REVIEW OF SMART PARKING SYSTEM AND DIFFERENT SENSORS

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Abstract—There is a rise in the number of vehicles on the road and this is one of the major issues in the current world. Parking problems is increasing at an alarming rate in every major city. This is because we do not have a proper infrastructure to deal with such traffic. A lot of research and development is being done all over the world to implement better and smarter parking systems. In this research project, we aim at providing a solution to such existing problems. We conducted a literature survey on existing parking systems. We did a comparative study on different kinds of sensors being used, & built an API based on our research which proposes the best suited sensor for the parking system under a given set of conditions.

Keywords—Smart Parking, Infrared, Ultrasonic, Piezoelectric, Sensors.

I. INTRODUCTION

In the last few years many people have started coming in from the small towns to the big cities. With time they started improving their standard of living and in turn led to the increase in number of vehicles. 15-20 years ago there were no malls or shopping complexes, but now-a-days there are a lot of shopping malls and complexes where a huge amount of people come in everyday to buy day to day stuff. Out of 8760 hours in a year, a car runs for 5% of the time (400 hours approx.) the rest of the time (95%) it is in the parking (DARE Magazine NASSCOM). One thing that haunts people is that now-a-days finding a vacant parking space in the metropolitan cities is a major issue, especially during the rush hours or at times of festivals. Most of the times the parking spaces are left empty because they are remotely located and people are unaware of them. This leads to traffic congestion, people getting frustrated and less footfall. A report tells that 45% of the total traffic is generated by the traffic congestion caused due to searching for parking spaces [1]. There are a lot of smart parking systems that are being used in order to solve these problems, few of them are using the LED board to indicate the number of parking spaces that are left in the parking lot. But that doesn’t help people as they are unable to find those spots on their own.

II. LITERATURE SURVEY

2.1. Smart Parking Systems

The smart parking systems were initially implemented in Europe, USA and Japan (Shaheen et al., 2005)[4] but later on as the other countries started developing, these smart parking systems are being installed in these countries as well. With further advancement in the smart parking systems the problem of finding vacant spaces and all the hassle is going to deprive.

2.2. Advantages of Smart Parking Systems

- Travelers would be aware of the parking space.
- Reduction in time spent to find the parking space.
- Reduced driver frustration.
- Reduction in traffic congestion.
- Elimination of queues.
- Better distribution of flow and parking.
- Revenues and profitability.

2.3 Types of sensors in smart parking

2.3.1 Active Infrared Sensor [2] - Active Infrared sensors are configured to detect the presence of a vehicle by using infrared energy emitted towards the vehicle and then measuring the energy that has been reflected of it. It can be used in different conditions and operations. The sensor is pretty accurate in determining the vehicle position but is a bit sensitive to the outdoor environment conditions.

![Fig.1. Active Infrared Sensors](image)

2.3.2 Passive Infrared Sensor [2-3] - The passive infrared sensors operate on the pyroelectric technology which detects the thermal infrared emissions from the vehicles and thereby converting the signal received into a DC output. Since they
measure the infrared radiation instead of emitting the same, they are known as Passive Infrared Sensors. This type of system is generally mounted above ground for a wider field of view. When a vehicle gets into the vicinity of this field, a significant change is caused in the signal received by the sensor and compared to the steady state when there isn’t any vehicle. The vehicle speed and length can also be inferred using the above technology, hence making it easier to identify the type of vehicle (2-wheeler, 4-wheeler etc.). These systems are sensitive towards the weather as their performance depreciates in conditions like snow falls, heavy rains etc.

2.3.3 Ultrasonic Sensors [4-5] - Ultrasonic sensors are the non-intrusive type of sensors. These are transducers (also known as transceivers), which work on the principle similar to sonar & radar systems and are used to determine the attributes of the vehicle based on the signals echoed back. These sensors can both transmit and receive the signals. These use high frequency sound waves as a medium, which are inaudible to human beings. The ultrasonic sensors send the signal, and wait for it to come back. The signal sent hits the object and bounces back, which is received by the sensors. The received signals are interpreted, measuring the time interval between sending and receiving of the signal, and frequency of the received signal. These are then used to determine the presence of a vehicle, and also the distance of the vehicle. Despite its low power consumption and low cost realization, these are extremely sensitive to changes in environment, such as temperature, pressure, humidity etc. Also these sensors must hit a hard surface to receive proper echoed signals.[7]

2.3.4 Piezoelectric Sensor [6] - These are the sensors which convert kinetic energy into electrical energy when subjected to any kind of vibrations or mechanical energy. These generate electrical signals whenever there is a change in its pressure. These sensors generate an electric charge that is proportionate to the amount of pressure applied. These sensors serve the purpose of not just telling about the passing of a vehicle, but much more additional information. We can get to know about various attributes like weight of the object, speed at which it is passing by, axle spacing and also the kind of vehicle it is by interpreting the above parameters. The disadvantages of the same would be that it requires multiple detectors to set up a proper instrumental location. Also, the sensors are extremely sensitive to high temperature and traffic stress.

III. RESEARCH METHODOLOGY

3.1. Introduction
The research is comprised of two main phases. First phase involves getting the title of the research and determining the objective of this project. The first challenge was to determine the most used sensors in the smart parking systems. And finally to find the most suitable sensor for given set of parameters. Second phase involved some more research on the sensors and gaining the knowledge. In this phase, the literature review on various types of sensor and methods that are being used in the smart parking systems was done. And finally an application interface was implemented on the basis of the comparative study of the various sensors.
IV. DISCUSSION AND IMPLEMENTATION

This literature survey aims on studying the different kinds of sensors used in smart parking systems and a comparative study on the same, as to how different sensors work under different conditions. The table below summarizes the survey on the types of sensors being used in the smart parking systems and their suitability to different parameters.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Active Infrared</th>
<th>Passive Infrared</th>
<th>Ultrasonic</th>
<th>Piezoelectric</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity</td>
<td>Bit</td>
<td>Moderate</td>
<td>Extreme</td>
<td>Not sensitive</td>
</tr>
<tr>
<td>Detection</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Power Consumption</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Low</td>
<td>Moderate</td>
</tr>
<tr>
<td>Cost</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Low</td>
<td>high</td>
</tr>
<tr>
<td>Sensitivity to Traffic</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Highly Sensitive</td>
</tr>
</tbody>
</table>

Thereby, we created an API using PHP, which takes into consideration certain parameters like Traffic, Cost and Environmental conditions, and would give the output proposing the most suitable sensor for the given conditions.

CONCLUSIONS

With the advancements in technologies and rising number of vehicles on road, Smart Parking System has become a necessity for us. The number of vehicles is more, and places to adjust/park the vehicles is less, which leads to many problems. So it is very important that these are implemented properly and solve the problems like driver frustrations, cumbersome parking experiences etc.

So this literature survey focusses on various kinds of sensors used in the market in smart parking system and a comparative study on how do they affect the working of these systems under different conditions is needed, since they affect the working and efficiency of smart parking systems. We came up with an API as a proposed solution, which would suggest the best suited sensor under different kinds of conditions. This would be a great help to the parking owners as it would help them in getting efficient outputs/ results from their parking systems, and also encourage more people to come up with new parking systems with best suited technologies.

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