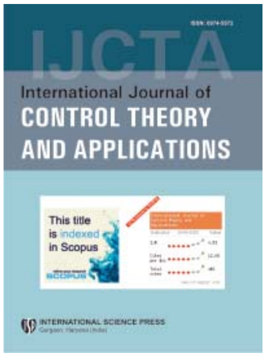

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Smart Parking Assist System using Internet of Things (IoT)

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Abstract: The present work proposes a fully-automated vehicle smart parking system using IoT. The Smart parking assist system (SPAS) is basically a standalone system which helps to utilize the control of micro-controller integration with wireless communication to provide user with remote notification, control, and assist of elements and help them with their parking details and provide real-time notification feeds to the drivers. SPAS optimizes the utility of the sensor inputs from parking lots to process and provide the user with details and access to the parking spaces allowing to work on a low budget platform ensuring no, or minimal human interaction.

Keywords: *Internet of Things (IoT), Smart Parking Assist System (SPAS), Arduino, IR Sensor, Micro Controller, Servo Motor.*

1. INTRODUCTION

With the sudden advancement of the Automation technology of our 21st century, life is getting simpler and easier in all aspects. In today's world Automatic systems (automation) are being preferred mostly over the use of manual system. With the drastic increase in the number of internet users over the past decade; it eventually has made Internet our very part and parcel of life, and IoT is the latest and emerging trend in the internet technology. Internet of things consists of a vast growing network of everyday objects, starting from industrial-grade machinery to different types of consumer goods that possess the unique ability share information and complete tasks while you are busy with other activities. IoT offers its user with its advanced connectivity of devices, systems and features which is beyond the existing scope of machine to machine communications. The implementation of IoT in solving the problems and issues faced on vehicle parking has been addressed before too, but each of them does require an in-depth implementation of inter-device connectivity and much needed constant monitoring by the team of developers, in-order to ensure the proper working and system stability.

The Smart Parking Assist system (SPAS) using IoT is a reformed technology that uses any computer or mobile devices to control basic functionality. Its features automatically linked through the internet are easily operable from anywhere around the world. It is meant to save time, electricity and eventually minimize Human Efforts to a great extent. The SPAS system differs from other existing system by allowing the user to easily operate and monitor their system's functioning from anywhere in the world through an Internet connection. In this paper we present a Smart Parking Assist system (SPAS) using Arduino Mega micro-controllers that employs the integration of wireless communication, to provide the user with the remote control of various elements like: lights, sensors, and appliances falling within their working range of the designated environment. It also possesses the ability to store all the records and activities for future reference purpose. This system is designed to help its users, by assisting them with their parking of vehicles in the car park lot. The system will automatically provide all the details in the parking areas on the basis of processing all the sensors data. It is designed to be running on a low-budget platform and in the meantime, allowing its developers to eventually work-on and expand their controls over a variety of other inter-connected electronic devices.

2. IMPLEMENTATION

2.1. System Architecture

In consideration of Fig.(1), the proposed system is controlled via a centralized server or command center, which is protected by a secured gateway. This would ensure the control would stay only with limited users. Connected to the main hardware and monitoring systems, the proposal assures full redundancy and ease of access. The centralized server holds different sets of data and information and issues command according depending on the sensors feedback. The system utilizes linear topology with a very redundant contention protocol along with Bus Controller-Remote Terminal (BC-RT) protocol. The data rate of upto 1 mbps is suggested to ensure faster command and feedback rates and is secured by end-to end encryption method.

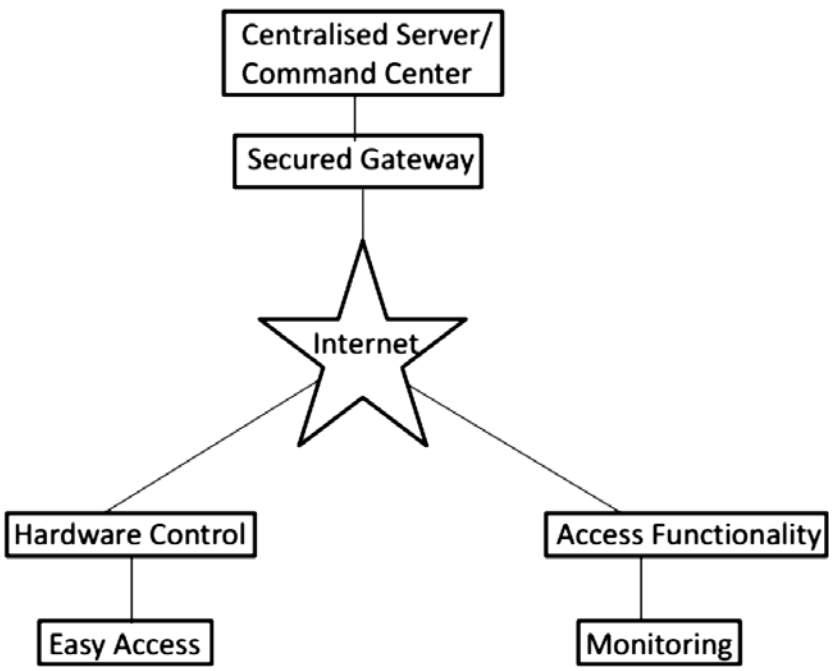

Figure 1: System Architecture

2.2. Working Methodology

The system, Fig. (2) shows the utilizes different sets of command and feedback protocol. Thus the server or bus controller issues a command, in-order to detect the presence of the system hardwares connected to it. The main server holds all the various informations about the parking lot configuration and eventually issues its command after receiving a positive feedback from the sensors accordingly. The feedback ensures a working node, to further analyze and issue command.

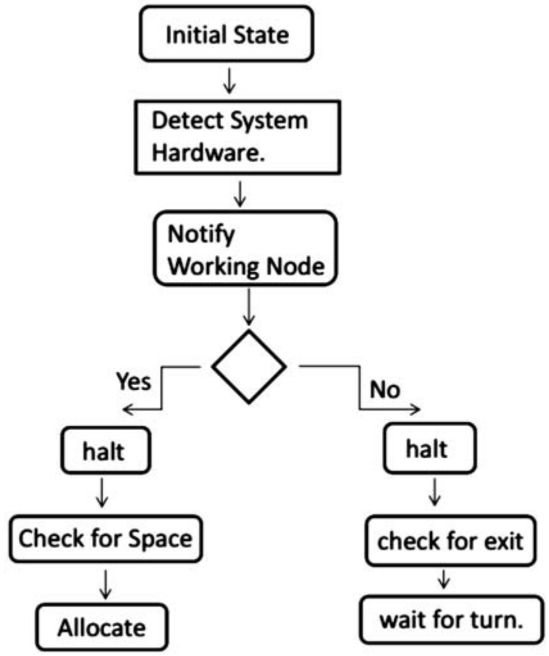

Figure 2: Working Methodology

All the working nodes issues two different kinds of feedback types. A positive feedback means that the system, which further checks for the space availability and all the empty slots, in-order to allocate it for the incoming vehicles. The barricade opens up if there is an available space. If the node issues a negative feedback, eventually the further action is dependent on the time slot provided for the already occupying vehicles have opted for. If a slot is being emptied then the incoming vehicle are kept waiting, or is asked to exit, as there is no more space available. The prime key feature of this system is, it allows time slots for parking. This ensures proper utilization of space and avoids illegal or over utilization of the parking permission.

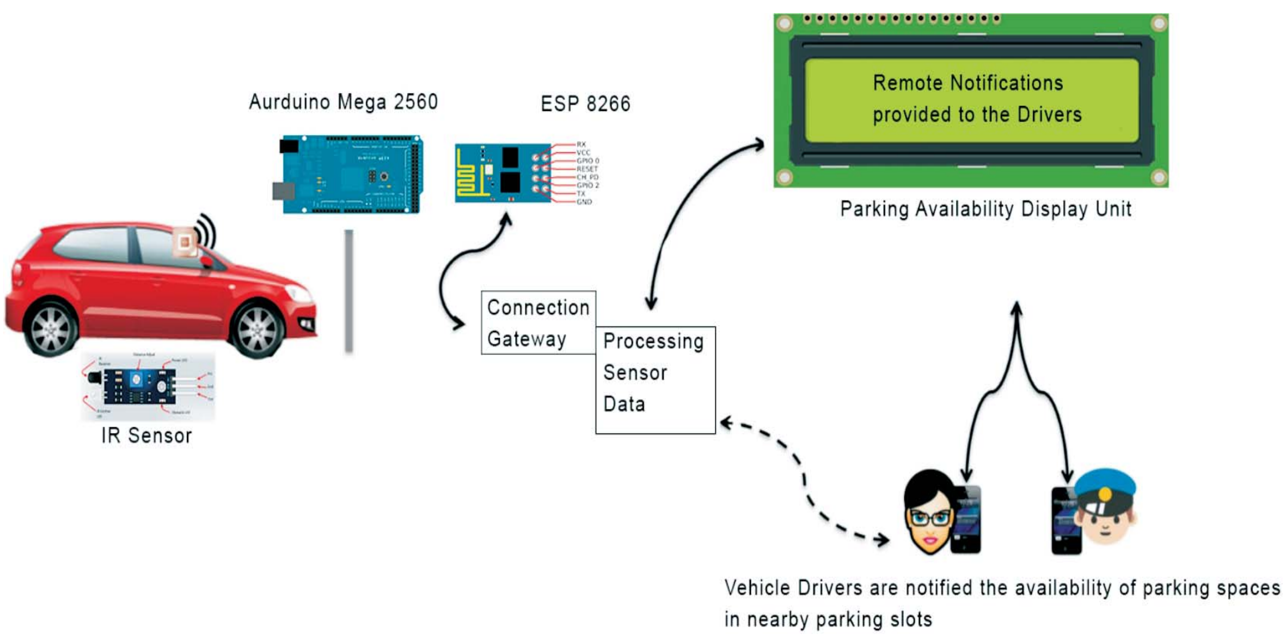

Figure 3: Modular Design

3. MODULAR DESIGN

While refering the proposed system from Fig.(3) we can analyse all the testing activities performed using Arduino and its sensor configuration. To study and ensure proper working, a working model with live feedback is very necessary. Sensors are the prime interceptor of communication and relaying of the messages. In this proposed system, we have implemented Infrared (IR) Sensor to denote all the parking areas present. The main principle behind the working of IR Sensors is by using a specific light sensor to detect a particular light wavelength in the Infra-Red (IR) spectrum. By using an LED which produces light at the same wavelength as what the sensor is looking for, we can check for the intensity of the received light. When an object is close to the sensor, the light from the LED bounces off the object and into the light sensor. This results in a large jump in the intensity, which we already know can be detected using a threshold. This eventually triggers the sensor to transmit digital output to its respective micro-controller denoting by 0 and 1. Sensors like Ultrasonic sensors are also amongst one of the widely used sensors. But the conversion of signal from analog to digital makes the process more tedious. Hence using of sensors with digital signal output is much more preferable is such cases. The modularity of the system is been made, while keeping in-mind to reduce time and space complexity.

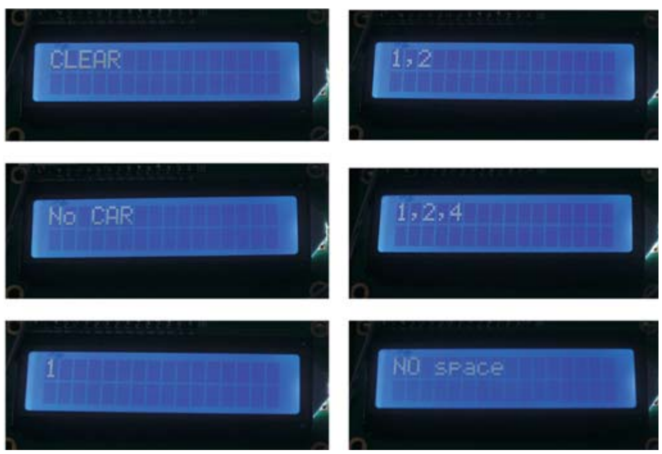

Figure 4: Real-time Parking Space Display

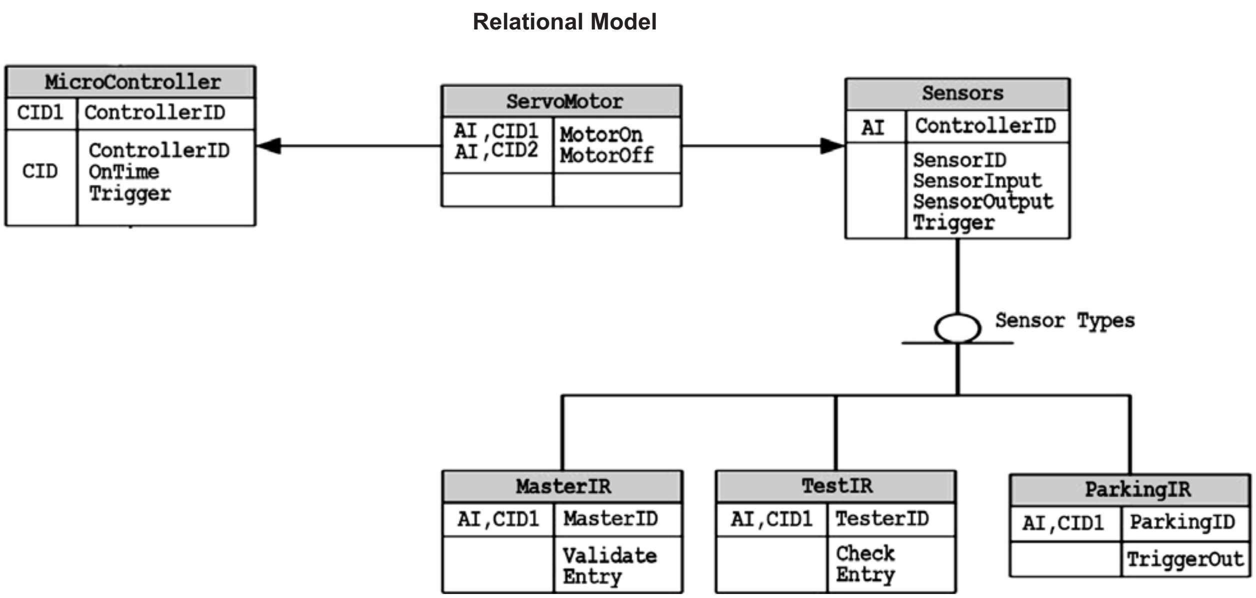

Figure 5: Relational Model Diagram

3.1. Relational Model Diagram

The Relational diagrams Fig.(5) depict the illustrateion of the different logical structure of the databases. At first glance, this diagram looks very much like a flowchart representation. The diagram representation shows the relation of servo motor with the output triggered by the IR Sensor and then eventually sent to the Arduino Mega Board. Each sensor has a Unique ID, with different I/O channel and trigger function to send the output. The model Fig.(6) shows the overall representation of our proposed model.

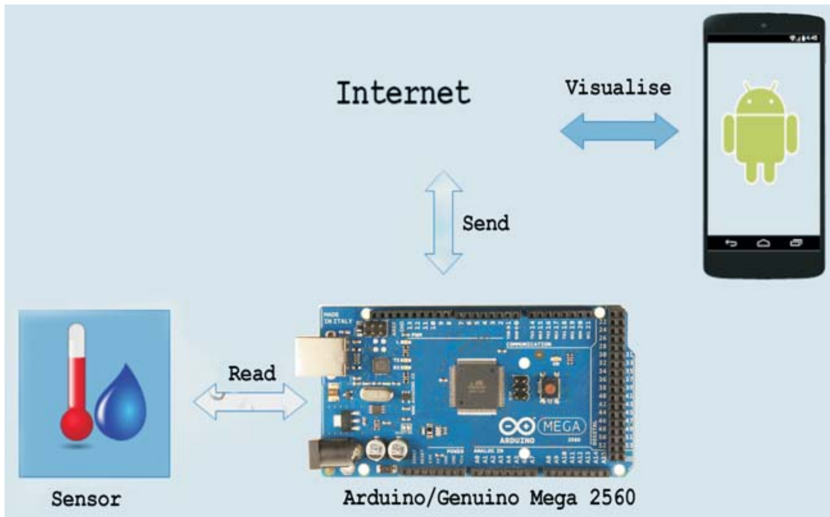

Figure 6: IoT Implementation with Sensors

4. CURRENT SCENARIO

In India, there is an ever-growing population of motor vehicles, which is comparatively much faster in the rate of increase on our economic and population growth. The betterment in the world of technology, by enhancing the mobility while challenging the very existing system, the changes on the expansion of road networks has been eventually brought forward with it. According to the sources from the World Health Organization (WHO) it can be observed that the injuries faced by the road traffic accidents are amongst the major cause of deaths happening in India with a major impact on the countries socio-economic losses been observed mostly in the middle-aged population.

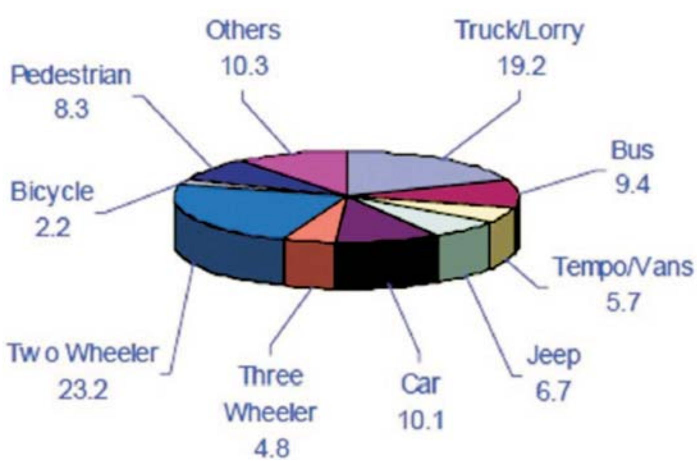

Figure 7: Vehicular Distribution on Roadways

5. PROBLEM FACED

While following the cases of emergency, Fig.(8) depicts certain cases of emergency, where a patient has to be transported immediately to the hospital for emergency life support becomes quite challenging for both the patient and the driver of the ambulance to make it in-time. India has an unusual ever-growing traffic patterns observed, which is difficult to predict. As the ambulance makes its way through the traffic, there is a significant delay caused due to over-crowding of the streets; making it quite a stress full and challenging situation for the ambulance to make it up to the hospital. Considering the vehicles on the road, most of them are searching for their parking spaces nearby; hence by increasing vehicle overcrowding in the streets.

ROAD ACCIDENT PROFILE OF SELECT CITIES (2010)

Sl. No.	Name of city	Total number of				Accident Severity*
		Fatal Accidents	All Accidents	Persons Killed	Persons Injured	
1.	Ahmedabad	226	2135	235	2,124	11,0
2.	Bengaluru	791	6,490	832	5,376	12,8
3.	Chennai	590	5,123	607	4,425	11,8
4.	Colmbatore	264	1,131	274	1,066	24,2
5.	Delhi	2,104	7,269	2,153	7,108	29,7
6.	Hyderabad	473	2,797	494	2,662	17,7
7	Indore	383	4,961	414	4,180	8,3
8.	Jaipur	414	2,000	436	1,808	21,8
9.	Kanpur	558	1,413	640	1,249	45,3
10.	Kochi	153	1,779	166	1,783	9,3
11.	Kolkata	341	2,843	354	2,239	12,5
12.	Lucknow	482	1,275	498	709	39,1
13.	Ludhiana	222	430	227	239	52,8
14.	Madurai	120	568	120	526	21,1
15.	Mumbai	609	28,424	637	5,940	2,2
16.	Nagpur	301	1,548	317	1,404	20,5
17.	Patna	444	1,170	444	606	37,9
18.	Pune	417	1,999	439	1,701	22,0
19.	Vadodara	180	1,335	188	1,121	14,1
20.	Varanasi	234	359	248	126	69,1
21.	Visakhapatnam	437	1,865	460	1,804	24,7
	Total 21 cities	9,743	76,905	10,183	48,196	13,2
	All India	1,19,558	4,99,628	1,32,513	5,27,512	26,9

Note: Accident Severity: Road accident deaths/100 accidents
NR: Not Repeated

Figure 8: Indian Road Accidents Statistics (2010)

6. PROPOSED SYSTEM

The proposed design on Fig.(9) shows the system of Smart Parking Assist System is a revolutionary reformed idea that can be implemented in the real-time. In our country like India, majority of roadways are been covered by the over-increasing number of vehicles from its tremendous population. Taking the approximate ratio of an average car owners passing by daytime over a common route, is much greater than the vehicle population proposed for the roads; which is leading to over-crowding in most of the cases. People moving from outskirts of their city to their main working hubs often face serious problems in order to find available parking spaces. As mostly all the parking spaces are being maintained by private contractors, they remain without proper maintenance; which eventually makes it difficult for users to park their vehicles.

Hence the proposed system can let the users know the availability of the parking spaces even before reaching the place. This system if implemented in the real-time can significantly reduce traffic congestion; as drivers will move for the parking spaces according to its availability.

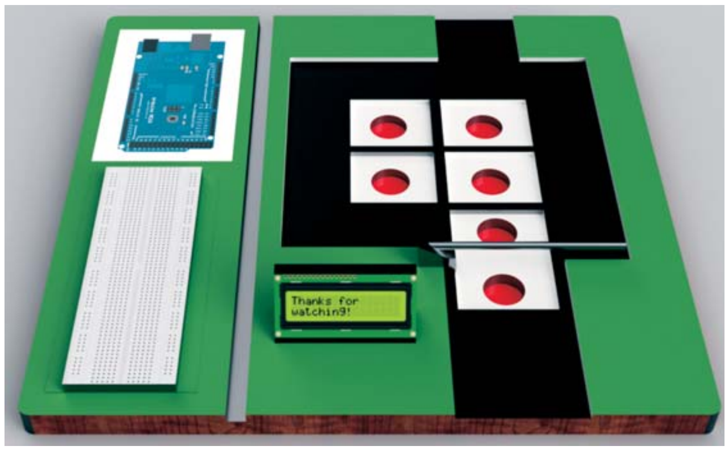

Figure 9: Proposed system Simulated CAD Design

7. SYSTEM BUILD

The system is built based on non-human interaction platform, where minimum human interference will be observed, as most of its processing is done purely based on sensors and micro controllers. Our proposed system is standalone system with very minimal maintenance required In cases like power cut-off, our system is backed up by its own power source, which would make sure that even though DC power is absent, the system still stays online as seen on Fig.(10). Our whole system can be monitored via an open-source platform, which can show all of the processed data output from the sensors available. Our primary goal is to minimise traffic congestion on the roads, by intimating with the drivers with the parking space availability even before they start their commute.

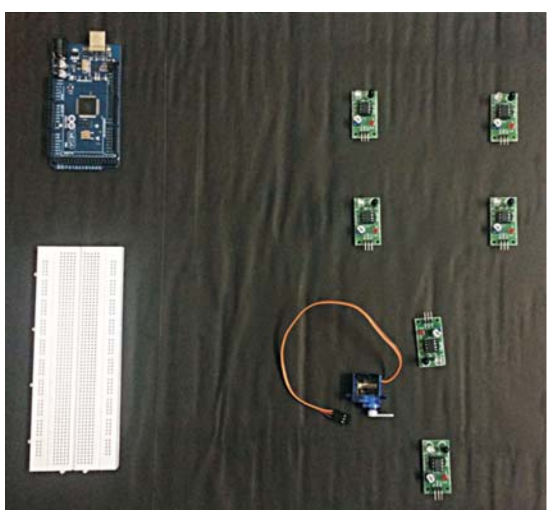

Figure 10: System Built Assembly

8. CONCLUSION

As of now many projects under the domain of smart parking systems are been implemented in real-time, but most of these are inclusive of all expensive hardware or have their certain complex operational setups to be implemented. Hence the implementation of proposed idea would help to save time and complexity especially with low hardware setup cost than the currently existing setup. It is intended that this work will eventually help and persuade the future researchers to move forward working in a new path, instead of improvising already existing methods to enhance the quality of vehicular transportation and parking system.

9. RESULTS AND DISCUSSIONS

The proposed system was implemented and sucessfully demonstrated by a planned working model. The prototype was modelled to implement most of the challenges foreseable in the ested for all possible systems and optimized for robust implementation.

10. FUTURE WORK

The future scope for this Smart Parking Assist System (SPAS) will involve the displaying the availability of spaces over any smart devices through the implementation of Virtual Reality, equipped with advanced satellite navigation system and hardware that would periodically notify all the drivers on the incoming lane by making them aware of whether free spaces are available or not. Real-time info will be displayed on vehicle HUD (Head-up Display) to ease-up the time and navigational complexity shown in Fig.(11).

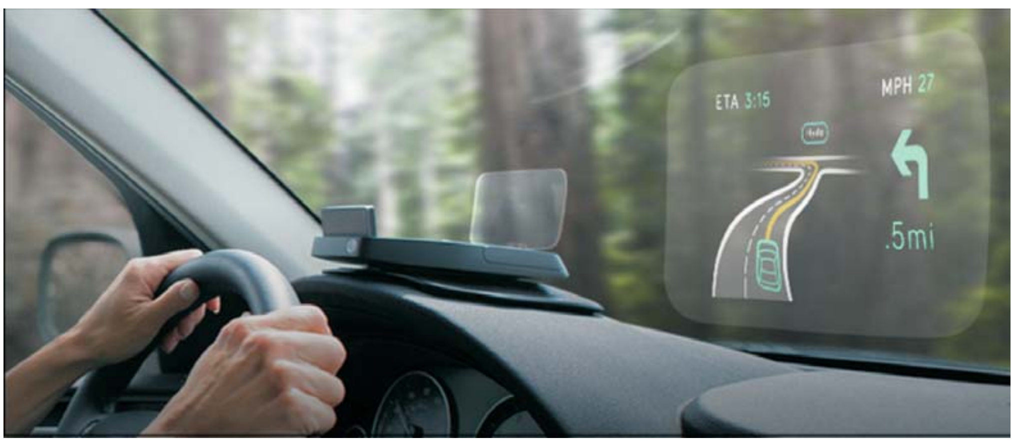

Figure 11: Vehicle Parking display using VR with HUD Integration

11. ACKNOWLEDGMENT

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