSIS: Elevation of the cart during the parking of the car into the slot with the help of cart.

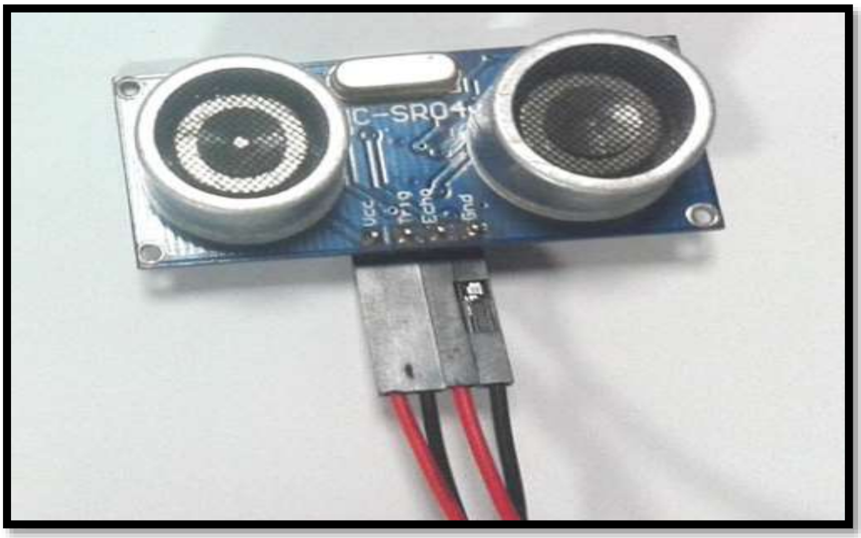

Figure 4: ultrasonic sensor

5. EXPERIMENTAL SETUP: The setup includes the instruments and sensors in carrying out the activity. The parking divided into Model & Cart.

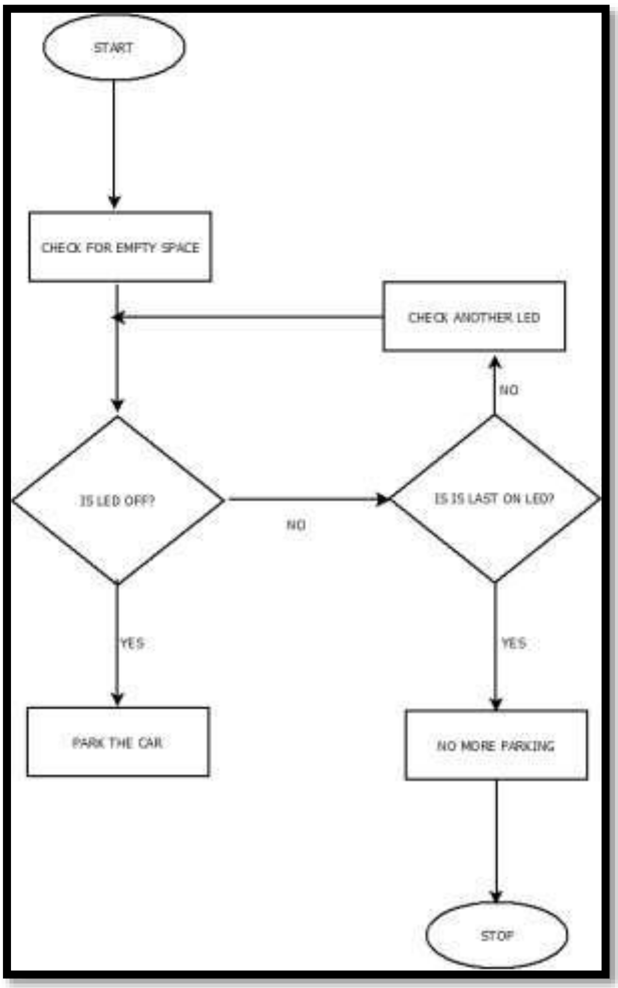

Figure 5: Led display flow chart

5.1. Model:

- LEDs that have been used in the display board for displaying whether there are any slots available for parking.
- Infrared sensors :In the model as per the size we have used 4 infrared sensors[10][11] at the place of parking slot if car is parked it will indicate that car is parked and will transmit the signal to the display board using LEDS.

- Arduino which will provide the model to work smoothly. Arduino uno is a microcontroller-based board having input and output pins implemented in the model based on the ATmega328P.

5.2. Cart:

- Arduino which is placed in the cart also and helps in the connection of the cart with all the motors and the code in the system for the movement of the cart.
- Cart which has been designed using the 3 ultrasonic sensor, 1 Ultrasonic and infrared sensor. Infrared sensor[10][11] have been used on the cart such that whenever a car comes over the cart it indicate that the cart is holding a car for the parking as well as at the place of parking slot if car parked it will indicate that car is parked and it will help the LEDS to display. Ultrasonic sensor[4][3], there are 3 ultrasonic sensors that has been equipped over the cart to measure the distance, move and the occupancy of any other car in the slot as well as detecting any hindrance into the way of cart during parking, 1 sensor at front and rest of 2 at the sides of the cart.
- Motors connected with 12 volts of battery. There is 1 servo motor on the cart which has been used for the inclination of the cart during parking. There are 2 dc motors in the cart that will help during the movement of the overall cart during parking. There is 1 motor driver to control all the motors and their speeds. Jumper Wires have been used for the connection of all the sensors, motors, Arduino and Led. Toy cars have been used for the model.

6. OUTCOME AND CHALLENGES:

The experimental set-up was successful in detection and communication. The issue of using the automated valet for a single layer has been brought up. It has been decided to keep it to that since there are a number of issues with robotic parking systems for multiple floors. In addition to any technical problems, the system has relatively balanced throughput and works well. Such as shopping malls and train stations but the system is not suitable for high rising volumes, very high rush hour or applications such as stadiums. In addition, people not used to the system might cause issues. For example – being unable to send an alert to the automated system to work during parking. Complete automated structure resembles much like a robot doing parking. The driver lifts the car into the area of entry. The vehicle is now empty, the owner is provided with the token. When the vehicle is empty, a cart is ready to lift the vehicle and place it to the available slot in the structure of the parking. Following are the issues that are resolved to make our project liable for real-life use. The content of the vehicle as well as the vehicle itself are safe as there is no chance of entry of any outsider. Removal of any little damages in the lot. It is safer as both driver and passengers don’t have to go through the parking area. Looking for empty spaces have been eliminated[5]. Thus, minimising the pollution emission. There is only a requirement of proper ventilation and lighting systems. The physically disable will get better access. Visual impacts along with the volume of the valet model is reduced. Next view of discussion is to consider factors which will decide the space optimization in an efficient way. The cost per space of the parking model lays over the following two measures: 1) the design of the area along with the number of parking lots, 2) the efficiency of the model required. These two variables in the equation of estimating project costs are of equal importance. Overall development cost, not construction cost, is the most vital factor. A Valet Parking System will always result in a ratio of lesser construction amount with the spending of funds that creates high income with comparison to driver based manual parking setups across the city[5]. The system will be implemented in an area that provides the defined space for parking spaces[5]. It should be seen as a parking space that seems fit for manual valet parking being replaced by the automated system.

7. CONCLUSION:

The paper describes the model for the Automated valet parking through layout based on the construction of cart. The idea uses sensors which are cheap, being used for navigation and are used for automated detection and movements. The Automated Valet Parking model is under an advance stage but not finished yet. The information and the quality content mixed with the IR sensors[10] and ultrasonic sensors[3] provides quality outcomes. Assuring that the used methods will convey the purpose of the project. During the construction stage, some imitations were required. An imitation of the complete system or under a hardware-in-loop is also important to illustrate the working of the model. Such as, when it comes to situations in real life, ultrasonic sensors do the needful but for other features of the cart. We need more complex designs. In preparation to form a compound platform, the requirement of practical counterfeit and functions which can generate use cases that cannot be formed in real life situations. Towards gaining the trust of the people and convincing them that the system is trustable. Many queries can be answered: can the model work in all kinds of weather and thunderstorm condition? Is the machine capable of avoiding complex artifacts like pedestrians, animals, bicyclists or vehicles around? This involves any restriction on space of parking and construction of slope. If yes, how does the system try to address such problems? Is the machine capable of finding its place even though the environment does not have unique features, how to handle alike surroundings? The topic isn’t finished, so the final move is to get a commodity available for use on a wider scale. However, integrating the expertise from different research institutes with automobile industries enhances a likelihood of a positive answer to all these concerns.

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