

IoT-enabled smart car parking system for smart cities

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Description:

Over the last two decades, car parking in urban areas has become a major concern for urban managers in most large cities all over the globe. This is mainly due to car ownership and use keep growing faster while urban space becomes infrequent. As a result, traffic conditions tend to deteriorate, and the loss of time while searching for parking has substantially increased in many congested cities. Experts estimate that about 30% of urban traffic is caused by motorists looking for parking. In a previous study, the traffic in a 15-block district in Los Angeles has been measured for a year. As a result, researchers have found that drivers drove more than 950,000 miles, have produced about 730 tons of carbon dioxide, and have used about 178,000 liters of gas searching for parking. Smart car parking could minimize traffic congestion, reduce carbon emissions, and eliminate labor inefficiencies associated with parking management. As an application of IoT technology, the system to be built in this capstone project must assist the motorists in searching and selecting an appropriate free parking space based on its proximity to their ultimate destination. The data collected by the system must be sent to the cloud database, a centralized server which houses the information about parking areas, availability status, parking time durations, parking reservations, parking capacities, parking costs, and motorist's position with respect to parking areas. The system must be able to assign and reserve a parking space for a motorist based on its distance from a given parking area, the parking cost as well as the overall parking capacity. Considered as an optimal resource allocation problem, this functionality adds new constraints to the design problem and makes the target system different from existing ones. At this point, the project provides students with some scope for design creativity.

Radio-frequency identification (RFID) devices together with Infrared (IR) sensors are used as part of the IoT system to keep track of the above information for each parking lot. A wireless sensor network (WSN) connects the IoT system to the cloud server through a gateway that interfaces the WSN to the Internet. Existing smart parking systems typically use Bluetooth, Zigbee or Symphony Link to allow for two-way communication with sensor devices. In this project, it is suggested to use Bluetooth Low Energy (BLE) to achieve an energy efficient smart parking system. Finally, the actual vacant parking spots associated to the selected parking lot, the parking cost and the distance to the parking area must be displayed on the screen. The most efficient implementation in terms of cost, size and energy consumption must be achieved.

Requirements:

The student should have the following skills: • Good programming skills in C++ or Java (COEN 244). • Understanding at all levels of microcontroller-based system design and implementation (COEN 317). • Familiar with optimal resource allocation mechanisms (COEN 346). • Knowledge of networking and communication protocols (ELEC 463 or ELEC 464 or COEN 445 or COEN 421). • Familiar with a variety of hardware and software implementation technologies such as those used in embedded computing systems (COEN 317 or COEN 421 or COEN 422 or COEN 446 or COEN 320).

Tools:

Hardware: • Raspberry Pi with BLE built-in or Arduino board and BLE module. • IR receivers/transmitters. • RFID readers, antennas and passive (or active) RFID tags. • GPS receiver. • Other IoT hardware (Intel XDK and IoT is also an option). Software and online services: • Samsung ARTIK Cloud for IoT (free at artik.cloud). • Google Maps or any other free platform. • Mobile or Web application which provides

information to users. Programming languages: • C++. • JavaScript.
• HTML.