

# A Systems Approach to Improving the Spectator Experience at Collegiate Football Games

A Capstone Report  
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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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# A Systems Approach to Improving the Spectator Experience at Collegiate Football Games

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**Abstract**— As ticket sales and student attendance for University of Virginia (UVA) home football games decline, the university must find ways to engage fans with the football program. The following technical evaluation used a systems methodology to improve the customer experience for Scott Stadium spectators, with the additional hope of paralleling an improvement in the school’s football community. Taking a three-pronged approach, the analysis focused on traffic, in-game experience, and website design. A ride-along and interviews with the University Police Department (UPD) yielded observational data regarding game day pedestrian and vehicular traffic. The UVA Athletics Department provided ticketing data. Concessions numbers supplied by Aramark, a student survey, and the team’s observations from game days offered information regarding in-game experience. The research team’s examination of the department’s digital presence gave an analysis of the website design. The interview data and analysis of patron and vehicular traffic patterns indicated that a paucity of signage, GPS directions that only route drivers to prepaid parking, and a dated traffic plan contribute to pregame traffic backups. Investigating ticketing statistics showed that tardy students and inefficient distribution of stadium staff create sparsely attended kickoffs and entrance bottlenecks. An assessment of the game day website revealed a User Experience (UX) design that hinders fans from finding parking, concessions, and general information efficiently. Analysis of concessions data revealed that stadium staff fail to make student-preferred food items available in multiple convenient locations. Finally, the survey data revealed that many students leave before halftime, find the in-game entertainment in need of improvement, and attend games to fraternize with friends rather than watch football. Due to these results, the primary traffic recommendations involve increasing parking signage during game days and an updated traffic plan. To improve the in-game experience, suggestions include prioritizing student-preferred food items, rearranging event staff at entrance gates, incorporating incentives that encourage students and fans to arrive early and stay late at games, and updating in-game entertainment to shift student focus to on-field activities. Finally, recommendations to restructure the game day website include reducing text by utilizing images and bullet points, highlighting critical content through bolding and underlining, and grouping similar information with panels and icons.

**Keywords**- *Systems Approach, Process Improvement, Transportation, Traffic Analysis, Modeling, Customer Experience*

## I. INTRODUCTION

In 2019, UVA reported an average home game attendance of approximately 47,000 people [1], a number that has fallen to roughly 25,000 during the 2022 season. With college football being the highest revenue-generating sport for many schools

[2], the UVA Athletics Department is targeting ways to increase fan engagement and loyalty. Through a full system analysis, the team identified three main areas as key contributors to the game day experience: (1) pedestrian and vehicular ingress and egress, (2) experiences during the game, and (3) the presentation of key information on the game day website.

Scott Stadium sits in a unique position centered between UVA grounds and the neighboring Charlottesville community. This location, along with the lack of large-scale parking lots creates issues for those traveling to games. Furthermore, single-lane roads, a lack of parking information, and an outdated traffic plan contribute to driver confusion, leading to backups and frustrated fans. Pedestrian traffic also remains a point of contention as gate congestion creates long lines at stadium entrances. Inside the stadium, lower attendance and sparse crowds form gaps across the arena that cause low energy levels. Additionally, cheers, songs, and games performed throughout the season fail to engage the current fan base, having been reused year to year. Finally, the structure of the game day website, which remains limited by the university’s current contract with its site provider, hinders customers from efficiently finding general stadium information. Each of these issues makes it difficult for the UVA football program to maintain its current fan base and build toward its future.

To better understand the current state of the customer experience, the team met with a main point of contact each week to discuss data collection and design ideas. Furthermore, meetings with stakeholders from each prong of the analysis informed the research and provided an opportunity to ask questions, showcase ideas, and garner feedback. Throughout the remainder of this paper, these points are addressed along with recommendations at each step of the game day process in the hopes of improving fan engagement.

## II. LITERATURE REVIEW

### A. Traffic Planning

To successfully control game day and other event traffic, the US Department of Transportation (DOT) Federal Highway Administration offers a handbook outlining the best practices for traffic planning. The DOT states that strong traffic plans “[indicate] how traffic, parking, and pedestrian operations will be managed on the day-of-event; [coordinate] and [mitigate] transportation impacts; and [adapt] to traffic demand scenarios” [4]. Furthermore, the DOT recommends that these

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plans provide "...ways to (1) modify predicted flow routes to maximize system operating efficiency while meeting public safety agency needs and (2) provide advance information to patrons and participants on best access routes to the event" [4]. In summation, the DOT advises that traffic plans be specific, organized, adaptable, efficient, and informative. Additionally, for recurring events, the DOT suggests mitigating the impact on the surrounding community by designing plans around residents and businesses, while providing them with designated areas and passes during event times [4].

### B. In-Game Experience

Fan engagement is a major contributor to attendance at sporting events. A 2018 "Stadium Experience" study conducted by Deloitte found that the most important factors to a spectator's experience include a safe, comfortable, and clean environment; a view that meets their expectations; a quality game; and an exciting atmosphere in the stadium. The last of these, an exciting stadium atmosphere, provides fans with the most satisfaction and is a primary focus of our analysis. While it should be noted that these are not the only attributes that determine a patron's game day experience, focusing on the basics will lead to a more engaged and recurring fan base [3].

### C. Website Design

According to Adobe, one of the foundations of a quality User Experience (UX) design is to not "overwhelm users with too much information" [5]. Decreasing the text presented to the user not only allows them to quickly find the information they are looking for, but also increases the readability of the site. Another hallmark of good UX design is promoting "recognition over recall" [5]. Utilizing icons, pictures, and a consistent layout improves a user's awareness of where they can find certain information rather than stressing their memory, decreasing the time it takes them to navigate the platform. Additionally, organizations should strive to improve the usability and accessibility of their UX design to allow it to work better for all its consumers [5]. Implementing these practices will provide users with a positive experience and allow them to efficiently find the information they need.

## III. GAME DAY TRAFFIC PATTERNS

The infrastructure layout surrounding Scott Stadium cannot easily withstand high volumes of traffic and contains many barriers, including a large residential neighborhood bordering its southeast side. This design inherently creates traffic congestion when a large number of drivers and pedestrians attempt to enter and exit the area at once. To better understand traffic flow on game days, we conducted observations and interviews with UPD, who enforce a special event traffic plan each game day. The data revealed a lack of spectator knowledge about how to navigate the area to arrive at both reserved and free parking areas, as well as a challenge for UPD officers to properly enforce the traffic plan due to limited and inconsistent staffing. Football

game days at Scott Stadium are classified as "discrete events" because they occur at a permanent venue, have predictable traffic volumes, and accurately estimated attendance. Thus, the core considerations for the traffic plan center around high peak arrival and departure times [4]. From the information collected and based on the standards put forth by published literature, we generated three recommendations to improve traffic flow: increased signage along common roadways, design changes to both the physical environment and resources distributed to parking pass holders, and revisions to UPD's traffic plan.

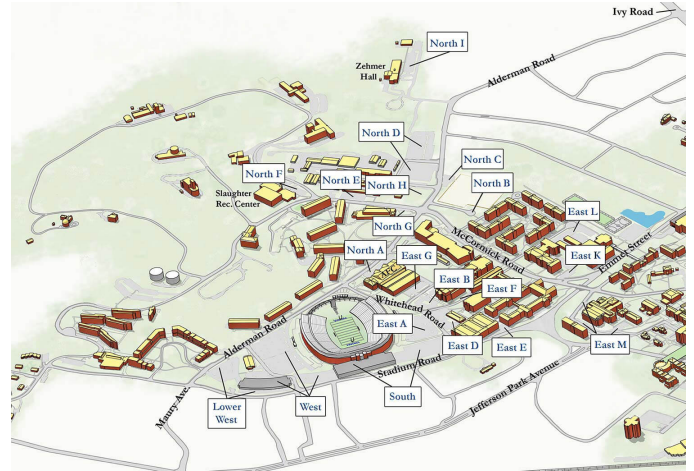


Fig. 1. Map of Scott Stadium and Surrounding Area

### A. Signage

To minimize confusion around the stadium and on surrounding roads, the first recommendation is to increase the amount and clarity of game day signage. In consultation with the UPD along with observations of game day traffic flow, we identified multiple areas of concern that proper signage can mitigate. Many drivers in Charlottesville on game day, both attending and not attending the game, do not know how to efficiently arrive at their destinations. For example, when heading east on Ivy Road, the right lane is dedicated to parking pass holders and turns onto Alderman Road while the left lane is designated exclusively for through traffic. Given the signage displaying this information is small and towards the end of the street, drivers are unaware of these options. This creates backups on Ivy Road and causes drivers to make dangerous lane changes, leading to longer than necessary wait times for all vehicles. Adding larger and increased signage to this area beginning further west on Ivy Road will provide all drivers with information regarding the lane designations to help address confusion and keep traffic flowing along this pivotal route. Additionally, signage on Highway 250 directs people to exit at Barracks Road, confusing spectators as it fails to mention other exits that would place them closer to the stadium. This causes unnecessary backups and uncertainty

for patrons on Route 29 and Barracks Road as no signs explain how to get from the street to Scott Stadium, with many spectators having to backtrack to the arena. There is also no signage on Interstate 64, making it difficult for drivers new to the area to plan their next steps in getting to the stadium. Placing informative signage regarding parking on Interstate 64 would allow spectators to take advantage of free parking at the Fontaine parking lots instead of driving into the city and contributing to traffic on Highway 250, Interstate 29, and Ivy Road before ultimately getting to a crowded parking lot. Finally, we recommend the addition of signage with the details of the clear bag policy be made and placed around all lots, particularly at Fontaine, which is a roughly 20-minute walk from Scott Stadium. These signs will inform spectators leaving their cars of the policy, allowing them to respond accordingly before getting turned away at the stadium. This increased spectator knowledge will help mitigate foot traffic by minimizing pedestrian cross-flow and increasing the efficiency of ticket lines.

### *B. Design Improvements*

In addition to increased signage, traffic will be mitigated through a number of design changes. Currently, spectators enter “Scott Stadium” into their GPS instead of their desired parking location. In interviews with police officers, we found that spectators are resistant to follow UPD directions if their GPS conflicts with an officer’s instructions. While more accurate and frequent signage will decrease this issue, having supplementary information about parking options and navigation to those options will further clear confusion. Providing a list of parking options in one central hub as well as linking Google Maps directions to those exact locations in an email to ticket holders and on the game day website will allow spectators to efficiently navigate to their designated areas. A more informed pedestrian not only mitigates traffic, but also allows police to focus on their job.

Further design changes will improve the pedestrian traffic issue caused by the large number of spectators who walk to the stadium from free parking at Fontaine. Currently, spectators walk in the street instead of staying on their path, limiting a car’s ability to drive along the route. Proposed solutions include the addition of a railing along sidewalks to prevent the blockage of the roads, routing spectators through the Hereford and Gooch-Dillard dorms to keep them further from streets, and the incorporation of shuttles that run from Fontaine to the Stadium during peak walking times to limit the amount of foot traffic. Our final design recommendation addresses observed issues with parking passes. In order to access Alderman Road, all cars must have a parking pass for one of the reserved lots surrounding the stadium. These tags must be displayed to get past a police checkpoint and turn right onto the street. However, patrons frequently fail to hang these passes, creating backups as drivers search for them. Simple edits to the parking tags like increasing the font size, boldness, and contrast of text color for

the “tag must be hung” instruction on the hang-tag itself, along with detailed instructions mailed with the tag, will ensure it is clear that the passes must be hung before reaching Alderman Road.

### *C. Traffic Plan*

The final recommendation is to edit the traffic plan to reflect changes in police staffing and traffic routes that have occurred since the plan was last updated. In recent years, the Charlottesville and Albemarle County Police Departments have experienced staffing shortages, making it difficult to implement the traffic plan that was designed for a significantly larger police force, where the same officer was assigned to the same position each game day. Due to a smaller staff, the police department has removed positions, yet these posts remain on the map. The direct result is that police officers incorrectly assume certain roads are closed or under the direction of another police officer. To boost police understanding of how to manage traffic on game days, we propose a modified traffic plan that signifies which positions are filled or unfilled so each officer has a holistic understanding of traffic flow on game days. Furthermore, we created a map with feedback from police staff of officer presence in and around the Scott Stadium area to be distributed to UPD staff as a visual guide. Additionally, ongoing construction projects in Charlottesville create an ever-changing traffic landscape. Thus, it is critical that high-risk areas, including new intersections or construction zones, are added to the traffic plan as they appear. Finally, we recommend this traffic plan be updated annually to reflect the current landscape of traffic in the area.

## IV. INGRESS FOR SCOTT STADIUM

### *A. Ticketing*

Vehicular traffic is not the only problem facing spectators at Scott Stadium. Observational data show that the majority of fans enter just before game time and most students do not arrive until midway through the first quarter, causing a passive kickoff atmosphere. To better understand the arrival times of students and spectators, as well as compare the foot traffic at each gate, we analyzed ticket data provided by the UVA Athletics Department. Knowing arrival rates and spectator entrance patterns will give the department evidence of fan disengagement and detail where they can lessen pedestrian traffic around the arena. The data consisted of each ticket’s scan time, gate of entry, and seating section for a game. Patterning the flow of ticket scans, we utilized Excel’s COUNTIF() function to compute the total number of tickets scanned each minute. Once calculated, we created time series plots for each game showcasing the influx of spectators into Scott Stadium. Using these graphs we found that roughly 60% of spectators enter the stadium before game time. We also conducted this analysis for each gate to increase granularity, separating the data using Excel’s FILTER() function. This breakdown allowed us to determine which entrances had high traffic volumes.

Traffic-dense gates include the North and Southeast entrances, which take on roughly 50% of the total arrivals each game as shown in Figure 2.

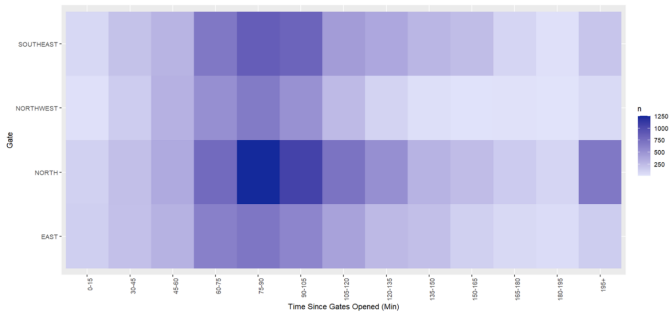


Fig. 2. Heat Map of Spectator Volume at Stadium Gates - UVA vs. Louisville

This heavy foot traffic leads to bottlenecks and long lines, creating spectator confusion and impatience as they struggle to enter the stadium. Furthermore, while students may enter through any gate, years of conditioning cause many to still arrive through the North entrance which exacerbates the already long lines. Additionally, as students remain a top priority for UVA Athletics, we filtered out student tickets and produced time series plots from this data. As shown in Figure 3, these plots indicated that only 29% of students on average are seated before kickoff, less than half the value for normal spectators. This tardiness displays another issue with the customer experience as failing to get students to arrive at games on time contributes to an underwhelming kickoff atmosphere. Therefore, the main ticketing issues for spectators are arrival time tardiness and bottlenecks at certain gates. To address these problems for the general fan, we recommend prize giveaways for early arrivals such as UVA t-shirts, hats, or other apparel; incorporating fun games for children to play such as cornhole that encourage families to arrive early; and placing signs in lots and around the stadium that direct spectators to the nearest entrances. For students, while prize giveaways like coupons to popular eateries will help get them in the door, more pointed recommendations include continuing to offer Sabre points for early scans, pregame contests such as trivia for a special athletics experience, and an email informing them that they may enter through any gate. Encouraging early arrivals and working to decrease congestion at certain entrances will lessen pedestrian agitation in getting into the stadium and create a more raucous kickoff atmosphere, improving the customer experience for all Scott Stadium spectators.

### B. Modeling Ingress

Diving deeper into the bottleneck issue, we generated Simio models to run stochastic decision analyses on the ticket data. To create the simulations, the data was subdivided into 30-minute time increments using the COUNTIF() function starting 90 minutes before kickoff and ending between 120 and 150

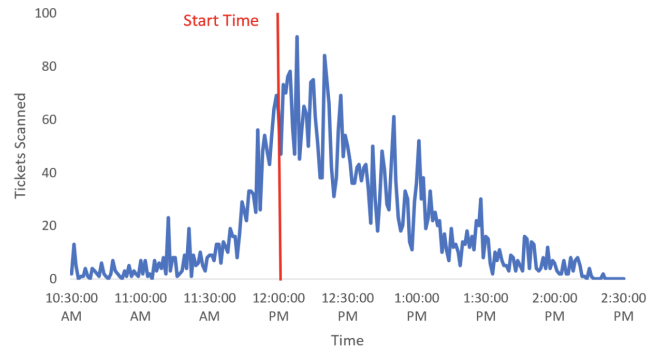


Fig. 3. Time Series Plot of Student Ticket Scans - UVA vs. ODU

minutes after kickoff. Following the calculation of the total number of scans during each 30-minute period, we computed the patron arrival rate per hour by multiplying these values by 2. Additionally, to get the distribution of spectators per gate, we divided the total arrivals at each entrance by the overall number of arrivals. Finally, the total capacity of each gate, represented by the number of workers stationed at an entrance, was supplied by UVA Athletics. Worker distribution by gate fluctuated depending on the game, so we used the average number of workers for each entrance. Translating the model to Simio, the “Spectators” entity and “SpectatorsArrive” source symbolized spectators, seven servers constituted the main gates, paths connecting the source to each server represented patrons arriving at a gate, and then paths connecting each server to the sink signified a patron’s entrance into the stadium. Polishing the model to simulate proper entrance patterns, we created a Rate Table which consisted of the spectator arrival rate per hour for each 30-minute block, gave each source-server path a selection weight equivalent to the percentage of patrons that used that gate to enter the stadium, set the capacity of the gates to the average number of workers, and assumed a service rate of 10 seconds. This assumption of 10 seconds accounts for spectators stepping up in line, pulling out their ticket or student ID, holding it under the scanner, and proceeding into the stadium. The model’s limitations include not accounting for spectator or worker error in finding or scanning a ticket nor the fluctuations in gate capacity due to worker breaks. Furthermore, the model assumes no line cutting and operates under a first-in-first-out system.

Running a simulated experiment for each game, we calculated the average wait time at each gate and the average number of spectators in each entrance line. While the specific times and line lengths differ for all games, similar patterns hold throughout. The North, Northwest, and Southeast gates generally obtain the most foot traffic - corroborated by the earlier heat map - leading to longer wait times and line lengths. For example, the average wait times at these gates were 1.82 minutes, 4.69 minutes, and 5.01 minutes respectively

for UVA's first home game of the 2022 season. The average number of people in line at each of these gates during this game was 52, 65, and 117. During lesser-attended games, the Southwest gate also became a traffic-dense area. Because attendance was significantly under stadium capacity, wait times and line lengths for each gate at these games were insignificant. Furthermore, it is noted that while the first game of the 2022 season provided a glimpse into the bottlenecking problem, the simulated values are expected to be relatively low when compared to previous years' games with higher attendance. Therefore, for larger capacity crowds the wait times and line lengths expect to worsen, exacerbating foot traffic and customer dissatisfaction if bottlenecking is not reduced. To mitigate this issue, UVA Athletics must take workers from lower-traffic gates and distribute them to higher-traffic gates while also allowing for flexible employee work schedules that can adapt if they need to transition a staff member to another entrance during a game. Repositioning the number of workers at each gate will decrease foot traffic and improve the influx of patrons into Scott Stadium.

## V. IN-GAME EXPERIENCE

An essential part of a successful collegiate football program is fan engagement. A large driving factor of fan engagement stems from the passion of students who attend the games year after year. To better understand how students feel about their game day experiences, we constructed and sent out a survey to UVA undergraduates asking general questions regarding home games. The survey sample was random as it was sent via email to a broad range of students and did not target a specific group. Therefore, it is assumed that the results of the survey closely match those of the general student body. Questions included multiple choice, yes/no, ranking, select all that apply, and free response. Examples of questions include "What concessions do you purchase most often?", "When do you arrive at your seat during home games?", "What do you enjoy the most about home games?", and "What improvements would you make to the home football game experience?" Garnering 50 responses, our survey sample was comprised of 50% fourth-years and 50% third- and second-years, and provided key information on how the students view game day at Scott Stadium. Most respondents claimed that they started off going to all home games, but stopped attending mid-way through the season. On the basis of attendance, 65% of students claimed to arrive after a game has already begun, corroborating what the ticketing data displayed, with 55% arriving during the first quarter. Of the students who attended games, 70% left at or before halftime, with only 12% staying until the final snap. In-game activities were rated low on students' lists of what they enjoyed about home games and most said these activities did not compel them to attend games. These statements were further backed up by the fact that 55% of students found TV timeout games "boring" or "slightly interesting," with 60%, 46%, and 58% of students finding the other forms of in-game

entertainment - jumbotron board games, hype-up videos, and food trucks - "boring" or "slightly interesting." Furthermore, 71% of students said that crowd chants are "quiet" or only "slightly loud," with 40% ranking their experience at Scott Stadium as "poor" or "fair." Finally, nearly half of the students indicated that they were "not passionate" or "neutral" regarding UVA football. Recommendations to increase student participation at home games to improve the in-game experience for all customers at Scott Stadium include incorporating interactive activities, increasing free merchandise and coupon giveaways for students, revamping hype-up videos and games, and shuffling the pump-up songs playlist to add variety.

In addition to conducting a survey, the team sourced data from UVA's concessions partner, Aramark. Utilizing this data, the team gained insight into the most popular stands as well as food and beverage choices among spectators. The Hoo Dog was the best-selling item according to Aramark; however, according to the survey sample, hot dogs were the seventh-ranked concession choice out of 11 options. This disparity between the sales data and student preferences could be caused by multiple factors. At \$3.59 per unit, the Hoo Dog is the lowest-priced food item, showing that UVA spectators may value the price of concessions above quality. Furthermore, the Hoo Dog is offered at all 12 concession stands whereas other concessions like seasoned fries, which was ranked as the fourth most preferred concession by students, are only available at 2 stands. Similarly, the chicken tender basket, which had the third greatest meal velocity of all food items, is only available at 2 stands which could contribute to abnormally long wait times. According to the survey, 73% of students were not aware of concessions on the stadium's top level, yet the two most popular stands were located there. This demonstrates that the main source of concession revenue is from non-student spectators who typically sit on the upper level and that students are purchasing relatively few concessions. After analyzing the Aramark data coupled with student preferences from the survey, it is evident that UVA should prioritize lower-cost food and beverage options at games while making other highly preferred concessions like fries and the chicken tender basket available at more stands.

## VI. WEBSITE DESIGN

An integral part of any game day experience is finding information regarding parking, concessions, and rules for attending the event. UVA Athletics provides this information via their game day website. However, an outdated stack pull-down format and copious amounts of text make information difficult to parse through. While the University cannot currently make certain changes to the website due to its contract with the site provider, recommendations for adjustments are still made to improve its future aesthetic, readability, usability, and navigation. These improvements will allow patrons to quickly find answers to their questions and increase their knowledge regarding game day procedures.

Looking through the football game day page, we attempted to find answers to typical questions fans may ask, such as “Where can I park?”, “What am I allowed to bring into the stadium?”, and “Where are concessions located?” While we found the answers to these questions, we spent more time reading unnecessary information due to the outmoded UX design of the website. Therefore, utilizing the hallmarks of good UX design and other schools’ websites that have the same provider, we identified critical changes to improve the game day platform. To not “overwhelm users with too much information,” [5] we recommend decreasing the amount of information presented to them by replacing paragraph text with bullet points, while highlighting necessary details like phone numbers and addresses through bolding, italicizing, or underlining. Furthermore, to promote “recognition over recall” [5] we recommend grouping similar facts and utilizing icons and pictures to denote where this information may be found. These changes increase usability by decreasing scrolling and facilitating information sharing, while improving the overall aesthetic of the website.

To further progress the usability and accessibility of the design, we recommend that UVA change all-caps text to sentence case to increase readability and build off current parking and concessions maps by making them interactive. These interactive maps can provide location, cost, and picture data of both concessions and parking lots. While the current non-interactive visuals include some of these details, having this information appear only when hovered over will declutter the present maps and give patrons critical pregame knowledge. Finally, to increase spectator connection to all UVA sports we recommend that the athletics department place their social media handles at the top of the game day website for easy fan access to upcoming events. Keeping customers connected to additional UVA sports will not only shed light on more school organizations, but will also build fan bases for other university teams. In conclusion, updating the UX of UVA’s game day website will make patrons more informed by efficiently providing them with valuable parking, concessions, and general information, enhancing their spectator experience.

## VII. FURTHER AREAS FOR IMPROVEMENT

To continue identifying avenues to better the UVA football customer experience, the athletics department can explore other areas such as a new video board and sound system, along with an upgraded tailgating environment for spectators. Additionally, sending out an updated survey to an expanded number of UVA students, alumni, and casual fans will improve the athletics department’s understanding of how all customers feel regarding their home football game experience. This increased comprehension will allow the department to pinpoint further areas for advancement regarding the in-game experience. As the spectator experience improves and more patrons attend home football games, the department can regather traffic, concessions, and ticketing data to see how an increase in fans

exacerbates low-attendance issues and if any new problems arise.

## VIII. CONCLUSION

To decrease traffic congestion in and around Charlottesville on game day, spectators must be educated on the unique limitations enforced for a special event. By increasing relevant signage, updating the design and readability of digital information, and updating the traffic plan to reflect current staffing resources, both spectators and those directing traffic will be informed as to how to arrive safely at their parking space. The implications of these changes are that spectators will have a more positive experience navigating the area both before and after the football game. Future work with traffic congestion caused by football games should include an iterative analysis of changes implemented in the next few seasons. Doing so will account for season-to-season changes in attendance and time of kickoff in ways our data from the 2022 season was limited.

Key patron traffic recommendations include repositioning stadium staff to higher-traffic entry gates and encouraging students to arrive on time. These recommendations will improve traffic flow around the stadium and liven the kickoff atmosphere. As pedestrian traffic patterns shift with higher attendance, traffic-dense gates and stadium staff positions may change as a result and must be monitored by the UVA Athletics Department. Finally, main website recommendations include increasing panels and images, decreasing text, and accentuating critical information. Implementing these suggestions in the will improve the readability, usability, accessibility, and aesthetics of the platform. With these improvements comes smoother information sharing, which will lead to a more informed patron and an improved spectator experience.

Overall, traffic congestion, repetitive in-game activities, and a website that is difficult to navigate diminish the customer experience for UVA football game spectators. Proposed solutions to mitigate these issues include an updated traffic plan, a rearrangement of workers at entrance gates, updated in-game entertainment, and a restructured game day website. Incorporating these recommendations will improve the customer experience for UVA home football game spectators, enhancing the stadium atmosphere on game day and helping build a more loyal fan base.

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