

Spot and Park: Where Mobile Technology Meets Parking Management

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ABSTRACT

Spot and Park is a parking and event management system. It was built with the intention of facilitating the process of finding parking. The problem with parking is identified in frequent and non-frequent visitors. For those who frequently visit, they know where to park, but do not know if there are any parking spaces available. On the other hand, infrequent visitors do not know where to begin to look in the first place. Therefore, *Spot and Park* provides a way for users to find parking from anywhere, using their mobile devices. The system is composed of three main parts: the mobile web-application, the database, and the admin website. The user interface is adapted based on the user type, of which are three: visitor, staff/student, and admin (who are event managers/planners). Features in the application allow the user to find parking based on a specific event or based on the building they are trying to find on campus. Moreover, a map with parking information is provided to help the user find a parking lot/space. Currently, *Spot and Park* is a prototype molded for the needs of university parking. However, future work will go towards making it available for other kinds of organizations as well.

Keywords

Mobile, Application, Parking, Event Management

1. INTRODUCTION

One of the first questions that crosses a driver's mind when arriving at their destination is, "where can I find parking?" Whether it is as a first-time visitor, or a frequent client, this question remains relevant. Knowing *where* to park does not mean that there will be a parking spot available; knowing where to park does not *guarantee* parking. Additionally, not many institutions provide clear parking information at hand, unless someone chooses to search the Internet or call the Administration for such information. Thus, visitors – both new and frequent - find themselves driving around the parking lot checking each spot to see if it is empty.

Why has this problem often remained unaddressed? It is assumed that as a person goes to a place more and more times, they will learn where they are supposed to park. However, this does not mean that they will actually find parking. Moreover, it does not seem to be a big enough problem until one is pressed in time looking for a spot, or until several vehicles are found waiting for a spot in the same parking lot.

Moreover, this represents a problem not only for the visitor but also to event managers who spend part of their planning in renting out specific parking spaces or parking lots for specific times and occasions. Their tasks often involve finding adequate parking spaces for their event, and advertise this so their attendees know where they are allowed to park. Therefore the problem of parking affects both sides of the spectrum – the person parking and the person behind the event for which the parking is necessary.

Nonetheless, this is one out of many everyday challenges that can be solved by a now everyday tool: mobile technology. Specifically, smartphones have the characteristic of being carried everywhere the user goes (or drives), providing real time location data. In fact, according to Hage et al [2], "the user's location is central to many mobile services [...] because the location is quite indicative of the user's context." Moreover, smartphones are becoming more popular among a diverse population; according to the Pew Internet and American Life Project, one third of American adults own a smart phone as of May 2011, as detailed in [1]. Another representation of mobile technology is the tablet, which shares many common features with the smart phone, and provides similar functionalities, such as location services.

Such unique characteristics of the smartphone coupled with its growing distribution make mobile technology a well-fitted medium for a solution designed to target the problem of parking. Location services available in smart phones make it possible for users to find parking based on their location or based on their desired destination. Moreover, the fact that smartphones can connect to the Internet at anytime makes it easy for applications to be readily available at an inexpensive (many times completely free) cost. Updates are also easily released over the Web. This ushers the way for developers to create attractive, easy-to-use and easy-to-acquire products.

Therefore, here we propose a solution for the problem of parking: Spot and Park. This represents a parking management system that involves mainly a mobile web-application, along with an admin website, and the database responsible to store all the parking and event data. The mobile web-application is designed mainly for the person parking (although an admin interface is also available),

whereas the admin website is specifically for the event manager who is responsible to provide such parking spots.

In the following sections, we will describe some of the current tools that are associated with facilitating parking, and go through the details of the Spot and Park prototype that make it different from other available products. It is to be noted that this prototype is currently targeted to be used at the University of Maryland, College Park campus, but will be extended for other locations as a future work.

2. RELATED WORK

Previous work has already been done towards coming to a solution for the problem of parking. Mathur et al created the system “ParkNet” [3]. The concept behind this is that vehicles will have mobile sensors in them that will detect empty parking spots as the vehicle passes by parking spaces. This data will be sent to the central server, which will distribute the data to other users. Users are assumed to have Internet access, ie: a smartphone with Wifi or cellular data capabilities. At the time of their experiment they were using a single ultrasonic transducer as their sensor platform, and obtained some promising initial results. Nonetheless, the system did not work as well when the vehicle would go too fast for the sensors to detect correctly if there was an empty parking spot, affecting the accuracy of its results.

On the other hand, work associated with facilitating parking has not only been done in the academic field, but also in the commercial sector. For instance, “Parkmobile” [4] provides a way for drivers to pay for metered parking online through their smartphone apps. The system is also set up in a way that customers can pay also by calling their mainline. Otherwise, if it is done through the app, the user has to download it and create an account. It is available in several versions for three platforms – iPhone, Blackberry and Android. “Parkmobile,” however, does not focus on the process of finding available parking spots. It covers mainly the payment process. Moreover, it deals with public metered parking – if we were to talk about finding parking within an institution of sorts, “Parkmobile” would not be applicable.

Lastly, there is also “PrimoSpot” [5]. This system has a website as well as a mobile app. Again, the user is required to download the “PrimoSpot” app to their phones, if it is available for their respective operating system. This app will display on a map where you can park based on the location you input. It can be used to find street parking, garages or even bike racks. However, it does not provide information of whether the parking spots are available or not.

In summary, there has been work done to make parking (finding and paying for parking) an easier and more streamline process. However, there is not much work done in combining parking and event management. In other words – the parking applications currently available are mostly tailored for parking in public areas. Parking in institutions and event parking within institutions is not really covered. *Spot and Park* is designed with the intention of covering this aspect of parking –not so much public parking, rather parking within institutions (ie: at the University of

Maryland, College Park), and being equipped to handle event parking within these institutions. Daily parking in such institutions is covered as well (ie: non-event parking).

3. SPOT AND PARK ARCHITECTURE

Spot and Park will be mainly used as a mobile web-based application. From the driver’s perspective, using *Spot and Park* from the comfort of their phone is the most convenient, which is why using this kind of technology for this tool makes sense. However, there are other components that comprise the *Spot and Park* system that also play an important role. First, there is the database, which contains in a centralized way all the data sent by the users via their smartphone Internet connection. Second, there is a *Spot and Park* website for admin users who are event planners responsible for booking parking lots/spaces for specific occasions.

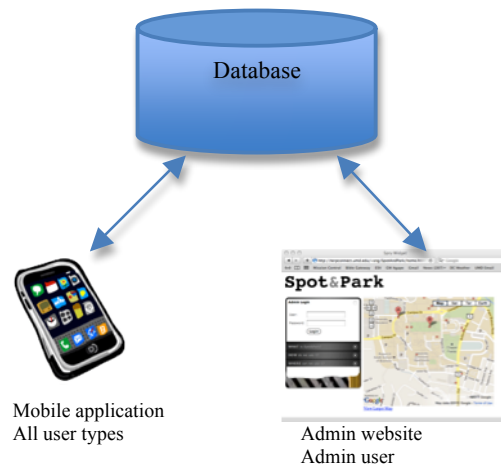


Figure 1: Spot and Park Architecture

3.1 Mobile Web-based Application

Most of the products already available for parking services are applications that you are required to download to your smartphone. However, this means that the application is platform-specific. In order to make it more compatible with any kind of platform, we chose to implement *Spot and Park* as a web-based mobile application using JSP, Javascript, JQuery and HTML5. The user is only required to have Internet access from his/her smartphone and a web-browser that supports HTML5. Another benefit of having a web-based application is that updates are displayed immediately – we do not need the user to download them to begin to benefit from them.

3.2 Database

The database is written in MySQL. There are four main tables, which comprise the main aspects of our system. These are the following:

- Events table: Event information such as event title, date, location
- Parking Lots table: Parking lot information such as number of parking spots, geo-coordinates
- Users table: User information such as ID, user type (student, faculty, staff)

- Admin table: Admin users information such as ID. Admin users are event managers.

Given that *Spot and Park* is currently still a prototype, information such as parking lot information (including its geo-coordinates) need to be entered manually by a developer. However, we will be working towards making this an automated process. Moreover, some institutions already have parking lot information in their systems – it is just a matter of transferring this data and make it useful for our purposes. Moreover, information such as number of empty parking spots per lot will be made available from sensors placed in parking spaces. Again, being in its prototype stage, the system has not been tested with sensors yet but the database is apt to receive this kind of data.

User and event information is obtained from user input. The admin table is currently entered manually. Admin accounts will be given based on the institution’s policy which outline who is eligible to book parking spaces for events.

In short, the database communicates with both the mobile web application and the admin website, which will be described next.

3.3 Admin Website

The admin website is targeted solely for event managers (who we call admin). It is implemented in PHP and HTML. The purpose of creating a website is to make it an easier process for event managers to enter data required by the database. For instance, information such as event date, number of parking spots booked and event title is easier to enter using a personal computer rather than a phone. Admin users are able to do the following through the website:

- View events
- Add events
- View parking lots map
- Change account settings

Again, the admin website sends and receives data from the database.

4. USER TYPES

There are three main user types, each with their respective characteristics. These user types are currently tailored for educational institutions, specifically universities. However, these roles can be adapted to other types of institutions or organizations as well. The needs and requirements for each user type are outlined in the following:

4.1 Visitor

Visitor users are those who come to the institution infrequently. They do not need a permanent account given the temporality of their visit. Moreover, they may have no direct affiliation with the institution. They usually will not know their way around the institution, let alone the parking spaces in which they are allowed to park in.

4.2 Student, Faculty and Staff

Student, faculty and staff all share the same parking needs. They have an affiliation with the university, they frequent the location often, and they know where they can park. In fact, they may be registered to a parking year plan which gives them an assigned parking lot. The main issue is that they do not know if there are enough parking spaces in their assigned parking lot(s). Moreover, there may be events which they may be attending to or for which they will need to move their car elsewhere. For example, the University of Maryland often has basketball and football games on site. For certain parking lots, students, faculty and staff are required to move their cars to allow the event attendees to park. For the purpose of shortening the name of this user type, we will just refer to them as “Staff/Student”.

4.3 Admin

Admin users are event planners. They may or may not have direct affiliation with the institution, given that an event planner may be hired temporarily or may be a permanent staff. This user type is the most different from the two previously mentioned. Their only concern is to organize events and make sure there is parking for it. *Spot and Park* does not provide admin users the ability to book a parking area, however, it provides a way for visitors, students, faculty and staff to find out about their events (ie: when is the next basketball game?) – the date of the event, and where parking is assigned for that event.

Table 1: Features according to user type

	Visitor	Staff/Student	Admin
Parking for events	Yes	Yes	No
Parking for buildings	Yes	No	No
Campus map	Yes	Yes	No
Signup for notifications	No	Yes	No
Events	No	No	Yes

5. USER INTERFACE

The user interface is adapted to each of the types of users and their needs, as described previously. Visitor and student/faculty/staff users share similar features, whereas admin users’ features do not overlap with the rest. Table 1 summarizes the features currently available for each user type for our *Spot and Park* prototype.

When the user first enters the web-based application, he/she is required to choose their user type: Staff/Student, Visitor, or Admin. Then there is a menu listing the features that are relevant to that user type. The application saves the user type information for next time the user enters the site.

Furthermore, the mobile application uses mobile optimized interface. This enables it to adapt its interface to the size of the screen which the user is viewing it from. It also provides easy and

smooth navigation controls. For instance, when the user goes from one page to another, the transition has a Web 2.0 style. For the sake of convenience, the user is able to click on the “Log out” button after they have logged in as their user type. They can also click on “Home” to go back to their home user menu.

We will describe the user interface based on each user type in detail. Note that the application has been designed as if it were it used at the University of Maryland, College Park, so all maps and events are based on it.

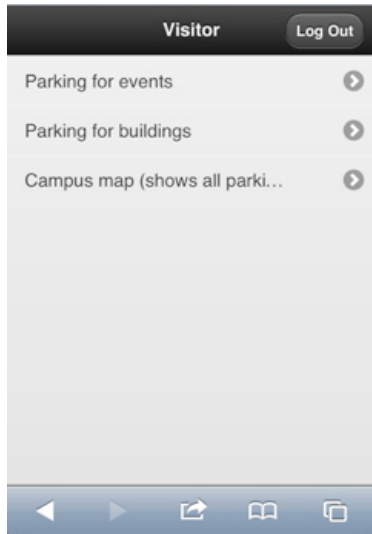


Figure 2: Visitor home menu

5.1 Visitor

Visitors are allowed to look for parking based on events and buildings. They are also able to view a map with the parking locations.

5.1.1 Parking for Events

When the user clicks on Parking for Events, the user will see a list of events in chronological order. The list shows snippets for each event, summarizing the name of the event and its date and time, as shown in figure 4. Moreover, events can be viewed based on category, ie: Sports, Cultural, Other. This kind of filter allows for easier search.

When the user clicks on the event he/she is interested in, he/she will see the parking lots assigned to that event. The parking lots with available spots will be shown as green, and the parking lots with no available spots in red. Moreover, the user can view the parking lot on a map to help locate where the parking lot is. This they can do by simply clicking on the link that says “View on Map.” This is shown in figure 3.

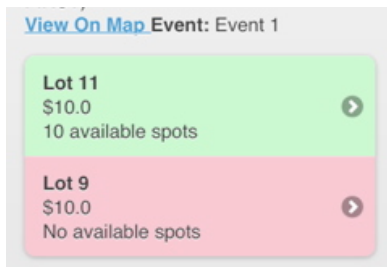


Figure 3: Select Event for Parking for Event

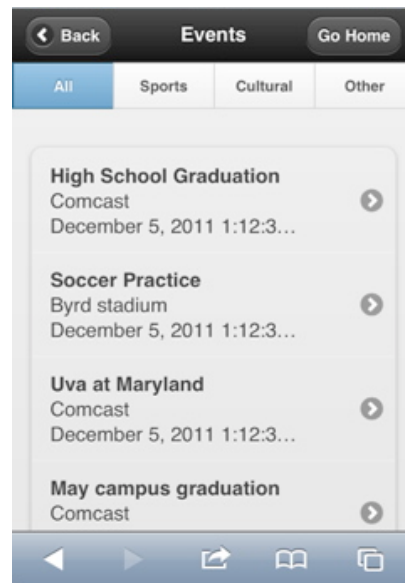


Figure 4: Parking for Events

5.1.2 Parking for Buildings

At times, visitors who are not familiar with the university campus are looking for a particular building, and wish to find parking close to that building. Staff/Student users do not have this problem since they are expected to know the campus. However, for visitors only, we have provided the feature “Parking for building” that allows them to find parking close to the building they are going to.

They can do this by clicking on “Parking for buildings” and selecting the building they are looking for. Once that is done, they will be provided with a list of parking lots that are close to that building. Again, the user can view that lot on a map as well by clicking on “View On Map”, as shown in figure 5. If there are any fees required to park in those spots, this is included in the information displayed.

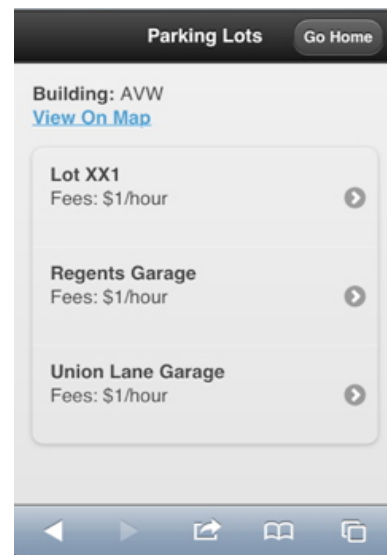


Figure 5: Parking for Buildings

5.1.3 Campus Map

As indicated by the name of this feature, the user is able to view all parking lots available to them on a map. Although a link (“View on Map”) to this feature is provided in other pages as well, the visitor has the option to see the whole campus map from the home menu. The advantage of having a map is that it helps the user visualize where he/she needs to go in order to find parking, based on where he/she is at. Given that location services play such an important role for smartphones, implementing this feature increases the usefulness of this system.

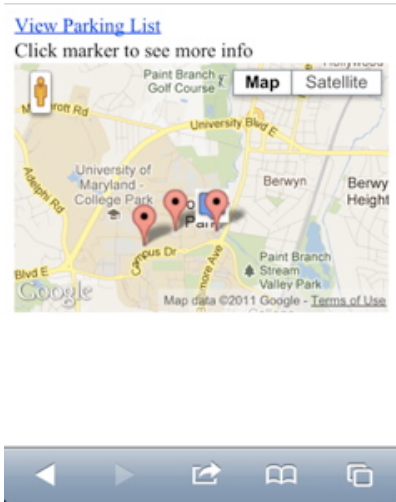


Figure 6: Campus Map

5.2 Staff / Student

Staff / Student users share similarities with Visitor users. They both have the Parking by Events and the Campus Map features, which were previously described in detail. However, there is one feature that is unique to this user type: Signup for notifications.

5.2.1 Signup for Notifications

As described earlier, staff / students may have assigned parking spots. However, due to certain campus-wide events such as football and basketball games, they are required to move their car elsewhere. *Spot and Park* has a Signup for Notifications feature that reminds them of an upcoming event that will require them to move their car. This way they are not putting their car at risk from being ticketed or tolled.

To use this feature, they just need to select the “Signup for notifications” option from their home menu. Then they are asked to select the parking lot they have been assigned to, and enter an email address to have their notifications sent to, as shown in figure 7.

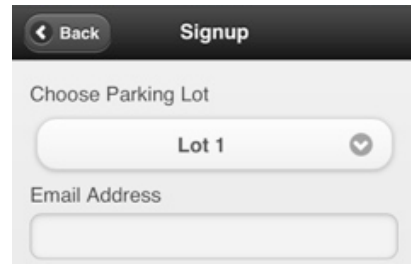


Figure 7: Signup for Notifications

5.3 Admin

Admin users are the most different from all the user types. Currently in the mobile application, they only have one main feature: indicate how many parking spots are available in the assigned lot. The idea behind this feature is that event managers may be at checkpoints in the parking lot to guide visitors. As visitors enter, they can indicate that one more parking spot has been used in that lot, or that the lot is full. That way, as visitors (and staff/students) come into campus, they know what lots to avoid.

Currently, admin users cannot add events using the mobile application. This will part of our future work. However, they are able to add events using the admin website.

5.3.1 Events

When admin users enter their home menu, they can select the “Events” option. This will show an events list similar to that of the Visitors and the Student/Staff users, as shown earlier in figure 4. However, the difference now is that when the admin user clicks on a specific event, he/she will be led to the “Manage Lot” screen, as shown in figure 8.

Here, they can increase parking by 1, decrease parking by 1 (as vehicles leave the parking lot) or mark a parking lot as full. This feature is made available while sensors are not yet placed in the parking lots (to indicate if the lot is full or not). If sensors are placed in each lot, then there will be no need for this.

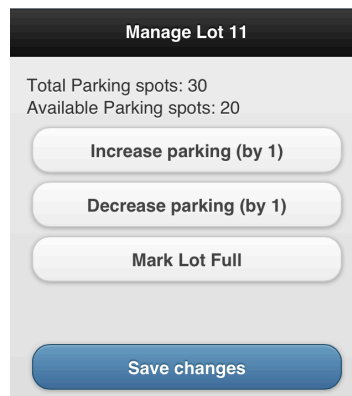


Figure 8: Manage Lot

Spot&Park

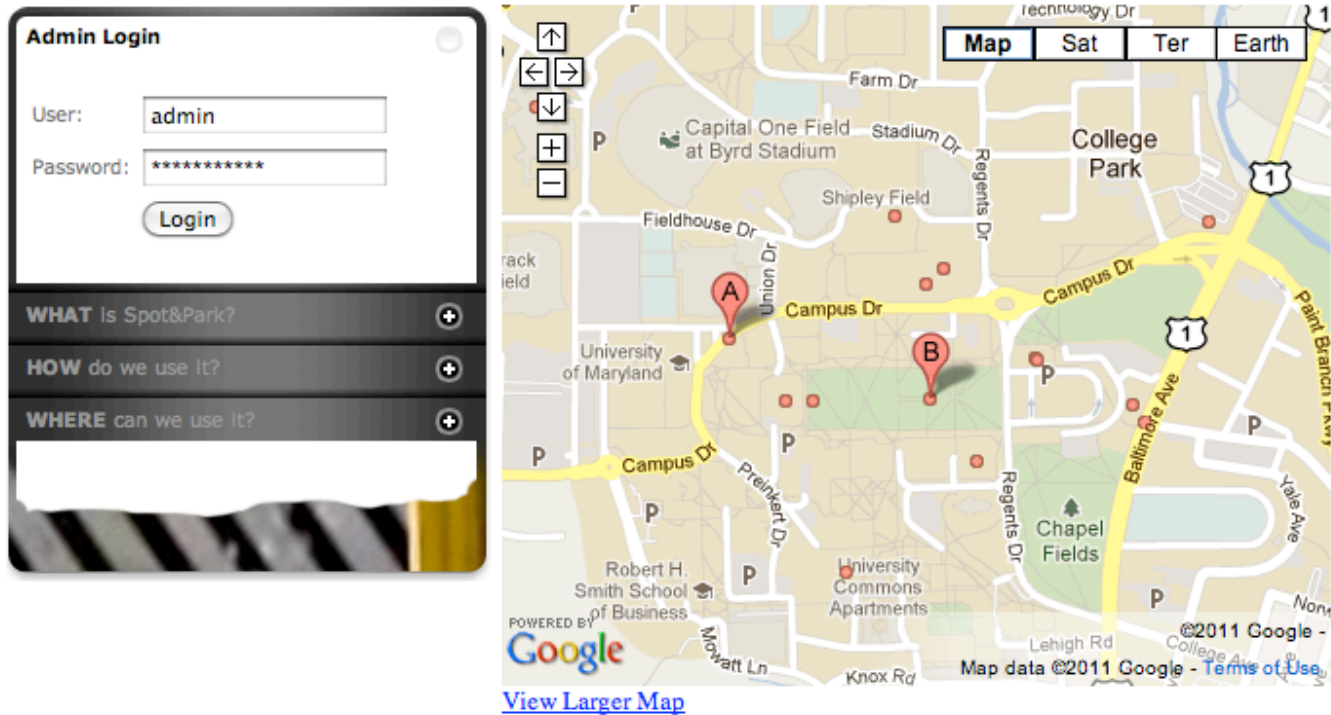


Figure 9: Spot and Park Admin Website – Home

Spot&Park

Logout

EVENTS

- ADD EVENT
- PARKING MAP
- ACCOUNT SETTINGS

NEW EVENT

Title:

Location:

Date/Time Start: --Click to select date--

Date/Time End: --Click to select date--

Parking Lot:

Fee: \$

Status:

Figure 10: Spot and Park Admin Website – Add Event

5.3.2. Admin Website

The main tool provided for admin users is the website. As shown in figure 9, the admin user simply enters their username and password to log in.

Consequently, they are able to view parking lots in the Parking Map feature and view a list of their events using the Events feature. They can also change their settings, at this time, that only means changing their password and email address.

The most valuable feature in the website however, is the Add Event feature. As shown in figure 10, the user simply enters the title, date, location, parking lot and fee for the parking lot and once they click on "Add", the information is sent to the database and made available for other users as well.

6. FUTURE WORK

Spot and Park is still a prototype. Therefore, there are some features that have yet to be fully tested with parking lot sensors and real data. As mentioned earlier, the process of populating the database with real data provided from sensors and the institutions' records needs to be entered in an automated way to avoid the slow manual process.

We will also work on extending the admin features on the mobile application to allow him/her to add, delete and edit events, as well as change their settings (password reset, change email address, etc).

Lastly, our current prototype has been adapted to the University of Maryland, but we will work on making it adaptable to other kinds of institutions as well, not just universities. As long as it is institutions with their own parking lots and set of events, *Spot and Park* has the necessary features that will be relevant to their context.

7. CONCLUSION

Spot and Park is a prototype of a parking and event management system. It consists of a mobile web-based application, the central database containing all parking-related information, and an admin website from which event planners can add events to the calendar for other users to be aware of. Three types of users have been taken into consideration when implementing this tool: visitors (infrequent users), staff/students (frequent users) and admin (event planners/managers). The user interface has been adapted to each user type to fulfill each ones' needs. Moreover, *Spot and Park* has been implemented in such a way that it can be adapted to other university institutions, and in the future, to other kinds of organizations as well.

8. ACKNOWLEDGMENTS

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