



Automated Car Routes to Their Parking Spots in Parking Areas Using Machine Learning

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AUTOMATED CAR ROUTES TO THEIR PARKING SPOTS IN PARKING AREAS USING MACHINE LEARNING

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Abstract—Parking places are very important all over the world especially in the metropolitan cities of the countries. Every day hundreds of automobile drivers spend lots of the time to find wherein to park. The end result of this example is theft in urban areas, growing traffic congestion and frustration of drivers. In order to solve this problem, a study has been carried out to use a smart parking application that utilises machine learning algorithms to help in providing automated car routes to their parking spots in parking areas at Galgotias University, Gautam Buddha Nagar, Greater Noida, India. Parking statistics become collected over a 4 week period and the WEKA Machine Learning Workbench changed into used to discover excessive-appearing algorithms for predicting future parking occupancy costs and provide automobile routes in parking regions as a consequence.

I. INTRODUCTION

The net of factors (IoT) revolution vows to change our city regions into extra liveable places. Open access to large records is assisting innovators with conveying the smart metropolis vision through utilising innovation to enhance current offerings and make new ones. The finest additions from this variation are relied upon to come back from the utilisation of AI and computerised reasoning in tackling actual problems, for example, traffic congestion and environmental contamination. clever parking is a incredible illustration of the way IoT innovation, information and AI may be consolidated to enhance individuals' lives. super parking frameworks don't clearly clean out the stopping revel in for drivers but similarly help in placing aside their time and cash, decrease strain, and might virtually have an effect on lowering congestion and contamination. it is assessed that among 30 to 45 percent of visitors in metropolitan cities is contained cars hovering for empty areas [1]. glaringly, tending to this trouble is likewise within the greater big hobby of the network.

There are numerous interpretations of clever parking systems globally and with each distinctive generation there are alternate- offs. committed parking sensors are popular and rather dependable but rather steeply-priced, generally requiring one sensor in line with parking space [2]. Cameras can provide broader insurance according to unit and decorate public protection, however they face issues with physical obstructions and occasional mild ranges [2] [three]. smart-telephones are reasonably-priced, flexible and extensively dispensed however depend on person participation and/or ongoing permission from customers to get admission to their statistics, therefore raising issues round man or woman privateness [2] [four]. smart parking structures normally produce actual-time records, in order that drivers could make higher-knowledgeable alternatives approximately their

instantaneous parking options. however, not all structures use system gaining knowledge of, which extends actual-time statistics via allowing predictions approximately destiny parking availability to also be made that facilitate better ahead planning. This examine focuses on the system independent information and device getting to know factors of smart parking structures. All smart parking systems generate information, so each has the capacity to apply device mastering algorithms in this information to enhance the utility of the system.

This paper provides a top level view of diverse smart parking packages and describes the pilot layout of a clever parking machine that has been developed for university Campus of Galgotias university, more Noida using some properly-recognised gadget studying algorithms. The closing sections of this paper are structured as follows: phase II describes the state of artwork within the domain of clever parking. section III elaborates the method adopted for this have a look at. The results and findings of this investigation examine are summarised in section IV and V. A end is supplied in segment VI of the item.

II. RELATED WORK

This phase presents a short summary of state of artwork in the region of clever parking applications plan. In [2], the creators have given an inner and out evaluate of the qualities, upsides and downsides of smart parking frameworks conveyed in the length 2001 to 2017. The creators utilise three classifications to realise framework types: foundation (sensors); vision, and crowd detecting. in any case, in advance and preservation expenses can have an effect on supportability and scalability, as located in San Francisco. vision-based totally frameworks are given broad inclusion for their destiny potential yet a massive portion of these frameworks are presently restrained to scholarly research. cost and versatility are promoted as key focal factors over specific methodologies, yet unwavering excellent of image making ready in authentic situations is a progressing project. determine 1 sums up the critical highlights of mainstream packages created round there.

There are approaches wherein statistics from crowd sensing apps is obtained- manually as well as automatically. by means of crowd sensing, we can estimate the quantity of automobiles entered inside the parking and therefore supply a suitable route to the car in step with its length to their respective spots. but, once the cameras are fixed, we do not want to get an estimate, since the software will do the work on its personal and show the route

URL	Coverage	Mobile				Off-street			
		Stats	Pay	Reserve	Location	Prices	Pay	Reserve	
www.parkme.com	4200 cities, worldwide	✓	✓		✓	✓	✓	✓	
en.parkopedia.com	6308 cities, worldwide	✓			✓	✓	✓	✓	
parknav.com	70 cities, USA & Germany	✓	✓						
www.waze.com	N/A	✓			✓				
maps.google.com	25 cities, USA	✓	✓		✓				
www.wazypark.com	Big cities, Spain	✓		✓	✓				
www.aparcandgo.com	Airports/stations 2 cities, Spain	✓			✓	✓	✓	✓	
www.parkapp.com	16 cities, Spain	✓			✓	✓	✓	✓	
www.wesmartpark.com	2 cities, Spain	✓			✓	✓	✓	✓	
parclick.es	170 cities, Spain & EU	✓			✓	✓	✓	✓	
www.telpark.com	+60 cities, Spain & Portugal	✓		✓	✓	✓	✓	✓	
www.e-park.es	13 cities, Spain	✓		✓					
www.parkwhiz.com	+200 cities, USA	✓			✓	✓	✓	✓	
www.streetline.com	N/A	✓	✓		✓	✓	✓	✓	
www.bestparking.com	+100 cities & airports USA & Canada	✓			✓	✓	✓	✓	
www.spotooops.com	Worldwide	✓		✓					
www.justpark.com	+1000 cities, UK	✓			✓	✓	✓	✓	
parktag.mobi	7 cities, EU	✓	✓	**					
www.peertopark.com	Nationwide, Spain	✓			✓	✓	✓	✓	
www.aparcalia.com	3 cities, Spain + airports & stations	✓			✓	✓	✓	✓	
www.carpling.com	Nationwide, 13 countries	✓		✓					
www.appyparking.com	11 cities, UK	✓	✓	✓	✓	✓	✓	✓	

Fig. 1: Smart Parking Apps[2]

to the parking spot within the software. figure 1 highlights the distinction between the identical.

The universality of smart phones helps in achieving critical mass and reliable data from users a big challenge in these systems. Furthermore, users need to make sure that their app is run constantly. For crowd sensing, stimulation of participation and encouragement of quality input can be obstacles. As derived from the figure, Wazypark in Spain has tried to increase user engagement with the help of additional features other than the obvious. Comparing local petrol prices is definitely a vital addition. A key observation about the main objectives of off and on street parking apps states that the former aim to identify cheap parking closest to the destination while the latter seeks to reduce competition for limited spaces.

The apps that utilise machine learning have big potential to generate highly accurate predictions about available. Vision based systems have more potential than sensor based approaches which have cost constraints. Data can be fed to the Machine and put algorithms so that it provides parking spots to different cars according to their sizes, such as different spots for MUVs, Sedans and Hatchbacks.

A smart parking system relying on smart phone sensors can also estimate car parking availability. Each machine's journey is plotted using GPS to be compared with those arriving at the same location. Using a set of google APIs the commuter's transition from driving to walking is predicted which further helps the system estimate when a vehicle was parked. Parking information is displayed through a heat map that displays parking activity in a given area. But the heat map doesn't directly depict parking space availability, it only shows commuter activity. Journey comparison may be better in a car pooling application.

Description of Smart parking systems can be classified into three categories-information collection, system deployment and service dissemination.

While crowd sensing and gap parking (an Uber like approach in order to access privately owned parking) are cost effective, issues of user privacy can not be ignored. In regards with data analytical in parking vacancy prediction, real time days will only be helpful when drivers are close to available spaces.

III. METHODOLOGY

Car park occupancy data was collected from a sub-sample of 20 car parking spaces (out of 60) at the Galgotias University Campus over a four-week period during the

winter month of November in 2020. Since parking sensors were not installed at the time, the actual number of cars occupying the sub-sample was counted manually at 15 minute intervals between the college hours from 8 am and 6 pm from Monday to Friday of each week. The data for class load i.e. class hours being held at any given time was extracted from Galgotias' timetabling database, corresponding to the same four-week period.

Following five machine learning algorithms were tested using the WEKA Machine Learning Workbench [7]:

- K-Nearest Neighbour (instance-based model)
- K Star (instance-based model)
- Linear Regression (linear model)
- Multi-Layer Perceptron (linear model), and
- Random Forest (tree-based model).

Random woodland became selected because it has been used effectively in other smart parking eventualities [four][8]. the other algorithms were selected arbitrarily to check quite a number algorithms. example-based totally models represent the simplest form of gadget gaining knowledge of. they may be a kind of lazy gaining knowledge of requiring no guidelines or trees. rather, new times are categorised according to their resemblance to times within the education set. Linear models create an equation that describes each elegance within the schooling set. The cost of every equation is calculated for every new example, with the equation yielding the largest fee being the selected magnificence. Tree-primarily based fashions use the divide and triumph over approach to the type of times. instances are divided from each other to gain the finest facts benefit in the pursuit of order (low entropy) [9].

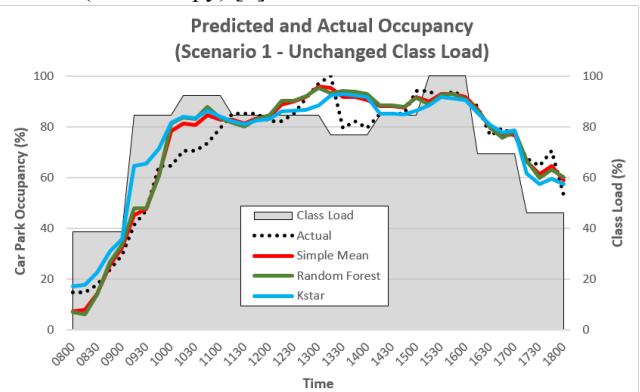


Fig. 2: The class load, predicted and actual occupancy (Scenario I)

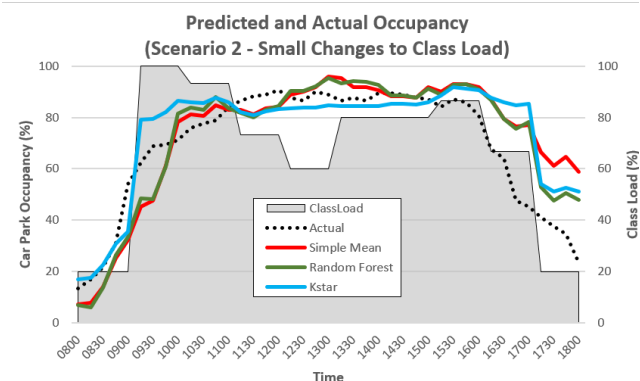


Fig. 3: The class load, predicted and actual occupancy (Scenario II)

Three scenarios were devised to test the ability of algorithms to make accurate predictions about future car parking occupancy rates when:

- elegance load remains the same from sooner or later to the following (situation I)
- class load adjustments fairly from sooner or later to the next (scenario II), and
- magnificence load modifications dramatically from at some point to the next (scenario III).

In scenario I, every algorithm become skilled the usage of occupancy and sophistication load information from each Monday inside the first 4 weeks to generate occupancy predictions for the Monday of week 5. In situation II, every algorithm became trained using occupancy and sophistication load facts from each Monday to generate occupancy predictions for friday, using the Friday class load. state of affairs III become devised to check the algorithms the use of a totally one of a kind magnificence load i.e. the inverse of Mondays elegance load, resulting in a high class load morning and evening and a low elegance load throughout the running day. although it is highly not likely any such class load might ever exist, the factor became to check the bounds of the algorithms in an altogether unique situation. The common rate of occupancy for every 15-minute interval for Monday of the primary 4 weeks turned into calculated (labeled simple imply), as a benchmark for measuring the performance of gadget getting to know algorithms in each scenario. In each state of affairs the magnificence load became normalised by representing it as a percentage of the highest variety of training being held on that given day.

IV. RESULTS AND APPLICATION DESIGN

This phase describes the results of set of rules overall performance for the three situations mentioned in section III.

A. Scenario I

The results for every set of rules underneath state of affairs I have been similar, intently tracking the imply and actual car park occupancy charges. the connection between magnificence load and occupancy can also be surely seen in figure 2 - (ok-celebrity and Random forest are shown). The easy mean turned into the first-class predictor of destiny availability on this state of affairs, exhibiting the bottom suggest mistakes price as highlighted in Figure 4.

B. Scenario II

The Random forest and k big name algorithms done exceptional in situation II, albeit marginally, and neither set of rules anticipated the located drop in occupancy from 4pm as virtually visible in parent three. each algorithms exhibited an average errors of about nine percentage, compared to approximately 10.5 to 14.5 percent some of the different algorithms as highlighted in determine four. curiously, the simple imply, primarily based on records from Mondays, changed into nonetheless an affordable, although poorer predictor of Friday occupancy rates, demonstrating that patterns of use were very similar on these days.

C. Scenario III

In situation III best okay-superstar regarded to reply proportionately to the extensively altered class load as highlighted in figure five, however, there is a query about

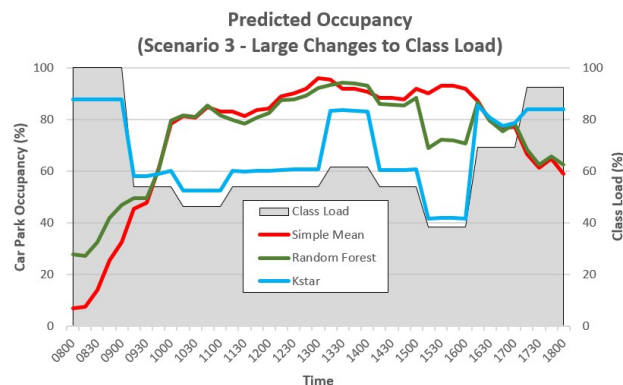


Fig. 4: The class load and predicted occupancy (Scenario 3)

whether overfitting to the elegance load occurred. Random woodland persevered to tune the (now redundant) simple imply on this state of affairs, really discrediting its predictions.

D. Pilot App Design

This phase describes the layout of the pilot application that has been devised to incorporate the capabilities highlighted earlier in the article. The layout of the pilot smart parking application that turned into formulated after research into the currently available packages as highlighted in section II with the aid of consisting of the following features inside the layout:

- easy and intuitive design with minimal user input
- Map-primarily based
- Having easy visible cues i.e. red for low availability and green for higher availability
- imparting real time parking availability (At this degree the information has been accumulated manually for the reason that sensors are not but set up, but there is scope for actual-time facts in a destiny version)
- offers predictions of future availability the use of machine mastering.

since the on-campus parking at Galgotias university Campus is free and no longer time confined, this app will no longer consist of capabilities consisting of price facilities, expiry alerts and bookings that are wanted in industrial settings. however it should be stated that those and some different capabilities can be without difficulty added in future variations of this application. The screen shot shown in figure 6 suggests the person Interface (UI) of the Android model of the smart parking app.

V. DISCUSSION

maybe of course, whilst situations are consistent, as in situation I, making use of gadget gaining knowledge of to foresee future parking spot accessibility is not important. right here, the simple mean is a advanced indicator of future vehicle depart accessibility. due to the fact device mastering is computationally costly, on the off chance that it is not wished, it ought now not be conveyed. From state of affairs II, which is maximum like this gift truth, plainly gadget getting to know calculations can growth the fee of a exceptional parking gadget. statistics from stopping sensors can be joined with facts about the known drivers of preventing hobby to precisely foresee future accessibility.

This speaks to a massive worth upload to continuous facts, that's exclusively focused round the prevailing time and area. A portion of the arena's excellent superb stopping applications, for example, ParkRight[10] in London, may be additionally stepped forward through using system learning to create expectations. despite the reputedly questionable predictions utilizing Random Forests in scenario III, it's miles sizable that this set of rules isn't excused out of hand as the scenario turned into severe. equally, it can't be assumed that the more realistic looking outcomes the use of ok-star are reliable. as an alternative, these outcomes factor to the feasible limitations of the

Random forest algorithm and the ability application of the KStar algorithm in occasions which are a large departure from prevailing conditions. A key obstacle on this examine become the fairly small volumes of statistics used. there's no limit to the additional layers of data that would be delivered in future research, which includes pupil and workforce numbers according to elegance, special events, weather, neighborhood visitors situations, public transport offerings, etc. including such data to the occupancy and class load information could substantially improve the accuracy of gadget getting to know predictions under all situations.

VI. CONCLUSION

Most of the sector's smart parking structures gather and share real-time facts with their clients thru smart-cellphone packages. the next logical step for these systems is to utilise gadget getting to know algorithms on that facts to expect future availability and unique features inclusive of assisting the drivers in providing the direction in parking areas to their respective parking spots in line with their sizes. in which actual-time clever parking systems have the ability to lessen visitors congestion, system-getting to know clever parking structures have the capability to put off site visitors congestion altogether. destiny work of this challenge includes deployment of parking sensors at Galgotias university campus with a view to imply that actual-time parking facts can be accumulated on an ongoing basis. because the dataset expands, machine studying will screen in addition insights about on-campus parking utilisation. Augmenting the parking statistics with facts from different phenomena that have an effect on call for may also be explored in destiny work. Leveraging smart-cellphone data, and including different features to the app to develop its enchantment are specially areas of interest for destiny variations of the app. this is anticipated to give upward thrust to a wiser parking utility this is even higher at predicting destiny parking availability and eliminating the congestion and pollution in looking for parking causes.

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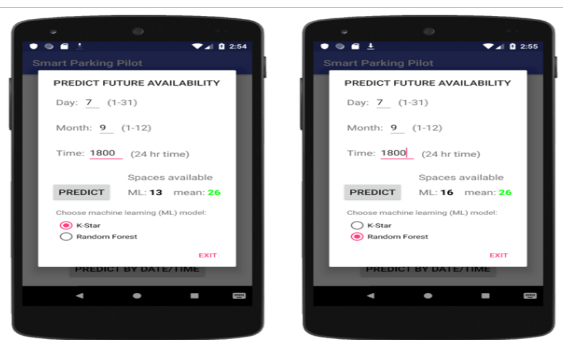


Fig. 5: Smart-Parking App User Interface-Prediction

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