Smart Parking Infrastructure

DETAILS

SECTOR | Transport

STAGE | Operations and Maintenance

TECHNOLOGIES | Sensors, Cameras, GPS, WIFI, Applications, VMS, Automatic Number Plate Recognition

SUMMARY

Smart Parking is a parking solution that can include in-ground Smart Parking detection/counting sensors or cameras. These devices are usually embedded into parking spots or positioned next to them to detect whether parking bays are free or occupied. This happens through real-time data collection. The data is then transmitted to a smart parking mobile application or website, which communicates the availability to its users. Some companies also offer other in-app information, such as parking prices and locations. This gives the user the possibility of exploring every parking option available to them.

Populations in urban areas are predicted to rise from over 55% of the world's population today to 68% in 2050[1]. Alongside this, private car ownership remains high in developed countries, and is increasing in developing countries. Urban centres are becoming increasingly congested. It has been estimated that drivers looking for parking account for 30% of total traffic volume in a city[2]. This congestion impacts health, productivity and satisfaction of residents. Expanding parking in cities is expensive and lessens the attractiveness of the area. Governments are seeking new mechanisms that can influence driver behaviours to increase utilization across the existing parking supply, and to decrease the usage of on-street parking overall.

Widespread deployment of smart parking will change driving in urban areas, improving the user experience of finding available parking, and enabling governments to modify driver behaviours. Smart parking will also significantly contribute to transportation-sector greenhouse gas and pollution reductions by minimising driving time and fuel consumption. On average, to find a parking space a car will drive an extra 4.5km. A typical car will emit approximately 140g of CO_2 per km. This, therefore, equates to approximately 630g of CO_2 emitted per car looking for a parking space[3], and will be significantly higher during times of congestion. Smart parking solutions can eliminate this unnecessary driving, by leading users directly to an open parking space.

By integrating smart parking infrastructure with a dynamic pricing system, local authorities, can further shape the behaviour of drivers in line with their local objectives. A dynamic pricing system would assign a value to each parking space based on its proximity to a specific location (e.g. the urban centre). This fee would vary based on the time of day, day of the week, month of the year, in line with recognized demand. Dynamic pricing could be

[1] "68% of the world population projected to live in urban areas by 2050, says UN", UN Department of Economic and Social Affairs, Accessed 12 May 2020.

[2] "World's First Pilot Project Started in Berlin: Intelligent Search for Parking Space", Traffic Infratech, Accessed 5 May 2020.

[3] "World's First Pilot Project Started in Berlin: Intelligent Search for Parking Space", Traffic Infratech, Accessed 5 May 2020.

used to discourage users from driving into the urban centre to park and may encourage uptake of other modes such as park and ride, cycling or mass transit either for the entire journey or part of it. By integrating this pricing scheme with a smart parking application, users would be able to better plan their trips in advance, either by opting to park in a specific location or choosing to use another mode, or travel at a different time.

VALUE CREATED

Improving efficiency and reducing costs:

- Increase utilization of existing parking and increase revenue for parking owners
- Minimise the need to build additional parking infrastructure by directing drivers to underutilized spaces
- Reduce operations costs by replacing parking rangers with technologies such as automatic number plate recognition (ANPR) and implement a more efficient payment process for users

Enhancing economic, social and environmental value:

- Reduce congestion, bottlenecks, car emissions and improve air quality as drivers will not spend additional time circling looking for available parking spaces
- Shape user behaviour to utilize parking in lesser used streets / locations and keep traffic out of the city centre
- Enable data driven decisions to better manage parking supply
- Optimize the use of existing parking to drive decreased demand for parking space surplus highlighting opportunities for repurposing of the infrastructure to create or expand living space

POLICY TOOLS AND LEVERS

Legislation and regulation: Regulation of pricing for smart parking infrastructure should be made with a logic to meet mode shift expectations and transport strategies and objectives.

Effective institutions: Individual smart parking efforts so far have been locally successful but uncoordinated, operating in their own bureaucratic or entrepreneurial vacuums without taking advantage of universally applicable insights to scale their operations citywide or globally. This is a missed opportunity for cities. A lack of collaboration among communities with smart parking pilot programs and lack of coordination among software developers, hardware providers and municipalities also contribute to slower adoption of smart parking, while considerable positive effects could benefit the physical road and city infrastructure.

Transition of workforce capabilities: Transport economists should consider in their pricing models the implementation of smart parking pricing and the related dynamic infrastructure management.

Funding and financing: By enabling new methods of paying for parking (such as applications) additional revenue can be produced. For example, if a user needs additional parking time they can do it through the app remotely, thereby reducing the instances of parking fee avoidance. By utilizing sensor technology, parking payments can be calculated on a pay as you go basis e.g. the user will pay for the exact period they parked there for, rather than guessing the amount of time they will require. This can encourage users to park for longer. By implementing a smart parking system alongside a dynamic pricing scheme (*see also the Dynamic Pricing for Roadways and Parking Use Case*) additional revenue can be accessed through the variance of parking fees in response to real time demand.

IMPLEMENTATION

Ease of Implementation 	Occupancy data, if it exists, tends to have many owners and is not standardized or accessible in a way that would allow software developers to turn it into user-friendly applications. Owners of data can also be reluctant to open this to developers. If existing data cannot be accessed, widespread sensor technology must be installed. As a relatively new concept, this will require careful planning to be implemented correctly, without issues involving sensor accuracy, relay of information, cooperation with applications etc.
Cost 	The cost of sensors and hardware-based solutions is decreasing drastically, for the first-time allowing cities and companies to gather detailed new data on transportation patterns. Furthermore, with smart phones and connected vehicles capturing more and more of the global telecommunications market in both developing and developed nations, software entrepreneurs can collect and analyse data and deliver insights and information to consumers in brand new ways that does not require the installation of new hardware.
Country Readiness 	Fragmentation between public and private parking providers can hinder widespread deployment and development of smart parking. For the smart parking system to be truly effective, it must span an entire city or region. Thus, governments will play a key role in bringing together different stakeholders and developing appropriate regulation that will encourage innovation in this space: dynamic pricing (*see also the Dynamic Pricing for Roadways and Parking Use Case*) will be a key to a successful implementation of smart parking.
Technological Maturity 	There is a selection of technologies that can collect real-time occupancy information including vehicle detection sensors and surveillance cameras. These technologies range in levels of accuracy and cost. Simple sensors can detect occupancy but cannot detect a change in vehicle. They therefore cannot be used to calculate occupancy time to determine a parking fee. High-precision sensors combine several technologies and offer enhanced responsiveness as well as additional indicators, like vehicle occupancy time.

RISKS AND MITIGATIONS

Implementation risk

Risk: The durability of sensor technologies is an issue. Where placed outdoors, care must be taken to ensure their functionality is not impeded by weather elements, and damage is not caused when cars move over them. The power management algorithm (for the longevity of the sensor batteries) and the actual positioning/placement of the sensors are also vital to ensure their reliability.

Mitigation: Consistent maintenance practises should be developed to ensure all aspects of the system are functioning properly.

Social risk

Risk: The introduction of new technologies, particularly utilizing mobile application technologies, can pose difficulties in user adoption for some citizens. The modification of user behaviour towards smart parking will be gradual.

Mitigation: To encourage users to buy-in to the solution, awareness levels must be increased. This can be done by emphasizing the benefits of the solution and implementing cost-related incentivises. Ease of use of the app, cost and reliability of the solution will also influence user acceptance.

Safety and (Cyber)security risk

Risk: Data-centric services inherently carry cyber security concerns, such as who owns the data, the user or the service? What constitutes appropriate use? Should user data be automatically shared with law enforcement and emergency services? Data privacy should be maintained for all users and they should be able to select if they accept their data to be used for tailored services as well as for crisis management. Smart parking can optimize safety within cities by minimising the stress related to driving and finding parking in urban areas. Drivers should be able to concentrate more on driving directly to the assigned space. However, there are safety concerns related to driving whilst using a mobile phone, and this should be considered by government's when regulating the use of such applications.

Mitigation: Governments must answer with regulations and users must be made aware of the implications on their privacy. As vehicles become inherently smarter and connected, they will have the inbuild capability to perform many of the same functions as a mobile phone. In car internet will enable smart parking applications to be accessed directly from the car without requiring the use of a mobile phone.

EXAMPLES

Example	Implementation	Cost	Timeframe
SFpark Smart Parking Pilot	SFpark combines real-time data indicating where parking is available, and dynamic parking pricing to make parking easier for drivers in San Francisco and improve utilization of parking infrastructure. It has since been implemented permanently.	The SFpark trial project was federally funded. The hourly rates at meters were decreased for the trial. Whilst overall parking demand grew, parking availability improved dramatically in SFpark pilot areas. The amount of time that the target utilization rate (60%-80%) was reached increased by 31% in piloted zones compared to 6% in control areas.	The trial ran from August 2011 to June 2013. During that time SFpark adjusted on-street rates every eight weeks (ten rate adjustments were made).
Intelligent Search for Parking Spaces Pilot, Berlin	The world's first smart parking pilot project utilizing a radar sensor system. The project aimed to reduce carbon dioxide, pollutants and noise emissions caused by road traffic. Data collected was open source, to enable app operators to utilize it for the end user.	The project was part of the City2e 2.0 project and was funded by the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB).	The pilot was conducted in 2015 with results available in 2016.
AppyWay Smart-Parking Scheme, UK	AppyWay's solution is the first to integrate technical capabilities (sensors and sensor-enabled payments) into a mobile application for customers, whilst also providing analytics to local authorities. AppyWay hosts the largest dataset of the UK's kerbside restrictions and has over 450 UK towns and cities mapped.	Paying for parking is simplified: app users benefit from the option of One Click Parking™, a concept created by AppyWay with Visa. The app pairs the user's mobile device with the sensor under their vehicle via Bluetooth, enabling them to pay-as-you-go rather than hourly rates.	AppyWay conducted a one-month trial in Westminster, London in 2015. It has since launched its scheme in Harrogate, UK (January 2019) and Halifax, UK (October 2019).