Spot Finder

"City parking made easy"

Intro & Goal:

Spot finder allows users to find, reserve, and navigate to a parking spot near their destination.

Why build it?

- It is time consuming and frustrating to find parking spots
- Contribute to climate change by reducing greenhouse gas emissions

Who uses it?

User Types:

1. Anyone who needs to park in urban landscape
2. Anyone who wants to contribute to fast and efficient parking
3. Parking controller

Brainstorming Features & Functionality:

Data collection: collect information about nearby parking spot
Ideas
1) Users mark a lat lng as parking spot on the app
Pros: compatibility with navigation app, no conversion needed
Cons: not very precise as the MSE in Google Map is larger than the width of a parking spot, a lot of work for users to mark each spots
2) Use satellite images to extract parking lots
Pros: scalable, not much manual effort involved
Cons: Accuracy might be low due to resolution. Images might not be updated for a long time
3) Have dedicated personnel to drive around a city with a camera. Conduct image recognition or manual marking for parking spots
Pros: Higher accuracy than 2), more scalable than 1)

Cons: Cost a lot of man hours to drive around the city

4) Similar to 3), but have users/volunteers drive around the city

Pros: Cheaper than 3), scalable as we crowdsource data with multiple users

Cons: Challenges in persuading people to install cameras for the purpose of data collection. Maybe we can partner with Uber/Lyft drivers on this.

5) Use high resolution cameras mounted on tall buildings. Parking spots would either be marked by someone. It'd also be interesting to use AI to mark free and taken spots. The downside it will likely be hard to find good spots to place cameras. Also trees and likely other high obstacles will obstruct vision so information will be incomplete.

6) Use a fleet of drones to collect and control parking spot info. This might be quite expensive but would also be a flexible way of approaching data collection. Also this could be done once to collect most current data and then occasionally we'd do another run. It suffers from similar problems than 5) with plenty of parking spaces being obstructed due to trees.

7) For underground or covered spaces existing system could be upgraded to accommodate reserving parking places. Plenty of malls already have a system in place that counts number of free spaces and marks a space occupied with a green/red light. A logical next step could be adding reservation of a spot. Also I think they are highly motivated to provide easier access to customers. The downside of integrating with such a system is that this doesn't cover outdoor spaces.

8) One option for finding parking spots is also to reduce granularity and instead of providing a single spot to a single user the app would suggest an area of 2, 4, 8 parking spots with at least one free space. Since other drivers might take the place while going to a destination this might help reduce frustration due to not getting that exact parking spot but still would allow for reducing pollution due to reducing the time to get to a free spot.

Work done

1) I've tried Amazon Rekognition for fun on a parking lot right in front of my flat. I was a bit disappointed since I expected it to recognize cars well
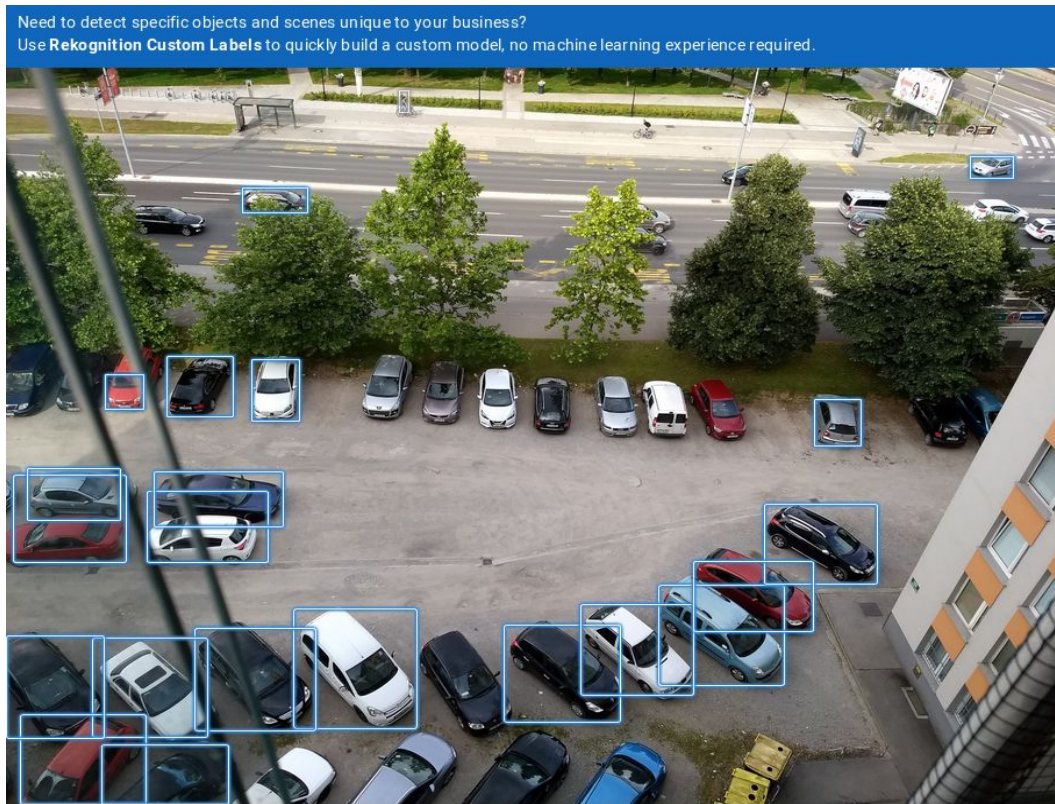
Identifying available parking spot and make reservation
Ideas
1) Use blockchain/smart contracts to keep track of available parking spots. Reserve a spot once a spot is identified and make the transaction. Verify car identity upon arrival.

Pros: Efficient, secured, and fast depending on the implementation
Cons: Blockchain technology itself consumes a lot of energy (needs to conduct analysis on the tradeoff on greenhouse emission). Challenges integrating with existing parking meters and non-participants. Hard to enforce rules for street-parking.

2) Figuring out the most environmentally friendly path to a free parking spot is quite a challenge. One way to approach the problem might be through traditional pathfinding (A*, IDA* with a well crafted heuristic). Maybe it's possible to hook into existing GPS software with custom software to guide user to a free spot.
3) Another idea for payments is a monthly/weekly subscription where within that period user is free to reserve any spot in an area. Cities usually split parts of town into zones, so subscription could be zone based.

Navigation
Ideas

1) Google
2) Custom built-in navigation

Parking control

Reserving a spot is one problem but another is how to handle fairness of such a system. Things like preventing misuse, coercing users into accepting such a system, rewarding good behaviour, possibly punishing system abuse.

Ideas

1) Parking spots could be fitted with hardware that physically prevents access and would allow access to users that have reserved the space and are right in front of it, possibly through detecting user location. This would require a substantial investment since many parking spots are not protected in any way. Also this system might require a lot of maintenance due to hardware needing eventual replacing.

2) Use existing inspection that already handles parking spot fines. They could get access to an administrative part of spotfinder app so they could check if users reserving a spot have parked at the spot or if parked car has not reserved that spot. The main downside of this system is that occasionally users won't get access to reserved spot which will be quite frustrating.

Environment

One motivation for doing this project is to reduce emissions during searching for a parking spot. In order to demonstrate that such a project reduces emissions we'd need to collect data about emissions in the area where this project would be set up. This might be doable with some kind of IOT sensors and a central collection database. Also some realistic goals of how much emissions can be reduced need to be determined.

Also since we are fast transitioning to fully electric cars in parts of the world it would be interesting to calculate how much power can be saved with electric cars that can reach a parking spot without circling around looking for a place to stop.

Ideas

1) I have experience with collecting data from IOT sensors using LORA, ModbusTCP protocols. It might be an interesting use case to develop a device capable of measuring emissions in real time and sending that data to a central database. Every cloud provider today has a way of processing such sensory data so there's a lot of options (Amazon AWS IOT, Azure, I've also worked with Actility and TTN).

2) Figuring out the environmental impact definitely requires someone with expertise on emissions.

3) One option to get emissions data is from https://breezometer.com/ . This was posted in slack on climate_resources however I don't know how they actually collect data. I see national agency for weather posts data on emissions but it is on city level. This is probably much too coarse to measure a noticeable effect in a limited area (say a covered garage).

4) An interesting metric would also be to measure time to finding a parking spot before and after implementing this system. This would allow estimating pollution reduction

based on car make and time spend parking.

Below in resources I've linked a standard for limiting allowed car emissions which could be used to hack an API for such a calculation.

Work done
1) Estimating per car CO2 saved - there's a simple script at
   https://github.com/crnkofe/spotfinder/blob/master/estimate_emissions.py
   In some ideal conditions it's possible to significantly reduce CO2 consumption during parking

Business side

Let's say this idea gets implemented and a demo gets made. How would a company get formed, that could live off of this idea (business model).

Ideas
1) As a technological provider the company could sell software/hardware and integrations to prospective customers. It would basically work project to project and help maintain a central system/app that handles reservations, billing and control.
2) As a first step a pilot project would have to get made to have a case study, where the company can show, how effective the system is, how it performs, what are the costs of such a system etc.
3) An interesting business metric would be how much emissions we can reduce for what financial investment. Calculating this would require someone who can

Potential customers

Ideas
1) Cities with parking problems (which is basically every city of significant size). Pitching a project would require going to talk to city officials and figuring out the funding side of this equation(either through state funding or in EU as an EU funded project).
2) Shopping malls
3) Big events might need assistance with setting up, managing parking spaces

Resources

Standards:
1) https://www.rac.co.uk/drive/advice/emissions/euro-emissions-standards/

IOT Sensors:
1) https://www.aeroqual.com/outdoor-air-quality-monitors/aqs-mini-air-quality-stations
2) https://how2electronics.com/interfacing-pms5003-air-quality-sensor-arduino/

Climate research:
1) https://www.researchgate.net/publication/339856993_An_Algorithm_to_Improve_Data_Accuracy_of_PMs_Concentration_Measured_with_IoT_Devices
2) https://trl.co.uk/sites/default/files/TRL469.pdf
   This study details parking place emissions and is very interesting. Also note the

concept of cold start, which produces way more emissions than after a vehicle is warmed up.

3) https://repec.org/ec-p/wp665.pdf
Math-heavy research paper. It's interesting to note, that author claims that even 15% of drivers cruising around looking for a parking spot creates heavy traffic.

4) http://www.isocarp.net/Data/case_studies/1387.pdf
Best practices on management of parking spots on a higher level.

5) https://inrix.com/press-releases/cod-us/

Similar projects:

1) https://techxplore.com/news/2020-06-smart-software-congestion-emissions.html