**LITERATURE SURVEY**

**1) Path Loss Models for Low-Power, Low- Data RateSensor Nodes for Smart Car Parking Systems**

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Smart parking management systems need to keep up with the state of parking spots at all times. This is efficiently accomplished via sensor nodes that detect vehicles and update the system's state as it changes in real time. When sensor nodes use wireless communication as their primary communication link, the deployment approach becomes important, since it directly affects network connectivity, cost, and lifetime. The main factor to consider when deploying wireless sensor networks (WSN) in parking environments is the prediction of radio frequency (RF) signal propagation. Inaccurate propagation models lead to systems that under- or over-perform, both of which negatively affect WSN performance. Most of the existing RF propagation models are created to support cellular systems environments, which drastically differ from indoor/outdoor parking environments-few or no model exists that accurately predict RF signal propagation in parking environments. Therefore, there is a need for models that accurately characterize RF signal propagation in these environments. This paper proposes empirical path loss models for WSN deployment in indoor and outdoor car parking lots. The proposed models are compared with theoretical models. Theoretical models deviate from the proposed models and the measured values by 10% to 46%. The provided models, as well as the measured data, can be used for efficient planning and deployment of WSN in various proposed smart cities, intelligent transportation, and parking lot systems.

**2) A design of automated parking system for shopping centers in Metro Manila**

**AUTHORS:** Ma. Janice J. Gumasing; Charles Aaron V. Atienza

Parking plays a vital role in a customers' shopping experience. It greatly affects the quality of service of shopping facilities due to long queues, long waiting time and difficulties of customers in finding parking spaces. Investing in an excellent parking system can give shopping malls the edge that will keep their customers retention and loyalty. The primary goal of this study is to design an intelligent parking guidance system for shopping centers in Metro Manila that will enhance the customers' experience in parking facility. 5 shopping centers were selected for the study. Structured questionnaires like ServQual tool, gap analysis, process mapping and time study were used in order to identify weaknesses and problems in the present parking facilities of shopping centers. In addition, regression analysis was also employed to determine significant factors affecting the service quality satisfaction of customers. With this, the researchers were able to design an intelligent parking guidance system that will quickly direct drivers to the closest available parking slot. The proposed parking system was validated through Monte Carlo simulation and failure mode and effects analysis. It was concluded that the new system will significantly improve the queuing time and searching time of drivers and thus improve the overall service quality of parking facilities in Metro Manila.

**3) Intelligent Parking System for Car Parking Guidance and Damage Notification**

**AUTHORS:** Sanaa Alfatihi; Soukaina Chihab; Yassine Salih Alj

This paper presents an innovative intelligent parking system (IPS) that has two functions: Car parking guidance and car damage notification. IPS is an advanced automatic driving system that consists of car guidance which proposes oriented assistance for drivers while parking. IPS has some interesting functionalities that ensure an easy parking without damages, parking within less time in any suitable spots and getting a notification if the parked car has been scratched or damaged while the driver is not in the car. The main purpose of the IPS system considers a control car system, an algorithmic move car system and a damage notification system to the vehicle. During the parking process, the driver is alerted by visual and sound signals. The IPS system provides a path planning image that is displayed on the on-board computer system to indicate the directions for the wheels. The damage notification system consists of car-camera shock sensors placed in the front and rear of the vehicle that record the incident when the driver is not in the car.

**4) Automated Parking Space Detection Using Convolutional Neural Networks**

**AUTHORS:** Julien Nyambal and Richard Klein

Finding a parking space nowadays becomes an issue that is not to be neglected, it consumes time and energy. We have used computer vision techniques to infer the state of the parking lot given the data collected from the University of The Witwatersrand. This paper presents an approach for a real-time parking space classification based on Convolutional Neural Networks (CNN) using Caffe and Nvidia DiGITS framework. The training process has been done using DiGITS and the output is a caffemodel used for predictions to detect vacant and occupied parking spots. The system checks a defined area whether a parking spot (bounding boxes defined at initialization of the system) is containing a car or not (occupied or vacant). Those bounding boxes coordinates are saved from a frame of the video of the parking lot in a JSON format, to be later used by the system for sequential prediction on each parking spot. The system has been trained using the LeNet network with the Nesterov's Accelerated Gradient as solver and the AlexNet network with the Stochastic Gradient Descent as solver. We were able to get an accuracy on the validation set of 99% for both networks. The accuracy on a foreign dataset(PKLot) returned as well 99%. Those are experimental results based on the training set show how robust the system can be when the prediction has to take place in a different parking space.

**5) An IoT-based E-Parking System for Smart Cities**

**AUTHORS:** Pampa Sadhukhan

The increasing number of vehicles on the road along with the mismanagement of available parking space leads to the parking related problems as well as increased traffic congestion in urban areas. Thus it is highly required to develop an automated smart parking management system that would help the driver to find out some suitable parking space for his/her vehicle very quickly. Although ample amount of research works on the development of smart parking system exist in literature, but most of them have not addressed the problem of real-time detection of improper parking and automatic collection of parking charges. In this paper, a prototype of internet-of-thing based E-parking system is proposed. The proposed E-parking system uses an integrated component called parking meter to address the above-mentioned issues as well as to provide smart parking management throughout the city.