Mobile Application for Identifying Anomalous Behavior and Conducting Time Series Analysis using Parking Lot Data

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Introduction

The primary focus of this project is to collect data from parking lot over time and perform time series analysis. Time series analysis is a method used to analyze and interpret data points collected over time. It involves studying a sequence of data points, typically ordered by time, to identify patterns, trends, and relationships within the dataset. This analysis enables the extraction of meaningful insights, making it useful in the identification of recurring patterns in parking lot occupancy over time. This information aids in predicting future demands, enabling parking administrators to allocate resources efficiently during peak hours and optimize space usage. It can be used in detecting irregularities in parking patterns, aiding in the prompt identification of unauthorized or abnormal parking and parking violations which includes parking of wrong type of vehicle, parking at restricted or reserved area.

Information Gathering Module

This work presents a mobile application that performs time series analysis and anomaly detection on parking lot data for decision making. There are two modules involved:

1. Information Gathering Module.
2. Time Series Analysis Module.

In the Information Gathering Module, users are able to drop pins in their parking lot (refer figure 1 & 2), and in Time Series Analysis Module, users can analyze the pins they dropped over a period of time (refer figure 3 & 4).

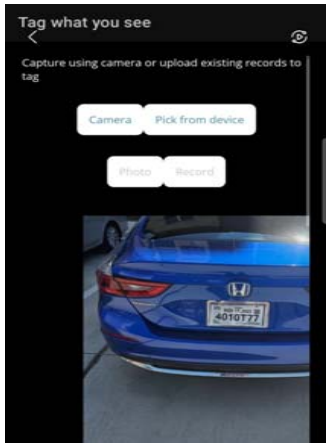

Figure 1. Capturing image of vehicle at parking lot

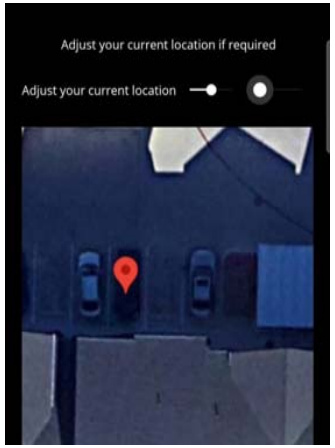

Figure 2. Adjusting the current location

Time Series Analysis Module

Efficient parking lot management is a critical aspect of logistics, directly impacting user experience, security, and resource allocation. The pilot research in this project involves developing a mobile application that collects parking data over time to leverage time series analysis. By analyzing data collected over time, this approach aims to provide valuable insights into parking lot dynamics, leading to better resource allocation, demand forecasting, and improved operational efficiency.

Figure 3. Home page with pins

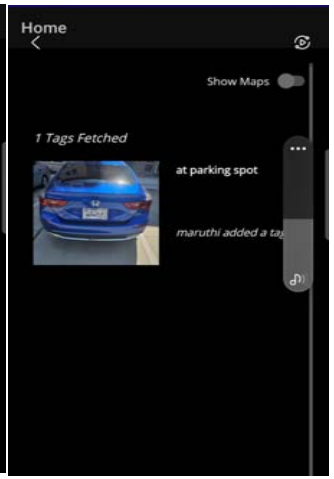

Figure 4. Detailed information about the pin

Anomaly Detection

Our approach uses parking pins to identify each vehicle and then collect specific data, such as temporal variables like latitude, longitude, time, date, and text (information from the license plate), as well as images and videos shot at the location. Users have the option of placing pins at the location where their car is parked, and the information collected can be used for time series analysis and pattern recognition. By examining the data pattern, we may quickly identify vehicles parked in restricted spaces but without authorization and vehicles parked in disabled spaces but owned by regular users. Using this information, the public safety personnel can easily take the proper action.

Conclusions

This project can be used in Anomaly detection, particularly in scenarios such as unauthorized parking in restricted or disabled areas, is essential for maintaining order and ensuring the proper use of public spaces. Time series analysis of parking data becomes a crucial tool in identifying deviations from expected patterns. By leveraging historical data, anomalies like vehicles parked in restricted zones or unauthorized use of disabled parking spaces can be swiftly detected. The analysis allows for the establishment of baseline parking behavior, making it possible to set thresholds for normal activity. When anomalies occur such as a vehicle being parked in a restricted area without proper authorization the system triggers alerts or notifications for timely intervention. This not only enhances security and compliance but also helps in the effective enforcement of parking regulations, contributing to the overall safety and accessibility of public spaces..

Future Work

This project can be scaled and deployed in polar regions to do topographical time series analysis where we focus on how the height of the ice shifts throughout the course of these images. The ice is melting or decreasing if, over time, we see that it is getting lower or thinner. Understanding how the ice is changing will help us better understand how polar regions are being affected by climate change and how sea levels are rising.

Acknowledgments

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Publications

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