Prospectus

Improving Software for Horse Show Management

(Technical Report)

Streamlining the Parking Process with Space Efficient Infrastructure

(STS Research Paper)

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Introduction

Parking within a city is often overlooked for the bigger and more global issues, such as pollution and energy, that plague a city. However, parking is a major problem in nearly every major city due to increasing vehicle ownership and lack of efficient parking solutions. Free parking spots are quickly taken when they become available and often have time limits attached to them. Paid parking, including parking meters and parking garages, quickly racks up fees and many people are reluctant to use them because of it. It is impossible to know when parking spots will be available and how much it will cost if it requires payment. The current parking situation in Charlottesville deters many local community members from even going to downtown Charlottesville. "'The cost and hassle of parking is one thing that prevents me from going to the [Downtown] Mall,' said Ashleigh Crocker, who said she lives too far away to walk or use transit" (Tubbs, 2015). This research project identifies two solutions for Charlottesville, which are changes to infrastructure planning in order to have more efficient parking and a smartphone application which will have a variety of features that will aim to ease the burden of finding parking.

For the technical portion, a previously developed system for managing horse shows was improved and made more efficient. This system was originally developed because Horse Shows are frequently ignored in the technological scene, and organizers usually use paper and pencil to record the scores and events, which is very error prone and time consuming. In biweekly meetings, the team met with the clients to discuss requirements and further improvements while showcasing the new changes. Throughout this process, the team wrote various documentation for creating and maintaining software products.

Technical Topic

The technical advisor of this capstone research project is Ahmed Ibrahim of the Computer Science Department. I am working alongside Alvin Yuan, 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).

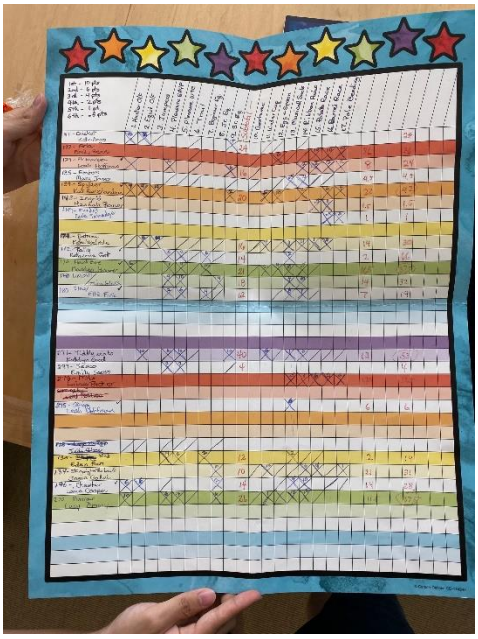

Figure 1. Previous system for recording results for Hoof n Woof horse show.

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.

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

Smart Parking is a necessity for the development of smart cities because it is a core pillar in supporting transportation and mobility around a city. Parking promotes community engagement by allowing community members to easily reach local areas without having to rely on cumbersome methods such as public transportation or walking. With Smart Parking, one of the many barriers to community engagement will be removed while reducing unnecessary stress and allowing for residents to waste less time looking for parking. Removing this barrier allows for the Charlottesville economy to benefit as well, as local residents are reluctant to travel or work in areas with contested parking due to the inconvenience and time consumption. "'It could help us with employment downtown,' Benford said. 'People don't take jobs downtown because there's a parking fee they might have to pay'" (Tubbs, 2015). Many downtown businesses are concerned over increases in parking fees as that will deter potential customers. Charlottesville currently has very limited infrastructure in place to support parking. Mostly all that Charlottesville currently does is maintain a few parking garages and patrol street parking.

Although the focus of the research topic is specific towards Charlottesville, it is important to look outward to other solutions that have already been implemented. These solutions should

be analyzed and understood in order to properly apply them to Charlottesville's unique circumstances successfully. One country of interest is China because of their increasing demand for private transportation which is causing similar issues regarding parking that many U.S. cities, including Charlottesville, are currently facing. China has innovated new ways of creating better infrastructure to support the increase in private transportation which could potentially be applicable to Charlottesville's parking problems. This raises the question of how China has improved their parking process with changes to their existing parking infrastructure and how this is applicable to Charlottesville's current parking crisis.

Literature Review

Private car ownership in China is constantly on the rise, and China has been continuously running into problems with finding enough space to all of the new cars. As part of the solution, China developed several parking applications in attempt to appease the problem. However, these smart technologies may bring significant benefits, but they also bring notable drawbacks with them, including information insecurity, privacy leakage, information islands, and digital divides (Ma, Lam, & Leung, 2018). This demonstrates the social construction of technology in that Chinese citizens are shaping where their technology goes. The increased demand for parking lead to the development and usage of smart parking.

One of the challenges of developing smarter parking is the evolving transportation methods available. Stakeholders may be hesitant to invest in parking for just cars because in ten or twenty years, cars may be irrelevant or completely autonomous. Zuev highlights the problem of other transportation options competing with cars for both the road and parking. "The situation with E2Ws in China and their role in low-carbon transition is still not very clear but the relationship between the ever-increasing number of cars and e-bikes in Chinese urban and

suburban space is becoming more and more conflictual on the road, in the parking lots and in the family space, where everyday mobility decisions have to be made" (Zuev, 2018).

The increase in demand for parking has lead to significant increases in the technological capabilities of parking garages. In Nanjing, the robotic parking garage implements Internet of Things technology to automate many of the parking garage functions, including parking and storing vehicles. "An automated platform then lifts the vehicle and moves it to an available diagonal port. Diagonal carports save space and are more efficient compared to vertical/horizontal/perpendicular ports. Robotically maneuvering a vehicle is also easier in diagonal ports due to the elimination of sharp turns" (Gautam, 2019). Automating the entire parking process reduces the chance of accidents and allows drivers to save time by simply dropping their vehicle off. The automated parking process only takes a few minutes and has measures in place to reduce theft, damage, and vandalism. The parking garage is capable of holding 60% more cars, which is a significant amount considering the large population and density of Nanjing.

In a different take on making parking garages more efficient, the Beijing Airport started a trial to use intelligent robots that are responsible for handling the parking process for drivers. Similar to Nanjing, almost the entire process is automated. "The robots can carry up to 3.5 metric tons… produce zero emissions and can work for up to six hours on a single charge, before automatically making their way to their charging station. Sensors enable the robots to dodge obstacles, including other robots and cars, which reduces the risk of cars getting dents or scratches from parking lot mishaps" (Chan, 2019). Parking robots handle many of the difficulties that come with parking, and drivers can instantly know whether the parking garage is full or not

thanks to the automatic system in place. To collect the car, the driver can simply scan a parking ticket or enter their plate number and the car will be delivered within a few minutes.

In the bigger picture, the expected integration of autonomous vehicles into cities is further complicating the conversation around parking. Although there are crucial steps in advancing Charlottesville's parking infrastructure, it is important to keep in mind that simply changing the infrastructure is not the only solution. In order to tackle the root of the problem, many other factors will have to be evaluated and analyzed to determine the best way forward. For example, autonomous vehicles are just around the corner, and they may complicate the parking situation even more. "Considering AVs could serve multiple users during the day and therefore remain parked much less than regular cars, or AVs could move back home or to cheaper parking areas designated by the city as less impactful to the overall traffic" (Duarte & Ratti, 2018). This is just one example of how a technological advancement could single handedly affect the parking crisis, and it will remain to be seen what exactly will happen in the future.

Next Steps

Although China may be implementing these innovative ideas, it is hard to just copy them here in Charlottesville for several reasons. Charlottesville as a whole is significantly smaller than both Nanjing and Beijing, and thus its parking problem is not as big. Also, funding these automated systems would be impossible for a city as small as Charlottesville. However, this does not mean that there are no takeaways from Nanjing's parking garages and Beijing's parking robots. Both of these examples use extensive Internet of Things technologies through the use of sensors and automation. Even something as simple as displaying where the parking spots are available within a parking garage could pay dividends in the form of saving drivers valuable time and unnecessary frustration. Current Charlottesville parking garages have essentially no data collection or usage which would be the first step in moving towards a smarter city. Connecting

this information with a smartphone application and displaying the information there, and even having the ability to reserve parking spots in advance through the app would be greatly beneficial.

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