An IoT-Based Intelligent System for Realtime Parking Monitoring

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ABSTRACT

Abstract— Parking space is becoming harder to obtain as the number of vehicles on the road grows by the day. Looking for parking space is a major problem, especially in large cities or areas where sporting or artistic events are scheduled and finding a parking site can be a frustrating experience. To combat this issue, some parking lots have installed sensors that detect when a car enters or exits a parking lot, allowing them to track capacity and alert drivers if it is full. This is a partial solution that allows drivers to determine whether a parking lot has available parking spaces, but not the exact location of those spaces. The Smart Parking Sensor Network project aims to create a low-cost sensor-based parking system for mapping parking area usage. This system consists of sensor nodes that can detect parking space occupancy; relay nodes that communicate between sensor nodes and the server; a server application that receives data from the relay nodes and sends it to a mobile application; and a mobile application that displays parking areas and occupancy on a map. The vehicle detection sensor node was created using sensors and components that were low in cost and power. A magnetic sensor and a distance sensor were used to create the vehicle detection sensor node. The magnetic sensor detects the vehicle's presence, and the distance sensor confirms it. The mobile application was developed using Android and the server application is hosted in AWS (Amazon Web Services).

Keywords— Smart Parking, AWS, node, magnetic sensor, android

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1. INTRODUCTION

The “Smart Campus” concept is an initiative to use ICT (Information and Communication Technology) within a college Campus to improve the quality and performance of the services, reduce costs and resource consumption, and age more effectively and actively with its members. Smart Parking is a constituent of a Smart Campus that looks to address the issue of parking within a campus. The difficulty in finding available parking spaces within a campus wastes time and fuel and impiousness among visitors and employees. There is no way to know where the available parking spaces are in a regular parking area. By delivering a real-time availability of parking spaces, the smart parking idea directly impacts the sustainability of the University, its revenue, and the level of its service.

The global vehicle population stood at 1.32 billion cars and trucks by the end of 2016. This number is more than double the amount compared to 20 years ago. On top of it all, vehicle production and sales aren’t showing any signs of slowing down. By 2035 it is expected that there will be almost 2 billion cars on the road, and some think it could be even sooner. With this staggering growth of vehicles but a limited amount of parking availability, the parking environment needs to adapt.

This parking system consists of sensing devices to determine the occupancy of the parking space, a network to transfer data, a server application to process the data, and a mobile application to display the occupancy of the parking spaces. Smart parking is a huge industry overseas, but not in Sri Lanka. Because of that, all the components should be bought from foreign vendors to implement a smart parking system, which includes the vehicle detection node, the relay node (to communicate between server and sensors), and the applications. The average price of a

vehicle detection node is 3000-8000 and the average price of a parking system is 5-6 lacs per year (excluding taxes and delivery cost). Therefore, it is prohibitively expensive for a developing country like India to deploy large-scale smart parking systems using imported components. To address this issue, this system presents a low-cost solution, which can be developed within the country and deployed on a mega scale.

2. LITERATURE SURVEY

Authors of [1] proposed an approach based on GCNN and an LSTM model to forecast real-time future parking availability by capturing both the temporal occupancy patterns and the geospatial interactions in traffic flow. Different model configurations were evaluated by varying the information fed to the model (e.g., weather forecast, parking violations), the extent of historical data used, and the forecasting period. Experimental evaluation over historical parking data of the city of Tandil in Argentina showed that the proposed approach was able to outperform other state-of-the-art models significantly.

This system[2] elaborates on pilot research on improving truck parking facilities cooperated with the Washington State Department of Transportation (WSDOT), building, and testing the advanced Truck Parking Information and Management System (TPIMS) with the real-time user visualization and prediction function empowered by artificial intelligence. Furthermore, by analyzing the activities of truck drivers, the researchers aggregated the regularity of truck parking patterns by a customized sequential similarity methodology. A Truck Parking Occupancy Prediction (TPOP) neural network for time-variant occupancy prediction by deep learning and attributes embedding is proposed and integrated into the TPIMS.

This paper[3] investigates a range-free approach to identifying spot-level parking availability. The author employs a monocular RGB camera installed in a vehicle and a computer vision-based object tracking mechanism to perceive the surrounding parked vehicles. Analyzing the time series of object tracking results and matching them with a digital map of a parking facility, the system identifies the availability of each spot without requiring depth information. The simulation results show that the proposed range-free parking availability sensing system can detect spot-level parking availability with an average accuracy of 83%.

3. SYSTEM ARCHITECTURE AND METHODOLOGY

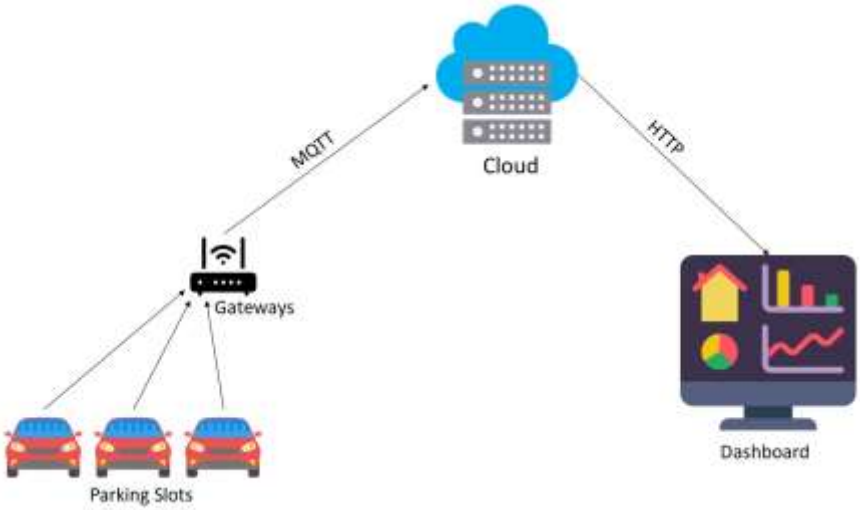

Fig -1: System Architecture

The system architecture of the solution is given in Fig. 1. This architecture consists of three main sections: a sensor network, a server, and a mobile application. The sensor network consists of vehicle detection sensor nodes and relay nodes. Sensor nodes connect to relay nodes through a wireless communication medium (Wi-Fi/MQTT). Relay nodes connect to the server through a wireless communication medium (Wi-Fi). Sensor nodes do not connect to the server

through the outer network because these nodes are designed to be low cost with limited communication capabilities. The relay nodes are more powerful and will transfer data using the MQTT (Message Queuing Telemetry Transport) protocol. The server application will be on the Internet and will send data about the occupancy of parking areas when requests come from the mobile application.

4. CONCLUSIONS

In this proposed system, an inexpensive solution is proposed to design and develop a smart parking sensor network with an Edge device, Cloud, and mobile application, and, magnetic and distance sensors. Vehicle detection nodes were designed along with the vehicle detection algorithm. The cost of these nodes is very less compared to existing available products.

5. REFERENCES

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