Adio

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Abstract

Adio is a location-based audio advertising platform for rideshare drivers that intersperses audio advertisements between songs played on a Spotify account and provides a portion of the advertisement revenue to the rideshare drivers. There are two main components to the project: a mobile iOS application that rideshare drivers can use to deliver ads in between songs, and a web application that advertisers can use to create geo-targeted audio advertising campaigns. The basic functionality for the mobile and web applications have been completed and evaluated thoroughly, but more work still needs to be done to integrate the components together, iterate over the current product, and receive more feedback from stakeholders.

1 Motivation & Goal

Advertisers, especially small businesses, want and need innovative and cost-effective ways to reach high-potential consumers. Moreover, consumers want and need relevant and effectual methods to discover and connect with businesses that are easily accessible to them. Rideshare companies, such as Uber and Lyft, provide a unique service and medium for novel, location-based advertising that provides supplemental income to rideshare drivers.

1.1 Market Research

We observed that many Uber and Lyft drivers play music through the radio, which features advertisements at regular intervals that earn revenue for radio stations. In 2019, spending on radio advertisements in the United States is projected to be $17.9 billion. This amount is projected to grow to $18.4 billion by 2023. However, radio advertisements are always broadcast to a large area, making them both expensive and less valuable to local businesses who may want to only reach a particular, fine-grained location segment. Additionally, Uber and Lyft drivers do not benefit at all from playing audio advertisements from the radio. Our team recognized these problems in the market, so we wanted to take this advertising opportunity and improve upon it while also providing another source of income for these drivers.

1.2 Value Proposition

Our goal is to provide a platform, Adio, for location-based audio advertising in rideshare vehicles that delivers relevant and effective advertisements between songs played by our rideshare driver-partners. Our driver-partners will be able to download our mobile application, select the frequency of advertisements they wish to play – perhaps one after every two songs – and begin streaming music of their choice from Spotify, Apple Music, or another mobile music streaming service. Based on the advertisement frequency chosen, our driver-partners' music will be automatically interspersed with advertisements from our advertiser-partners. Using the current location of our driver-partners (and potentially using rideshare trip data), Adio will play geographically relevant advertisements based on target regions selected by our advertiser-partners for each advertisement campaign. The value of Adio is immediate for three primary stakeholders.

1.3 Stakeholders

Our advertiser-partners, many of whom we expect will be small businesses, will be able to use audio advertisements to target geographically relevant customers. The value of each advertisement will

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be greater than that of a comparable radio advertisement, since businesses can broadcast their advertisements through Adio in a specific geographic region. This means that the cost of advertising through this novel medium will be affordable and practical for a larger group of businesses as compared to radio advertisements. Advertiser-partners will also be able to flexibly create and remove advertisement campaigns and monitor their existing campaigns at any time. If needed, existing campaigns can easily be modified to change the target region, impression limit, or the advertisement itself.

Rideshare passengers who will engage with advertisements through our platform will discover businesses that are relevant and easily accessible to them due to the location-based targeting of our advertiser-partners' advertisement campaigns.

Our driver-partners will be able to supplement their income through Adio as a portion of the advertisement revenue that we generate will be paid to our driver-partners based on the quantity of advertisements they broadcast to passengers. It is also incredibly easy for driver-partners to begin using Adio, as there is little initial setup or cost required on their part.

1.4 Stakeholder Research

From the inception of Adio, our goal has been to understand the wants and needs of our stakeholders and to best cater Adio to them. Each team member spoke to Uber and Lyft drivers to gauge their interest in our platform and to understand their perspective on features that we planned to include and ones that we had not considered. Specifically, we gave each driver a brief pitch of our idea and asked for their feedback on the following points: (1) whether they play any music while they are driving their passengers (and if so, through which medium) to see if drivers could play advertisements through Adio, (2) if they would use our platform, given the existence of other products with related – but not the same – goals, and (3) if drivers would be interested in beta testing Adio. We received positive feedback from the drivers, especially since the use of our platform requires little setup on their end and there are many potential benefits. The primary concern for drivers was that the passenger experience could be worsened due to advertisements. To alleviate this concern, we allow drivers to control advertisement frequency

and believe that the advertisements broadcast by Adio will be relevant and beneficial for riders.

We also spoke to family, friends, and other rideshare users to get their feedback on Adio and explore any concerns they may have. The feedback we received was generally positive, especially amongst college students. Given that students on campus frequently use rideshare services to travel to Center City, Philadelphia, they felt that relevant advertisements would inform them of activities and offerings in the area and would definitely be an improvement on traditional radio advertisements. Adults also expressed an interest in this idea, citing business travel to new cities as one of their primary uses for rideshare services. Relevant advertisements would allow them to cost-effectively explore the area around them during their free time.

With this feedback in hand, we approached different local businesses and potential advertisers. They were quite receptive to our platform and recognized the financial and location-based targeting advantages of Adio, as compared to other mediums that are available.

2 Related Work

To understand the existing market, identify competitors, important differentiating factors, what does and does not work, and more, we completed thorough market research. We categorized the existing landscape and competitors as follows.

2.1 Competitors

Tablet-based Rideshare Advertising
(1) Octopus (playoctopus.com) provides free tablets to rideshare drivers for passenger use that have trivia games and location-based video advertisements. Octopus pays drivers up to $100 per month.
(2) Vugo (govugo.com) provides in-car tablet-based entertainment for rideshare passengers in the form of video games, apps, film shorts, sports, and news. Vugo pays drivers $100–$200 per month.
(3) Surf (ridewithsurf.com) provides tablet-based entertainment for rideshare passengers that includes videos, podcasts, and live radio. Surf pays drivers $0.35 per four-minute advertisement interaction session.

Rideshare Billboard Advertising

(1) Firefly (fireflyon.com) provides electronic screens that are placed on top of rideshare vehicles and cycle through different geo-targeted advertisements. Firefly pays drivers about $300 per month.
(2) Halo Cars (www.halocars.co) also provides electronic screens that are placed on top of rideshare vehicles and cycle through different geo-targeted advertisements. Halo Cars pays drivers about $400 per month.

Music Promotion
(1) Steereo (steereo.com) creates playlists for drivers with sponsored music from independent artists paying to promote their songs. Steereo pays drivers once they have reached a minimum of $100 in earnings.

Our solution is similar to other competitors in the market in that it also provides drivers with an additional way to supplement their income while driving. However, Adio differs from the competition in several ways that we feel will benefit driver-partners, advertiser-partners, and riders. First, our product is purely software-based and thus avoids any hassle that may come with hardware solutions, such as billboards. Second, our product will be integrated with the Spotify API to deliver advertisements in between music playing chosen from our driver-partners' personal Spotify accounts, allowing for a higher level of personalization. Finally, our product will be particularly useful for smaller businesses who typically do not get the exposure that larger and more well-established franchises receive, as our audio advertisements will be cost-effective and easily produced.

3 Components Completed & In Progress

There are two main components to Adio: a web application, developed with JavaScript, Node.js, EJS, HTML, CSS, Amazon DynamoDB, and Amazon S3, and a mobile application, developed with Swift, SceneUI, and several relevant APIs. At a high level, the mobile application allows driver-partners to sign in and set various parameters regarding the advertisements that they wish to broadcast, such as volume and frequency. In addition, driver-partners can navigate to a dashboard that details their income history over specified timeframes, such as the past month or the past year. The web application is designed for advertiser-partners to easily create audio advertising campaigns that will be seamlessly delivered to consumers via our driver-partners. The website allows advertiser-partners to sign in, upload audio advertisements, and set the center and radius of the circular area in which they desire their advertisements to be broadcast. In addition to creating advertisement campaigns, advertiser-partners can also view their existing campaigns.

Listed below are the specific components that comprise the mobile and web applications, descriptions of their functionality, and our current progress toward these features (**completed** or **in progress**).

3.1 Mobile Application

(**1**) *Initial driver interface.* This is the main screen that allows our driver-partners to begin using Adio during their workday (and to stop using it after completing their rides for the day). It also shows whether or not an advertisement is playing at the current time. **Completed.**

(**2**) *Settings interface.* This view allows driver-partners to calibrate settings, such as the frequency and volume of advertisements that are broadcast, and to turn on and off location sharing. **Completed.**

(**3**) *Income dashboard.* This view renders a bar chart detailing the amount of income made by driver-partners through Adio over various periods of time. The graph is displayed using the Swift package Charts. **Completed**.

(**4**) *Interspersing music with advertisements.* This feature automatically pauses the music that is currently playing at specified intervals, plays an advertisement, and then resumes the music. The advertisement is played through an audio player created using Apple's AVFoundation library. This particular feature is located in the driver interface described previously. **Completed.**

(**5**) *Integration with Spotify.* Our mobile application integrates with the Spotify API to authenticate driver-partners with their personal Spotify accounts and play music of their choosing. **Completed – see appendix for details.**

(6) *Playing an advertisement after a set number of songs.* This feature allows driver-partners to specify a number of songs to be played in between each advertisement. The mobile application would connect to Spotify and only play an advertisement once this set number of songs have been played, creating a seamless transition between music and advertisements. **In progress – see appendix for details.**

(7) *Integration with Amazon S3.* This component will allow for querying specific audio advertisements from the database that interfaces with our web application. **In progress.**

(8) *Driver-partner statistics computation.* This feature will provide calculations and visualizations of various statistics for driver-partners regarding their income and the number of advertisements they have broadcast. **In progress.**

(9) *Terms and conditions.* These will detail the relevant legal information and terms of use for Adio, including required driver-partner qualifications. **In progress.**

(10) *Geolocation algorithm for ad-selection.* This algorithm will determine driver-partners' current location and interface with Amazon S3 to compute the most relevant advertisements to be broadcast to consumers, taking into consideration prior impressions for each advertisement and the broadcasting of other driver-partners. In this process, this component will select relevant advertisements and queue them to be broadcast. **In progress.**

3.2 Web Application

(1) *Account creation.* This allows a new advertiser-partner to sign up with Adio and create an account with an email, company name, first name, last name, and password. **Completed.**

(2) *Password hashing with salts.* For security, our platform uses a SHA-512 hashing scheme to store – upon account creation – and verify – during sign in – advertiser-partner passwords on the backend. For each advertiser-partner, we add unique random data – a salt – which we also store on the backend, to their password before providing this combined input to our hash function to guarantee a unique output even when the password inputs are the same. Consequently, the unique hash produced by adding the salt can protect us against different attack vectors, such as rainbow table attacks, while slowing down dictionary and brute-force attacks. **Completed.**

(3) *Verification of sign in credentials.* This feature, alongside the previous component, allow for secure verification of email and password combinations during a sign in attempt. In the case of an error, our application notifies the advertiser-partner of the cause for the issue. **Completed.**

(4) *Dashboard with Google Maps API for latitude / longitude selection.* This component features a map driven by the Google Maps API on the advertiser-partner dashboard. It allows for the latitude and longitude fields of the advertisement campaign / audio advertisement upload form to be populated by clicking on the map. This point serves as the center for the advertisement's targeting region. **Completed.**

(5) *Upload of audio files.* This component allows users to upload audio files that contain individual audio advertisements. This uploads the advertisement to Amazon S3 for later access and stores the advertisements' metadata in DynamoDB. **In progress – mostly completed but need to handle error cases.**

(6) *Form to input new campaign information.* This component allows advertiser-partners to input information regarding new advertisement campaigns, including latitude, longitude, radius, and campaign name, all alongside the corresponding audio advertisement. **In progress – mostly completed but need to handle error cases.**

(7) *Retrieval of existing advertisement campaigns.* This component allows for advertiser-partners to see their existing advertisement campaigns and metadata and download the associated audio file. **In progress.**

4   Evaluation of Completed Components

Below, we discuss the completed components of our product and the methodologies we used to evaluate them.

Mobile Application

In general, we used a similar protocol to test every feature we implemented for the mobile application. We first tested it on our local XCode iOS simulator, using various device types, such as: iPhone 11 Pro, iPhone XR, iPhone 8, and iPhone 6. Then, we tested the interface on our devices with different versions of iOS (iOS 9.3, iOS 12.4, iOS 13.2.3). We tested all of the completed components listed in the previous section and attempted various actions that a user may perform. Our final step of the evaluation process was to demonstrate the application on our phones to potential stakeholders and have them interact with the different features we were evaluating. Below we talk about specific evaluation points we were looking for.

(1) *Initial driver interface.* We wanted our initial driver interface to be both user-friendly and intuitive. Additionally, we did not want driver-partners to feel overwhelmed by a cluttered home screen. After a couple of changes to our initial design, we found that potential driver-partners were receptive to an easy-to-use and intuitive homepage that was not too cluttered with extraneous features.

(2) *Settings interface.* There are a few crucial points we wanted to touch on here, given that the settings interface is one of the most important views for a driver-partner. Firstly, we wanted it to be simple to navigate to the settings page. Secondly, we wanted the settings page to encompass everything that potential drivers may deem necessary. Finally, we wanted the settings controls to be easily understandable. The potential stakeholders who tested our application appreciated having the advertisement frequency and volume controls easily accessible, so we also displayed those on the home page. Beyond that, we added a few more setting controls, such as the option to edit account information and change location preferences to provide additional customizability to the application.

(3) *Income dashboard.* Similar to the previous, we wanted the income dashboard to be easy to find and understand. We received feedback that a table of numbers is difficult to interpret, so we opted to display charts of earnings over different time periods and splits. Furthermore, we made the figures for monthly and yearly earnings larger to draw the attention of our driver-partners to the most relevant statistics.

(4) *Interspersing music with advertisements.* We wanted the functionality of this feature to fulfill three main objectives: (1) music stops before an advertisement is played, (2) advertisements play to completion and do not stop before termination, and (3) music begins where it was paused when an interrupting advertisement completes. These features were tested by playing music through Spotify on our devices while Adio was operating to observe the functionality of interrupting advertisements when music is playing.

(5) *Integration with Spotify.* We felt the technical functionality and user experience for this feature should fulfill three main objectives: (1) a driver-partner can connect to his or her Spotify account to play music, (2) a driver-partner does not need to keep logging into Spotify after the first time they do so, and (3) the entire experience should be seamless for a driver-partner and should not abruptly halt at any given point in time. Feedback from potential stakeholders indicated that they would prefer if Adio automatically connected to Spotify when opening the application, so we ensured that the Spotify login functionality would remember passwords if desired after the first login.

Web Application

(1) *Account Creation.* We wanted this feature to be as streamlined as possible, given that it is the first page an advertiser-partner interacts with when using our application. Thus, we wanted our user interface to be intuitive and simple. We asked several potential stakeholders to review our user interface. We received overwhelmingly positive feedback, especially noting that the sign in and sign up process was aesthetically pleasing and easy to follow with consistent error reporting. We also evaluated this component by ensuring

that once an account is created, our company database is correctly populated.

(2) *Password hashing with salts.* To ensure the correctness of this approach, we checked our databases for consistency and security. Furthermore, we tried several basic malicious techniques to see if we could break our protection scheme, which we could not.

(3) *Verification of sign in credentials.* For this component, we wanted to make sure that our application would correctly check that an advertiser-partner's sign in credentials exist in our database. If they do, then the desired functionality is that they can successfully sign in. If they do not, then our application does not allow the sign in and reports the specific error. We evaluated this by testing the sign in functionality with all combinations of credentials and errors.

(4) *Dashboard with Google Maps API for latitude / longitude selection.* Currently, our map requests the location of the advertiser-partner (and otherwise defaults to Philadelphia) and correctly loads centered on this location. To fully evaluate its current functionality, we wanted to make sure that interacting with it successfully selects the latitude and longitude points that the advertiser-partner chooses. To this end, we tested several clicks on the map to see if the selected latitude and longitude pairs are populated. We tested throughout the map's viewable area, including points that are within near proximity to each other. Through this, we were able to see that interaction worked correctly.

5   Demo

Below is a link to a video demo of both our mobile app. It shows a background song playing, a 15-second audio ad playing, and then the background music resuming while the user explores the other pages and features in the app.

https://youtu.be/K8ysW92lypA

See **Appendix B** for more screenshots of both the mobile and web application.

6   Conclusions and Future Work

Our current implementation of the mobile and web applications provides much of the critical functionality of our desired product. Next, we need to iterate on the current implementation, finish integrating the mobile and web applications together seamlessly, and add additional features that may be useful to partners, such as dashboards to track advertisement campaigns and additional metrics for driver-partners to track income.

We plan to iterate on the existing features by surveying more potential partners, particularly focusing on the evaluation points mentioned in Section 4. We will finish up the integration of the mobile and web applications by working around a Spotify API bug we are facing (described in more detail in Appendix A) and integrating the database of audio advertisements and target locations for the campaign into both the web and mobile application. This will allow us to intelligently pick advertisements to be played on the mobile application based on location.

Additionally, we would like to add more features that allow partners to track their campaigns and expenditures or revenue. We would also like to implement additional security features. Since our application has the potential for driver-partners to earn money, we would like to ensure that this opportunity will not be abused or scammed. We will incorporate security checks, such as checking whether a driver is currently driving at a particular speed, integrating with the Uber or Lyft APIs to check whether a driver is currently on a trip, and ensuring that the car's volume is at an audible level while advertisements are playing using the microphone. Once these features are complete, we will have a more robust evaluation plan.

When all of our features are completed and finalized, we aim to partner with some local businesses in the Philadelphia area to test our advertisement services with real ads, as well as with some Uber and Lyft drivers in the area who are willing to test our application while they drive. We hope to receive positive feedback from drivers, riders, and advertisers after our platform is completed, as we believe Adio has the potential to benefit all stakeholders involved in an extremely positive way.

9.2 Appendix B: Screenshots of Mobile and Web Application