Prospectus

Improving Software for Horse Show Management

(Technical Report)

Streamlining the Parking Process with Smartphone Applications

(STS Research Paper)

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Introduction

Rapid growth, better quality of life, and global connections – all feats that have been achieved through the development of technology. As the world has advanced throughout the years, modern cities have grown in their ability to support its residents, providing access to smarter and more sustainable ways of living. Countries all around the world are working to create cities with a smart economy, a smart government, with smart living and mobility, a smart environment, and one with smart people. These are the core values of a "smart" city – a city whose goal is to provide a better quality of life for its residents, a competitive and productive economy, and a foundation for a sustainable future.

To help local residents, our team in the computer science department at UVA has developed a digital solution to manage horse show administration. The Hoof n Woof horse show run in Charlottesville hosts up to hundreds of horses and riders per show, and previously this was completely managed on paper. Our digital platform delivers an efficient, quick, and less error prone solution to manage these shows.

With the explosive growth in population within the last century, cities have needed to support millions of residents, and this creates issues in locations with minimal space. One major issue within densely populated cities is quickly finding available parking. Currently, people must find parking by driving around to check for available spots along the streets, or by paying for a spot. This comes with many problems: unnecessary costs for garages or metered parking, unknown availability for spaces, time limits for street parking, permits required for certain locations, and so on. The proposed solution for these problems is a smartphone parking application, one which displays all available locations with their conditions and makes the parking process convenient and automated. This paper will review the methods that China, a

major country in the development of smart cities, is using to alleviate parking issues in overcrowded cities through smarter infrastructure, and technological innovation.

Technical Topic

The technical advisor of this capstone research project is Ahmed Ibrahim of the Computer Science Department. I am working alongside Andrew Yim, Jack Schumann, Jacob Fullerton, and Draden Gaffney to complete this project. This project includes improving and adding functionality to an existing Django application developed to manage horse shows. We are working with a customer to define the requirements of the technical side of the project, and we will be producing documentation so that future students can replicate our team's development strategies and processes. While the software created from this project is reusable in the future, the main purpose of the project is to work specifically on improvements requested by a single client and write documentation for future students to follow.

In horse shows, a system must exist for tracking riders, horses, and combos of a horse and a rider. Additionally, for each combo the system must have a way to record scores for each event, also known as classes, in the show. Previously, our customer used a large poster for tracking all results where everything would be handwritten (fig. 1). This system is not optimal as all results were only stored in one location. All calculations of final scores had to be done manually, and fixing mistakes on the scorecard would be very messy. Tracking new riders and horses is time consuming, and this old system makes it especially difficult to track them between new shows. The team that developed the original software created a solution to fix these problems, but not without its own issues. We worked with our client to improve the software further, removing the bugs and making the process more streamlined.

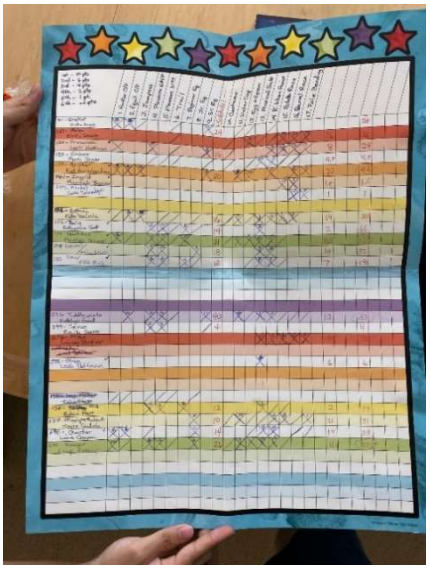

Figure 1. Previous system for recording results for Hoof n Woof horse show.

For this project, we used Jira to keep track of all the tasks that we had to complete and Git for version control. On the technical side, we worked on bug fixes, user interface, and new features that the client requested. A few improvements include a detailed search, increasing the valid combo number range, and the ability to include hyphens in the accession number. The user interface upgrades involved being able to sort riders and horses by categories and viewing a horse-rider combo's name and owner on the rankings page instead of just its combo number. A lot of the main feature changes involved the form to add a new horse-rider combo: the ability to add the combo to classes, searching for existing riders/horses, and creating new riders/horses without losing the combo form data entered already. Other features that were added include viewing the rankings of all of a show's classes on the same page, adding a notification system for adding, editing, or removing entries, and implementing a more secure method for website registration and data modification. After installing our updates onto the client's computer, they have since been able to organize new horse shows quicker and easier than before.

The other half of this project involved writing documentation for server installation, Jira installation, team workflow, and code coverage. The server installation documentation includes instructions on installing required dependencies and configuring settings to launch the application for both Linux and Windows. The Jira installation documentation includes instructions for installing and configuring Jira onto a Linux server. The team workflow documentation outlines how we use Jira and Git for our project, and the code coverage documentation describes how to use Coverage to view the code being tested. With these documents, future students can follow our example to quickly and efficiently create software for local clients.

STS Thesis

Introduction

With the development of society comes cities – largely populated locations, with extensive support for its people with systems such as housing, transportation, and communication. A city comes with many benefits: a city is thriving with culture, with countless local communities contributing to its history; it comes with convenience, where food, entertainment, work and other locations are just a short distance away; it also comes with opportunity, where citizens can become educated, develop a career, and even start a family and a community. With these benefits come logistical drawbacks, one such being parking.

Parking in densely populated cities is difficult, preventing people from going into the city. Residents cannot enter and engage with the community when they want to, and it is even more difficult for those unfamiliar with where to park. This restriction means city access isn't readily available; parking is cumbersome, inefficient, and even potentially expensive in many

places. Charlottesville is an example of a restricted city; parking is rarely easily available, and much of it is taken by locals who work within the city. Students, residents, or tourists who want to enter the city must first drive around the streets looking for a space that is most likely limited to a couple of hours, or by paying each time for parking. Many parking locations are underutilized, and the systems currently in place to find parking are either primitive or unbeknownst by a large portion of students and residents. For some, this is enough to prevent them from entering the city at all, which inhibits the growth of the local community.

To make it so that anybody in the community can enter the city and engage with its residents, a better solution must be created. This brings about the question, what technological innovations have China implemented to streamline the parking process, and how have they impacted the way that people park? Furthermore, how can these solutions be implemented locally within Charlottesville?

Literature Review

One of the main forces trying to combat the parking issue is China, a country with some of the most densely populated cities in the world. According to a census conducted by Beijing's transportation commission, Beijing requires 1.3 million more parking spaces, and China as a whole requires 50 million more (Zhang, 2017). Another study by Tsinghua University found that compared to other developed countries which average 1.3 parking spaces per car, China only has 0.8 – a large deficit when cities are so densely packed. Their team found that 50 percent of all parking spaces were underutilized (Zhang, 2017). The same holds true in the United States as well; according a study on the usage of autonomous vehicles within cities, in L.A. alone, "tens of thousands of parking spots could be converted in nobler uses," (Duarte & Ratti, 2018).

Parking spots can be better utilized with a smartphone app; if parking information was readily available, many parking locations wouldn't be as underused, and excess space could be allocated for other uses. The development of this technology can be explained by the social construction of technology (SCOT) theory, where a smartphone app is influenced by social benefit since less time spent parking means more time available to engage with the community and lead active lives. Smartphone apps can provide information and make parking more convenient for many. One of the values that an app would bring is accessibility; a study on the most used applications found that they incorporated accessibility features, showing that accessibility is a valuable consideration in development (Gebresalassi & Sanchez, 2018). Taking a look at existing solutions, the MyCville app is one that attempts to provide parking information, but not so clearly or easily. All of its information is simply a text-based list of parking garages and costs, making it hard to navigate and unclear (fig. 2). The only metric for available parking is a single number, which doesn't help with finding the parking itself (fig. 3). This app averages 1.2 rating by four total reviews, and it has had around 100 installations on Android in the 1.5 years it has been up. This clearly shows there is not only a problem with its design, but also knowledge of its availability to Charlottesville Residents.

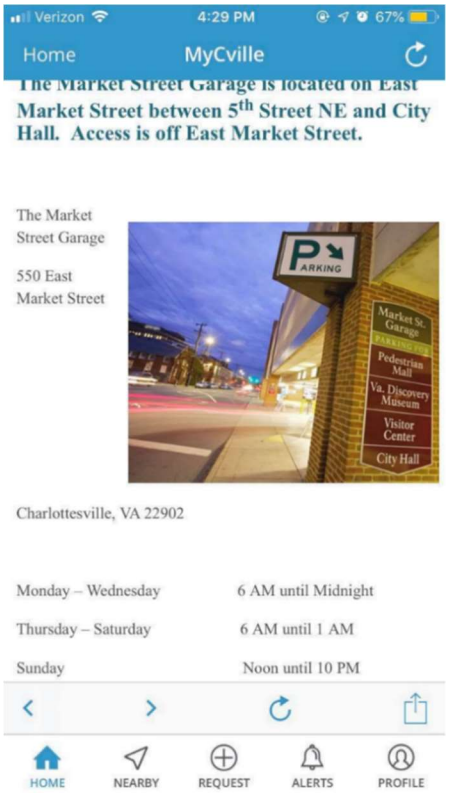

Figure 2. Information on Parking Garages

Figure 3. Real Time Parking Availability

China has implemented its own smart parking applications, but on a much broader scale. These apps are created by startups or companies with private investors who work with city officials and car park operators, though there have been proposals to have the government unify these solutions onto a single data-sharing platform. This process can be mirrored within the United States, where city governments can work with companies and parking garage owners to develop a local solution which can then be unified throughout the country.

One of the largest apps in China is called ETCP, and it covers 223 cities, 6,600 parking lots, and has 23 million users (Zhang, 2017). Some of its features include maps which clearly display available parking locations, parking spot reservations, and automatic payment (fig. 4).

The entire parking process is streamlined, and encompassed into one app; according to one user, “with the app, I can park as close as possible in just a short time” (Xuequan, 2018). One of the ways that it encourages people to use the app is by offering digital coupons and other incentives for mobile payments, making it quicker but also cheaper than traditional options. Integrating this modern solution with current infrastructure shows that it offers a better way of parking for many people, making it quicker and easier to enter the city. This application brings many features that can be implemented in a local app as well. If accurate sensors were installed in current parking locations, available parking would be easily locatable on a map, and proper development could lead to payment automation as well. This would bring more people into the city on a regular basis, and local shops could even be advertised within the app to provide benefit for both the local economy and for people looking to find places to go within Charlottesville.

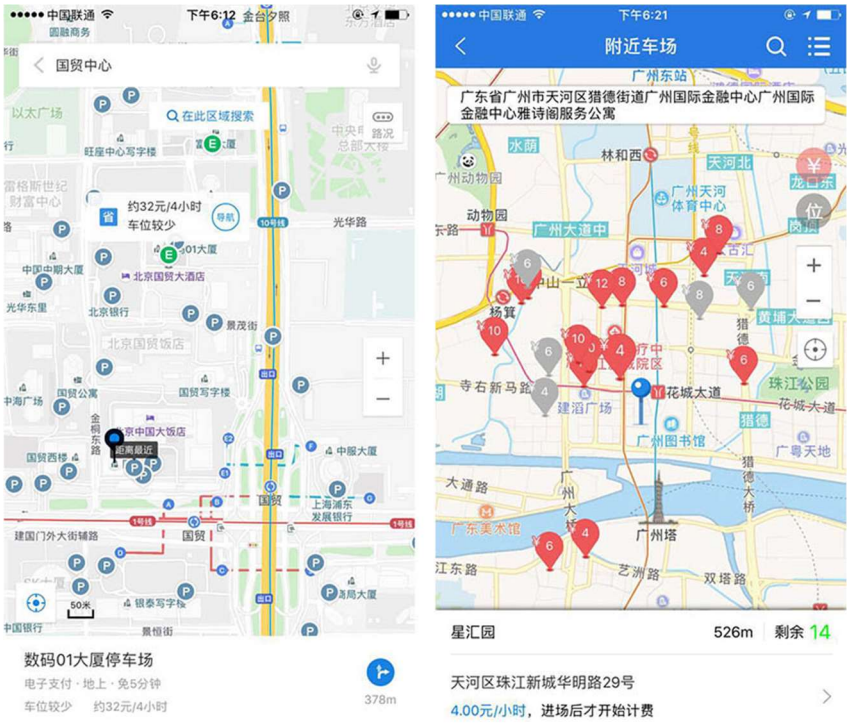

Figure 4. ETCP Smartphone Parking Application

The next step to developing this idea is researching more about how real time data should be collected, and how this system can be implemented and maintained. There are a variety of sensors that provide cost efficient and accurate data for parking detection: sensors that are in-ground, surface mounted, installed overhead in parking garages, integrated with cameras, and more. To get a better understanding of the costs of implementing smart parking within Charlottesville, different parking sensors should be analyzed with Charlottesville's geography and location in mind to determine the most efficient system.

Regardless of its wide usage in China, smartphone parking applications are still in their relative infancy compared to the large population that must be covered. There are still many great ideas to implement, and it serves as a great example for Charlottesville to follow. There is a strong foundation in terms of application features, but more research needs to be done on how to best integrate this application with local businesses and infrastructure, and how best to promote it. If a well implemented smartphone application that could provide quick and easy parking was promoted proficiently, then residents, students, and tourists could all find parking faster than before, and every community member could actively engage within the city.

Bibliography

Duarte, Fabio & Ratti, Carlo. (2018). The Impact of Autonomous Vehicles on Cities: A Review, Journal of Urban Technology, DOI: 10.1080/10630732.2018.1493883

Gebreselassie, Mahtot & Sanchez, Thomas. (2018, May 30). “Smart” tools for socially sustainable transport: a review of mobility apps. *Urban Science*.

Liping, Zhang. (2017, Sep 11). *The entrepreneurs tackling urban China’s parking problems*. Retrieved from https://www.sixthtone.com/news/1000815/the-entrepreneurs-tackling-urban-chinas-parking-problems

Mu, Xuequan. (2018, Jan 26). *Smartphone apps help ease parking headache in Beijing.* Retrieved from http://www.xinhuanet.com/english/2018-01/25/c_136924972.htm