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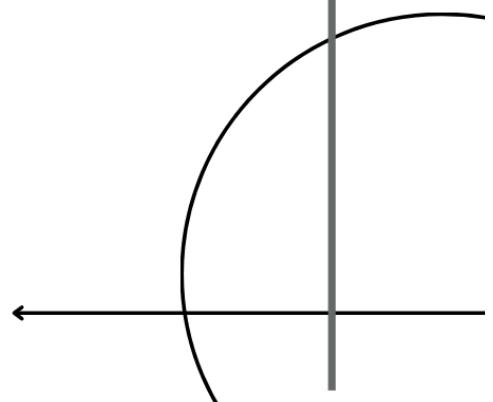


PopuLert

Your Crowd Compass

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1. Introduction:

After much research and extensive thought, a business opportunity with major potential for successful market penetration has been identified. Many businesses face overcrowding issues and many consumers face frustrations with wait times, which results in the inability to create an optimal schedule for their everyday life. Due to this issue being widespread, the best solution is one that comprehensively targets the real task: to evaluate occupancy levels to eliminate wasted time and optimize personal schedules. Users desire a tool that not only allows them to identify crowds and wait times but also one that is customizable to their personal schedules and busy lives. Regarding end users living in urban populations, there exist three distinct customer segments: college students, healthcare professionals, and other essential workers, each of which are comprised of busy individuals who have limited time to spend outside of their goals and careers. PopuLert's end goal is to create an interactive and reliable software solution that anyone in an urban environment, especially individuals in the target customer segments, can use to accurately evaluate when an establishment is busy and make better scheduling decisions that result in increased efficiency.

2. Problem Definition:

Crowds are a daily obstacle to the efficiency of countless hardworking and busy individuals. Unpredictable congestion causes college students, healthcare professionals, and other essential workers to feel as if they are wasting time. There is currently no comprehensive or widely used method of determining the occupancy of a location or boosting efficacy. PopuLert aims to evaluate occupancy levels to eliminate wasted time and optimize personal schedules.

A common inconvenience that individuals face is the inability to plan their day due to unknown wait times at their desired establishments. Many people lead busy lives and cannot afford to have an unreliable schedule. Another problem that many end users encounter is feeling like their time is being wasted waiting in crowded places. Having to wait while enduring a busy schedule causes people to constantly ponder how their time could've been better utilized. People also tend to struggle to find options and alternatives during peak hours due to limited availability.

The introduction of PopuLert would be of huge benefit to these individuals. The users would have access to long-term data that they could then use to plan their attendance. They would then gain the ability to create schedules around the crowd levels and optimize their daily routine. Individuals will be able to receive personalized recommendations of locations when needed. The most important gain that the user would experience would be the ability to check the live crowd level of any establishment.

To more accurately gauge where issues arise within the schedules of PopuLert's users, a user experience chart was developed to provide a visual map. This user experience chart is shown below in Figure 1.

Table 1: College Student User Experience Chart

Experience	Morning					School Day					Afternoon										
	Sleep	Wake-Up Early	Morning Routine	Breakfast (Dining Hall)	Waited 10 mins for Food	Had to Eat Upstairs	Attend Class	Free-Time (Campus)	Couldn't Find a Spot in Library	Attend Class	Lunch	Searched 5 mins for Table	Attend Class	Exercise at Gym	Repeatedly Waited for Machines	Dinner with Friends	Spent 30 mins Finding Restaurant with No Wait-Time	Homework	Free Time	Nightly Routine	Sleep
++	++														++				++		++
+				+				+			+			+							
0		0				0			0			0									
-		-			-						-			-		-			-		-
--			--					--								--		--			

This user experience chart illustrates the schedule of a typical busy college student. The student's day begins with waking up to the alarm, attending classes, eating lunch, walking back to his or her dorm, going to the gym, eating dinner, doing homework, etc. The schedule portrayed in this chart illustrates the need for a platform that helps individuals, especially college students, easily evaluate the level of occupancy at businesses and facilities, such as gyms and dining halls, to have a more efficient schedule.

Our end users desire more complete autonomy in building their schedules, which is only achieved through access to data surrounding busy periods and the capability to use that data to develop a more efficient schedule. Implementing a comprehensive solution would allow end users to make more informed and efficient decisions, as well as alleviate some pressure from both businesses and individuals. Customers would gain quicker access to their desired service, allowing them to spend less time at the establishment, effectively increasing their time efficiency. Businesses would be able to increase their user interactions through tapered occupancy levels and structured customer appearances, and would also be able to focus on maintaining their performance quality and overall upkeep once this problem is solved.

In summary, a software solution is vital to the resolution of this issue and would be pivotal in aiding college students in developing the most efficient daily schedules such that product expansion and further market growth remain within grasp.

The next section goes further in-depth on where PopuLert is providing value to combat this issue and provide users with a more efficient use of their time, after which the specific end users that PopuLert is targeting are detailed through personas that build on the user experience presented above.

3. Value Proposition:

PopuLert targets individuals living in urban environments and helps them evaluate occupancy levels in order to eliminate wasted time and optimize their personal schedules. Through the provision of this service, end users are able to spend less time on idle tasks and more time on the things that truly matter to them, like increasing their time efficiency and boosting productivity and satisfaction. No longer will users be plagued by the inability to plan due to the crowded nature of their environment.

PopuLert's design concepts will be directly driven by the desire to add value to consumer's lives through increased efficiency. During the brainstorming and design processes, the main focus will be on how crowd levels can accurately and reliably be tracked to eliminate unnecessary time loss. The main goal is to create an interactive and reliable software solution that end users can use to consistently evaluate when an establishment is busy and that provides optimized schedules aimed at increasing the personal efficiency of each user so that they can focus on their unique passions and goals.

4. End Users:

Urban populations primarily make up the end users of this product. Those living in urban environments are typically surrounded by crowded streets and bustling corners. They are living in a more densely packed area, meaning that they are not only interacting with more people on a daily basis than in rural environments, but they are also competing more heavily for goods and services. This competition increases the time it takes for the retrieval of said goods and services, which in turn results in more time wasted waiting in lines or traveling to a different location.

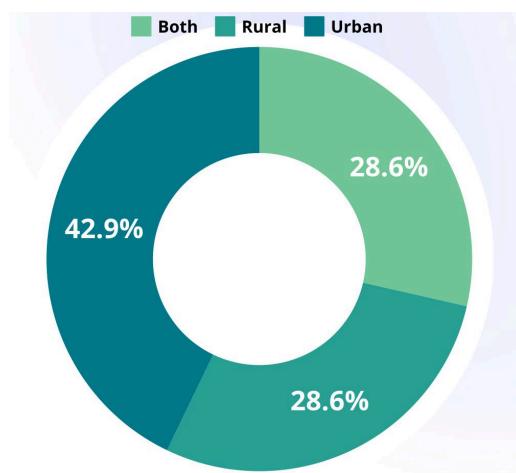


Figure 1: Survey Demographics

During the team's interview process, a survey was sent out to a large population. Almost 75% of the respondents reported having experience living in an urban environment, indicating that this population is quite large. While this is a problem for everyone in an urban environment, especially those surveyed, it affects certain groups to a greater extent because of their demanding and busy lifestyles. More detailed information on these groups can be found below.

Customer Segments

The large group of end users has been divided into three detailed customer segments: college students, healthcare professionals, and other essential workers, such as teachers and restaurant workers. These segments are representative of the groups often present within urban environments and make up a vast majority of urban populations.

College students have some of the busiest schedules among those living in urban environments. Not only are they full-time students with a challenging academic load, but most are also balancing having a job, being involved in extracurriculars such as school clubs/organizations, volunteering, networking, and self-care activities such as exercising. There are always time sacrifices being made, which often result in students choosing to focus on their academics or extracurriculars instead of eating at a certain time or working out at the gym [9]. Therefore, there exists a major market opportunity with this customer segment to help improve this issue and assist students in saving their precious time from unnecessary waste.

Healthcare professionals are also a notoriously busy group. They often work long hours multiple days a week, leaving minimal amounts of time for other things. This scarcity of time means that healthcare professionals want to spend their free moments with their family, exercising, or going out to eat at a favorite restaurant as opposed to waiting in line. Often, the stress of feeling like they do not have enough time to fit their passions/interests into their schedules increases feelings of burnout and decreases satisfaction in life. Those with the most satisfaction in their careers, and lives, are the ones who can do everything they love to do [10].

Lastly, essential workers mainly comprise the other third of urban populations. Those working in education, the food industry, retail, etc... are often found in urban environments where those services are vital to the city's functioning and flourishing. However, the requirements of those jobs are also typically demanding and leave little room for changes in a daily schedule. Educators, for example, are restricted to the schedule of their academic institution, leaving little time for things like morning coffee, afternoon lunch breaks, and the enjoyment of personal interests amidst grading deadlines. Those in these fields place a high emphasis on the ability to be efficient with their time so that they can find more time for enjoyment.

User Personas

After conducting primary research in the form of detailed in-person interviews and an anonymous survey, user personas were created, each corresponding to one of the three different customer segments. The persona pictured on the next page in Figure 2 illustrates a busy college student:

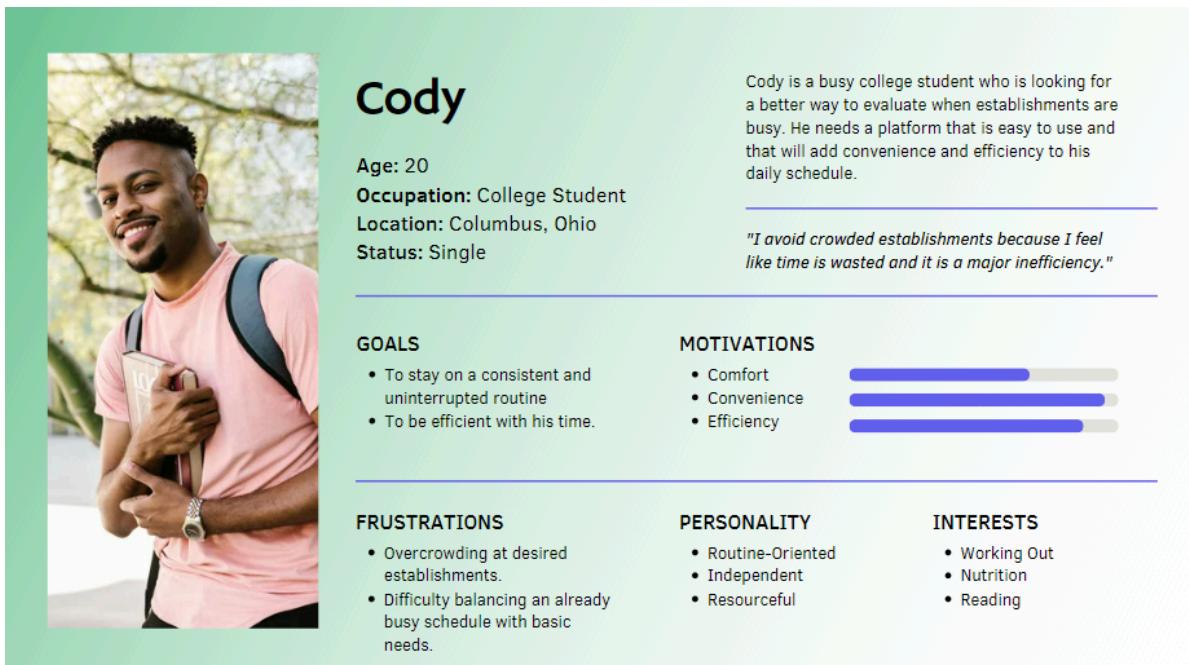


Figure 2: College Student Persona

This persona is representative of one of the most prominent and common end users of college students who do not like the crowded nature of establishments, such as gyms. In this persona, Cody dislikes the crowded nature of establishments due to the interruption to his planned daily schedule. Cody is a busy college student who believes that crowded establishments cause major inefficiencies and lead to decreased productivity. He is frustrated with balancing an already busy schedule with his most basic needs and oftentimes finds himself sacrificing exercise and eating because he feels more productive studying than fulfilling those activities due to the long unpredictable wait times at certain places.

The second persona that is illustrated below in Figure 3 represents a healthcare professional:



Figure 3: Healthcare Professional Persona

This persona is representative of healthcare professionals who work long shifts to improve the health of others. Therefore, they do not want to spend any more time waiting in long lines at crowded establishments. Rodger is a great example because he is a doctor in Columbus who works long shifts. He wants to create more free time for himself and create an optimal routine, but he cannot do that usually due to the crowds at establishments, such as grocery stores and gyms. The crowds also create inconsistencies in the time intervals in his schedule as a doctor who improves the well-being of others.

The final persona that is pictured below in Figure 4 represents a Kindergarten teacher, an essential worker:

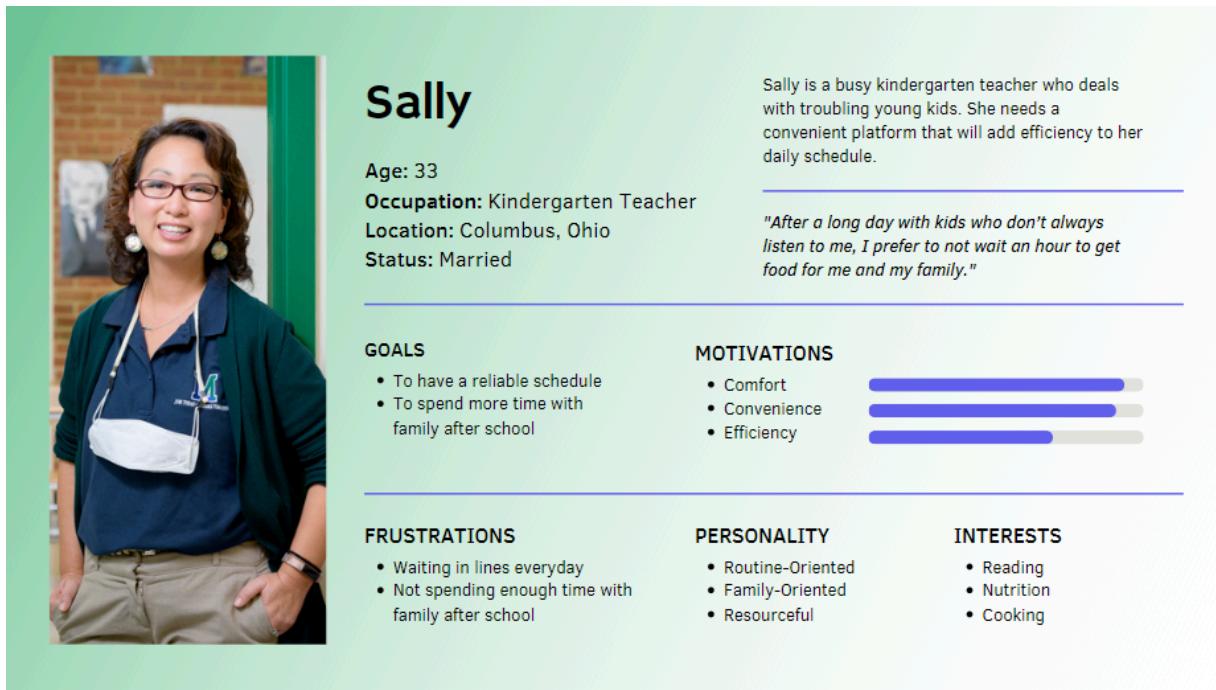


Figure 4: Essential Worker Persona

This persona is representative of essential workers in urban areas, which includes teachers, restaurant workers, construction workers, electricians, etc. Teachers who work with young children, such as Sally, need a break from dealing with the children after a long day at work. Thus, Sally does not want to wait in long lines which prevents her from spending quality time with her family after school.

As illustrated through the personas, Cody, Rodger, and Sally all want a software platform that will add efficiency to their schedules and eliminate wasted time. To tackle the development of a solution for these three individuals, a pairwise comparison chart was created based on the data collected during interviews. The data from the chart identified important user needs required from a software solution. This chart is shown on the next page in Table 1.

User Needs

Table 2: Weighted Needs Chart (Pairwise Comparison)

User Needs	Reliable Data	Functionality	Cheap	Multiple Locations	Sectional Crowd Level	Notifications	Gives Alternatives	Creates Schedule	AI	Score
Reliable Data		1	1	1	1	1	1	1	1	8
Functionality	0		1	1	1	1	1	1	1	7
Cheap	0	0		0	1	1	1	1	1	5
Multiple Locations	0	0	1		1	1	1	1	1	6
Sectional Crowd Level	0	0	0	0		1	1	1	1	4
Notifications	0	0	0	0	0		1	1	1	3
Gives Alternatives	0	0	0	0	0	0		1	1	2
Creates Schedule	0	0	0	0	0	0	0		0	0
AI	0	0	0	0	0	0	1	1		2

The table above operates using a 0-8 scale to indicate importance with 8 being the most important and 0 being the least important. Reliable data scored an 8 because users want accurate data for each location that is consistently updated. Functionality scored a 7 because users want an app that works as intended, in addition to the presence of reliable data. Multiple locations scored a 6 because urban users value an app that can be accessed at numerous locations.

Based on the conducted user interviews, cheapness also matters with a score of 5. This is because the app should be affordable for everyone. After all, everyone is busy and wants to eliminate wasted time. Sectional crowd level is also an important user need with a score of 4. The users want the app to indicate occupancy levels for each area of an establishment, such as the individual machines and courts in a gym. Users also want to be able to get notifications, a user needs a score of 3. Potential notifications include the busyness of nearby businesses, such as restaurants, or spikes in the crowd levels at a nearby gym, based on when the user usually goes to the gym. Through the notification feature, the user can set daily notifications for the crowd level at their desired time.

Both AI integration and the ability of the app to give alternatives are scored as 2. These needs are less important but are additional needs that the user can fulfill through the app. The AI-powered chatbot can give them important alternatives, for instance. If a Chipotle user is planning on going to is busy, the user can search for another nearby Chipotle location that is less busy or search for a place that is similar to Chipotle, such as Qdoba, using the chatbot. Finally, although schedule creation is scored as a 0 on the chart, it is an additional user need that the app can fulfill by creating a schedule for the user based on user choices, such as the time they usually go to the gym or get lunch.

In general, the scores in the chart above illustrate the importance of each user's need. Fulfilling these user needs will help the end users evaluate the level of occupancy at businesses and facilities, causing them to waste less time and have more efficient daily schedules.

The next section expands upon these needs and PopuLert's solution by detailing the potential stakeholders, market size, and various competitors of PopuLert.

5. Market Character:

The potential stakeholders for this new software include business owners, gym-goers, mobile-ordering users, restaurant patrons, and consumers as a whole. Business owners could experience simultaneous positive and negative outcomes by having their occupancy or wait time public. A software product that clearly and concisely provides accurate information about levels of busyness could alleviate rush and concentration for businesses. This outcome could benefit businesses that are understaffed, allowing employees the breathing room to provide their best service in a timely manner. On the other hand, this software would discourage consumers from directing their presence and capital to places that are crowded. Businesses that thrive or depend on a large quantity of customers may suffer. Clubs and retail stores utilize large amounts of customers on a daily basis to make their establishments feel more appealing [1]. A sense of urgency and fear of missing out can be conveyed to consumers through serving exorbitant amounts of customers. Gym-goers would benefit from having knowledge of a gym's level of occupancy by being able to schedule their exercise time during optimal hours. Mobile-ordering users and restaurant patrons would also benefit by being able to select a place of patronage that could provide quick service or seat guests immediately. Consumers overall would mainly be positively affected by having this software by being able to more accurately ascertain how to plan their purchases and activities. An unforeseen outcome of this software could entail more evenly distributed times of patronage, which would be a disadvantage to consumers who already had a plan in place to avoid crowds. For example, if the time they previously went to the gym was now more crowded, it would negatively impact their routine.

To most accurately evaluate the market size, comparisons can be made to the current software products and industries previously identified as stakeholders. The software being developed will likely be utilized primarily by frequent gym-goers, mobile ordering users, and restaurant/business patrons. While it is difficult to ascertain a specific number, by analyzing current statistics, an estimate can be made. According to information listed on exercise.com, 64 million Americans had a gym membership in 2019, while approximately only 44% of these individuals report going to the gym at least twice a week [2]. Viewing the food industry, about 60% of U.S. consumers order takeout at least once a week [3]. Comparatively, 29% of individuals in America report dining out once a week or more [5]. With these numbers, an estimated market size of 40-70 Million with a plus or minus deviation of about 30 Million is a fair assessment for PopuLert. To add to these findings, if there is to be a deviation from this estimate, it is likely to be in the positive direction, as PopuLert is multifaceted and spans a wide range of establishments.

Included below is a competitive matrix, assessing PopuLert's competition. This chart contains information comparing each competitor and their features/advantages.

Table 3: Competition Matrix

User Needs	OSU Website	Google Maps Popular Times	Planet Fitness Crowd Meter
Cheap	✓	✓	✓
Reliable data	✓	✗	✓
Frequently Refreshed	✗	✗	✗
Easy To Check	✗	✗	✓
Well Designed	✓	✓	✓
Gives Notifications	✗	✗	✗
Multiple Locations	✓	✓	✗
Sectional Crowd Level	✓	✗	✗

Visible gaps in the data are present, which would allow PopuLert a unique opportunity to surpass the competition. None of the competitors are able to maintain a current flow of information regarding levels of occupancy. Additionally, many competitors are not convenient or easy to access. Notifications are also absent from the competition and information provided to users is not specific in detail. By implementing a system to keep information relevant to occupancy level current and refreshed, PopuLert would gain an advantage. This could be achieved in the form of incentivizing users to self-report business occupancy in real-time.

Additionally, by making the software accessible and convenient to use, PopuLert will gain a leg up on the competition. Furthermore, users should be able to find their desired establishment quickly and straightforward graphics should convey all relevant information. Finally, the use of notifications could increasingly differentiate Populert from the current market. For example, Populert could send notifications to users if the reported occupancy of an establishment falls below a certain threshold.

6. Research Results:

While collecting primary data and information, in-person interviews and a self-selected survey were conducted. All participants remained anonymous. Minimal personal information was collected for demographic purposes. Age was recorded in the survey and relation to the interviewer was listed during the in-person data collection. The information-gathering process was minimally intrusive and respectful of individual privacy.

The in-person interviews provided insightful results pertaining to the final task and user needs. In general, the interviewees preferred living in a rural environment as opposed to an urban setting. Each interviewee also reported frequently visiting the gym. There were discrepancies regarding the usage of mobile ordering software and going out to eat, as both takeout, dining-in, and frequency of ordering takeout varied. Additionally, the interviews revealed that mobile ordering software, like GrubHub, was viewed as necessary when on campus, but not needed in other settings. Overcrowding was a large source of irritation and inconvenience for the interviewees, as well as inclement weather conditions and long walks. The results from the interviews also showed that people structured their days around their classes and struggled with sanitation, overcrowding, and wait times in a public space. Some respondents stated that they timed their visits to the gym to align with low levels of occupancy.

The survey tallied a total of 42 participants, which while insufficient to make definitive conclusions, allowed for further understanding of the pains, needs, and overall market for PopuLert. The age distribution for respondents ranged from 15-17 to 24-26 years old. 18 respondents had experience living in only an urban environment, while 12 respondents had experience living in a rural environment. Another 12 had experienced both urban and rural settings. About 64% of the respondents reported going to the gym more than two times each week, while only 4.8% of respondents stated that they never go to the gym. Public gyms and College gyms or athletic facilities were most commonly used, as compared to home gyms and high school facilities. Participants on average rated their experience with a public or college gym as 6.94 out of 10. When evaluating the frequency in which individuals order food or go out to eat, 78% of respondents stated that they order food or eat out at least once a week, while the majority of responses stated that they order food or go out 1-4 times a week. Chick-fil-A A and Chipotle were the most common favorite locations to eat. When asked whether dining-in or takeout was preferred, with an option stating that it depends, responses were relatively evenly distributed between the three choices. Three-fourths of respondents reported having used mobile ordering software and 45% of these individuals believed that mobile ordering software was an integral part of their day. Cleanliness, wait times, and occupancy/crowdedness were the top concerns of respondents when visiting a public facility or business. On average, respondents divulged that the level of structure in their day would be 6.04 out of 10. Lastly, responses revealed that individuals felt neutral about the presence of others in a public space, but that overcrowding did cause slight frustration.

Referring back to evaluating the product stakeholders, market size, and growth potential, extensive research was conducted using secondary sources. Businesses that depend on large amounts of customers may be negatively affected by PopuLert, while other businesses may prosper due to a less hectic environment. 4Service Group, an international research company, reports that retail stores are viewed as more attractive when experiencing a high influx of customers [1]. Contrastingly, 4Service Group also reported that during studies of busy establishments, staff struggle to provide personalized and effective customer service. Software that reduces the concentration of individuals may be viewed as a double-edged sword for some businesses. Addressing market size, Tyler Spraul of exercise.com compiled a list of statistics that provide insight into the fitness industry [2]. It was reported that while over 64 million Americans had a gym membership, only 44% of individuals went to the gym at least twice a week. Comparatively, in the food industry, Stephanie Resendes of lightspeed.com states that 60% of U.S. consumers order takeout once a week or more [3]. If PopuLert were able to intertwine with current mobile ordering software and provide more accurate assessments of wait times, then the market size could dramatically increase. As 87% of Americans who use mobile ordering software find that it makes their lives easier, PopuLert has the potential to add to the convenience of this already-established market [4]. Assessing the restaurant and dining-in market, 29% of Americans claim to dine out at least once a week [5]. By directing consumers to less-crowded establishments, PopuLert could work to eliminate wait times and provide further value to users.

To accurately assess the current market and competition, similar software was identified and compared to PopuLert. Secondary sources were utilized in evaluating competitors and their features. Google Maps is a large, proven competitor that provides its users with data displaying the popular times for establishments [6]. This data is gathered by users who have opted into Google's location history and data collection. Google's method of collecting data could be argued as an invasion of privacy, which would incentivize users to use PopuLert instead, which utilizes transparent and voluntary data reporting/collection. Additionally, this aspect of Google Maps is not a core feature and remains difficult to find for users. Google's data is also not always reliable, but their product features a professional design that can evaluate the busyness of multiple locations. USC's Gym Flow app allows users to see current data showing the levels of occupancy at USC gyms [7]. This software is cheap and reliable, but is limited to one college campus and does not extend its capabilities outside of the fitness industry. Planet Fitness's Crowd Meter software allows users to check a gym's capacity in real time [8]. One of the app's limitations is that it does not show sectional occupancy. For example, the application cannot distinguish whether the machines are full or squat racks are empty, it can only display general occupancy levels for the entire facility. While the app is easy to check and has a pleasant design, it is limited to serving Planet Fitness locations and does not serve businesses/consumers in other industries. Anjana Rajbhandary also writes that users have experienced discrepancies revolving around the app's accuracy, as some users claim the app purposefully states that the gym is busy even when it isn't in order to discourage people from coming to their facilities while still paying for membership [8].

7. Concept Designs:

Brainstorm Process and Results

Concept generation was a long and iterative process. Multiple brainstorming sessions took place in which rough sketches and bulleted lists were created to track the concept design process. The top priorities of the brainstorming sessions were to generate as many ideas as possible without restricting the ideas to what seemed possible at the time. After allowing the ideas to flow unhindered by constraints, a comprehensive list was made which was then evaluated according to the user needs identified above. Once each idea was evaluated, six concepts were sketched and then scored based on how well they each met the most important needs of the users. The specific user needs that were used to evaluate each idea are described above in section 3, while the six concept designs are described below.

Six Concept Descriptions

The first concept, pictured below, is a self-report system where users report what businesses they interacted with and the time in which it took to complete their trip. This concept is powered by location tracking services and automatic timers in order to obtain the most accurate data.

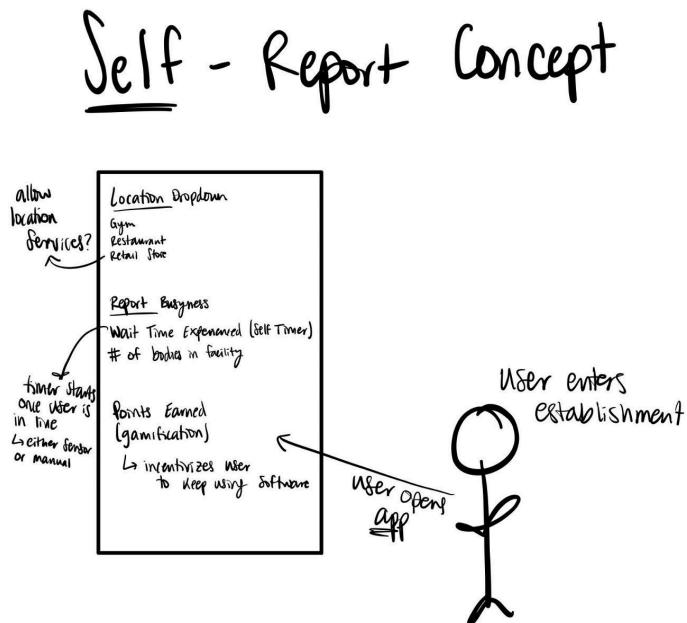


Figure 5: Design Concept 1 - Self Report System (Waze Adjacent)

The second concept is a feature design in which the software would analyze user patterns in order to provide recommendations for the best times to visit certain establishments, as well as where else to go if a business is experiencing high occupancy and wait times.

Recommendation Concept

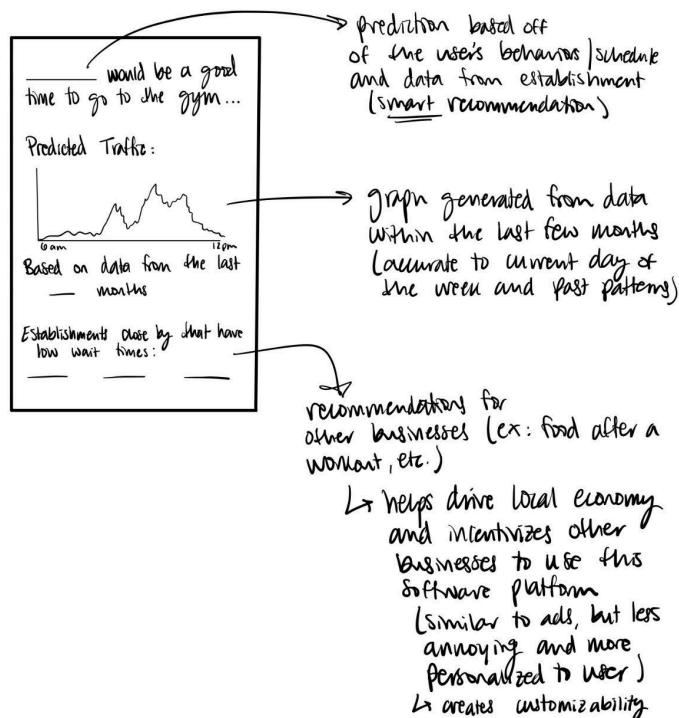


Figure 6: Design Concept 2 - AI Generated Recommendations

The third concept is an incentivization feature designed to maintain consumer interactions with the software. Users would receive points each time they report the busyness levels of an establishment, each time they go to a certain location, and every time they confirm their wait time. Users would also receive bonuses for continuous use of the software. These points could then be redeemed for gift cards or discounts at partner locations.

Incentive Concept

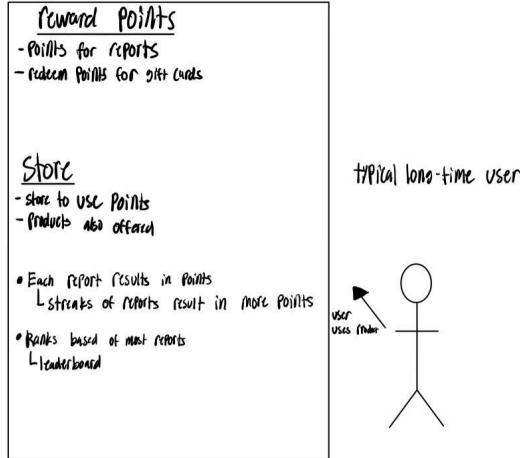


Figure 7: Design Concept 3 - Reward-Based System

These were some of the best concepts that the PopuLert team came up with during the initial brainstorming process. The final three concept design sketches are located in Appendix F.

Concept Screening Matrix

Table 4: Concept Screening Matrix

Needs	Reference	Design 1	Design 2	Design 3	Design 4	Design 5	Design 6
Reliable Data	0	+	+	+	+	+	+
Functionality	0	+	+	+	0	+	+
Cheap	0	0	0	-	-	-	-
Multiple Locations	0	0	0	0	0	0	0
Sectional Crowd Level	0	+	0	+	+	0	+
Gives Alternatives	0	0	0	0	0	0	0
Creates Schedule	0	0	+	0	0	+	0
AI	0	+	0	0	+	+	0
Notifications	0	+	+	+	+	+	+
Sum +'s	0	5	4	4	4	5	4
Sum 0's	9	3	5	4	4	3	4
Sum -'s	0	0	0	1	1	1	1
Net Score	0	5	4	3	3	4	3
Rank	7	1	2 (Tie)	3 (Tie)	3 (Tie)	2 (Tie)	3 (Tie)
Continue ?	Combine	Yes	Combine	Combine	No	Revise	No

Observing the concept screening matrix, the most suitable core concept is design 1. This design implemented the most desirable features and could be easily combined with other concepts to include more features. By utilizing a self-report core concept, the software will be basic in function, yet complex and rich in features. Design 2's scheduling and recommendations

features were adapted, revised, and restructured to be implemented into design 1. Design 3 also had strong ideas and concepts that were integrated into design 1. Design 4 was not utilized, as using physical equipment was deemed too expensive. Similarly, design 6 also required physical equipment in stores and was eliminated from contention. Design 5 had a strong business model that was combined with Design 1 and its additional features.

Concept Scoring Matrix

Table 5: Concept Scoring Matrix

Needs	Wgt	Reference		Concept 1		Concept 2		Concept 3		Concept 4		Concept 5		Concept 6	
		Rating	Weighted score												
Reliable Data	8	3	24	5	40	5	40	5	40	5	40	5	40	5	40
Functionality	7	2	14	5	35	5	35	5	35	4	28	5	35	5	35
Cheap	5	5	25	4	20	3	15	2	10	2	10	2	10	2	10
Multiple Locations	6	4	24	5	30	3	18	3	18	3	18	4	24	3	18
Sectional Crowd Level	4	1	4	4	16	3	12	4	16	5	20	3	12	4	16
Notifications	3	1	3	5	15	5	15	5	15	5	15	5	15	5	15
Gives Alternatives	2	2	4	4	8	5	10	2	4	3	6	4	8	3	6
Creates Schedule	0	4	0	5	0	3	0	1	0	2	0	3	0	2	0
AI	2	3	6	5	10	4	8	2	4	2	4	4	8	3	6
Total Score			104		174		153		142		141		152		146
Rank			7		1		2		5		6		3		4
Continue ?				Yes		Combine		Combine		No		Combine		Maybe	

Based on this concept scoring matrix, the strongest concept is the first concept, which is the self-report system. All of the concepts were compared against the weighted user needs using the rating system. Each need was rated from 1-5 based on how well the concept can fulfill that user's need. For instance, since users can self-report at any location, "multiple locations" was rated a 5 for the first concept. Additionally, the reference section represents how well potential competitors, such as Google Maps Popular Times, can fulfill each user need compared to how PopuLert can fulfill that user need. Since Google Maps Popular Times and some other competitors do not give notifications, for example, that is rated as a 1 in the reference section. The weighted score was calculated for each need by multiplying the weight, which ranged from 0-8, and the ratings.

The concepts were ranked based on the total weighted score of each concept. The team decided it would move forward with the first concept with the highest weighted score. In terms of the other concepts, the team decided that they would be combined, potentially considered ("maybe"), or not considered at all for the future ("no"). The team decided that it should not proceed with the fourth concept or the live camera concept, for example, because installing cameras might be costly.

The next section illustrates the final concepts through descriptions and wireframe representations of each page of the app.

Refined Concept Descriptions

After expanding upon the concepts that scored the highest in the matrices, they were then refined to add other features that were brainstormed before creating the final wireframe prior to prototyping. Features such as an area map and color-coded list of locations were designed and sketched, which can be seen below.

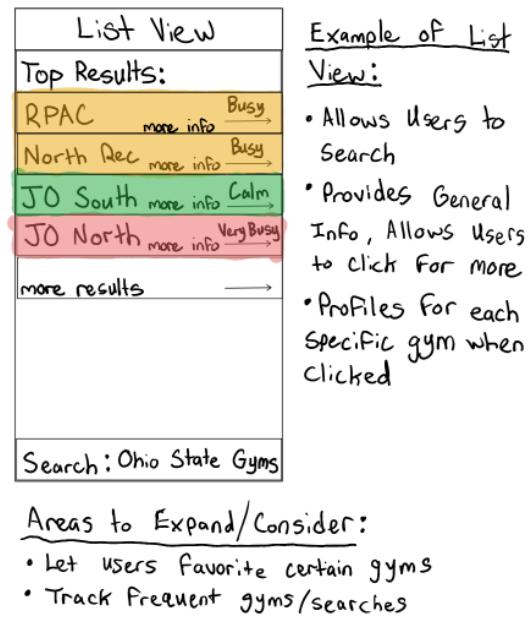


Figure 8: Refined Concept Feature 1 (Color-Coded List)



Figure 9: Refined Concept Feature 2 (Sectional/Area Map)

Final Refined Concept Description

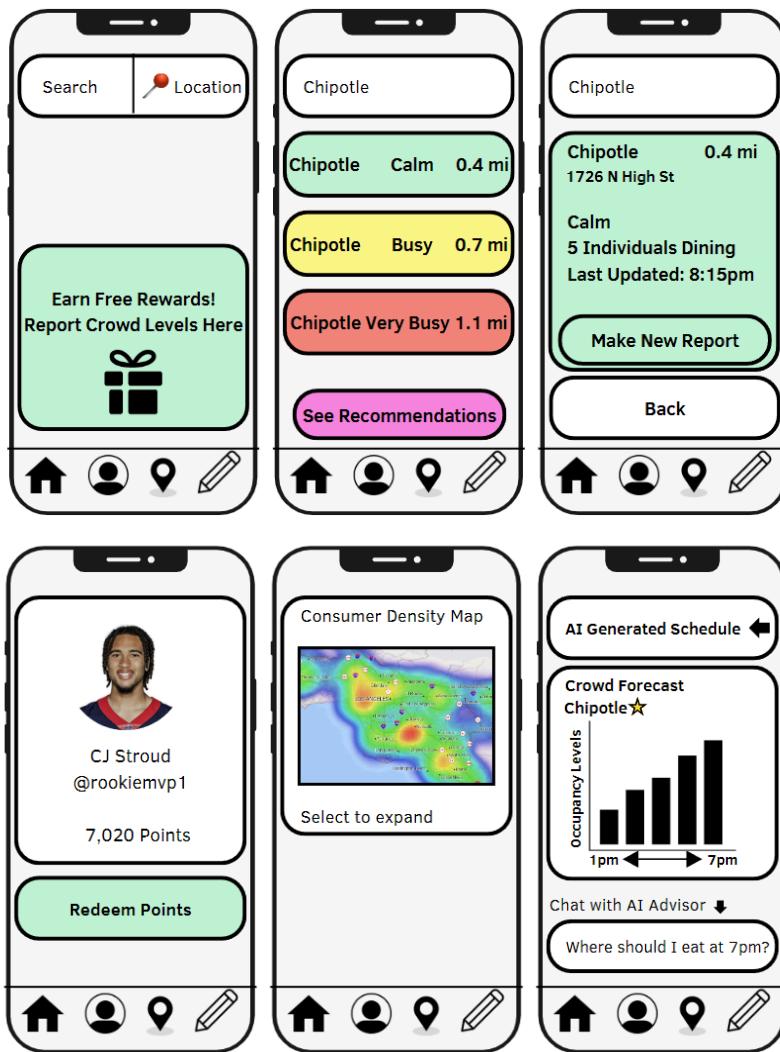


Figure 10: Refined Concept

The selected design, concept, and features are presented in a wireframe format above. The image is an example of what the home page may look like, in which users can search for their desired establishment and manually input a location. The image also features a button that prompts users to report crowd levels in exchange for points/rewards. The second image provides a mock search, with the user wanting to view the occupancy of nearby Chipotle restaurants. The results appear color-coded, with the distance and crowd level visible. This page also includes a button for users to access recommendations for similar restaurants if crowd levels are too high. The third image is an example of more detailed information that would appear upon selecting a search result. It lists how many individuals were dining in Chipotle and also lists the time this information was gathered. Once again, a prompt appears for users to enter updated occupancy information. The next image illustrates a user profile. In this instance, the user, CJ Stroud, is able

to view his amount of accumulated points and is also prompted to redeem those points for rewards. The fifth image shows how a heat map feature would be implemented, allowing users to view crowd concentration in a geographic area. The final image illustrates many of the features that were combined or added to the original concept. These features include an AI-generated schedule based on user input, access to long-term data and future predictions, and an AI chatbot that assists users with finding establishments. These features will not be accessible for users who do not pay, which relates to Design 5's ideas on a freemium business model.

User Feedback and Design Requirements

Overall, PopuLert's end-user feedback improved greatly based on this concept and design. Initially, end users were unsure of how the software would measure consumer density, update in real-time, and be a valuable tool to facilitate their daily activities. End users were able to realistically imagine how PopuLert could be a crucial application for their phones. Additionally, end users raised concerns about how location data would be collected or reported, and were pleased to learn that this concept includes incentivization for reporting location data. The correlation matrix was important for quantifying and evaluating how the design fulfills user needs.

Table 6: Correlation Matrix

User Needs	Requirements
Can Provide Reliable/Accurate Data	Self-Report System (w/ tap into current data with self-report buttons, swipe-ins, and/or kiosks)
Can Enhance Efficiency through Functionality	Has an easy to use interface that the user can use to view crowd levels, create schedules, redeem points, etc. Should be super simple to learn and understand upon first glance.
Can View/Report on Multiple Locations	Has a selection of locations that users may need to view the crowd level of.
Can Report Sectional Crowd Level	Shows the occupancy of areas in each part of the the location on the map, based on the self-report system and location tracking.
Can Give Notifications	A customizable notification system that allows the users to schedule updates or get updates based off unexpected dips
Can Give Alternative Locations	Different options similar to the original one are given to the user when the crowd level of the desired location is too high.
Can Create Schedule	Uses the users constraints and imputed interests to create a schedule for their day based off known crowd levels and trends
Can use AI to increase efficiency	Allow the user to ask a chatbot for recommendations of food and receive a recommendations that takes time, preference, and location into account.

The correlation matrix above shows the user needs on the left-hand side with the corresponding requirement of the product on the right. The team decided on the requirements by looking at each user's need and then identifying what kind of feature would best satisfy it.

Table 7: Quantified Product Requirements

Quantitative Requirements

Requirement	Threshold (Range)	Goal (Ideal)
Self-Report System	Overall data accuracy is $\geq 85\%$	Overall data accuracy = 100%
AI Chatbot	85% response to user choices, 1 non-comprehensive	100% response to user choices, 1 comprehensive
Location Services	Within 15 to 20 feet of perimeter	Show exact location
Sectional Occupancy Levels	85% of the location and different sections mapped	100% of the location and different sections mapped
Customizable Notification System	Within 0-30 seconds of the set time or dip	Within 0 seconds of set time or dip
Schedule Creation	A schedule that takes 80% of user constraints into account	A schedule that takes 100% of user constraints into account
Alternate Locations	Gives at least 3 viable alternative locations	Gives 10 alternative viable locations
Multiple Locations	80% of locations mapped in the Columbus area	100% of locations mapped in the United States

The table above has the requirements of the product along with the quantitative requirements of that feature. Each feature has a specific threshold that was picked to ensure the best experience for the user while also accounting for realistic circumstances.

8. Prototype:

Final Prototype Design

After deciding on a final concept design, prototyping in Figma was conducted. The prototyping process was relatively smooth, although there was a slight learning curve as Figma was a new software for the team to learn. However, it did not take long to understand how to use the most important tools and features. The Figma marketplace, for example, was utilized in order to streamline the creation of certain aspects of the UI prototype, such as the shapes of the buttons and popups. Below in Figure 11 are the different screens designed in Figma to showcase the various features of the app. The screens were connected together using the flow feature so that the Figma prototype could imitate how the coded app will function (i.e. which buttons will direct the user where, etc.).

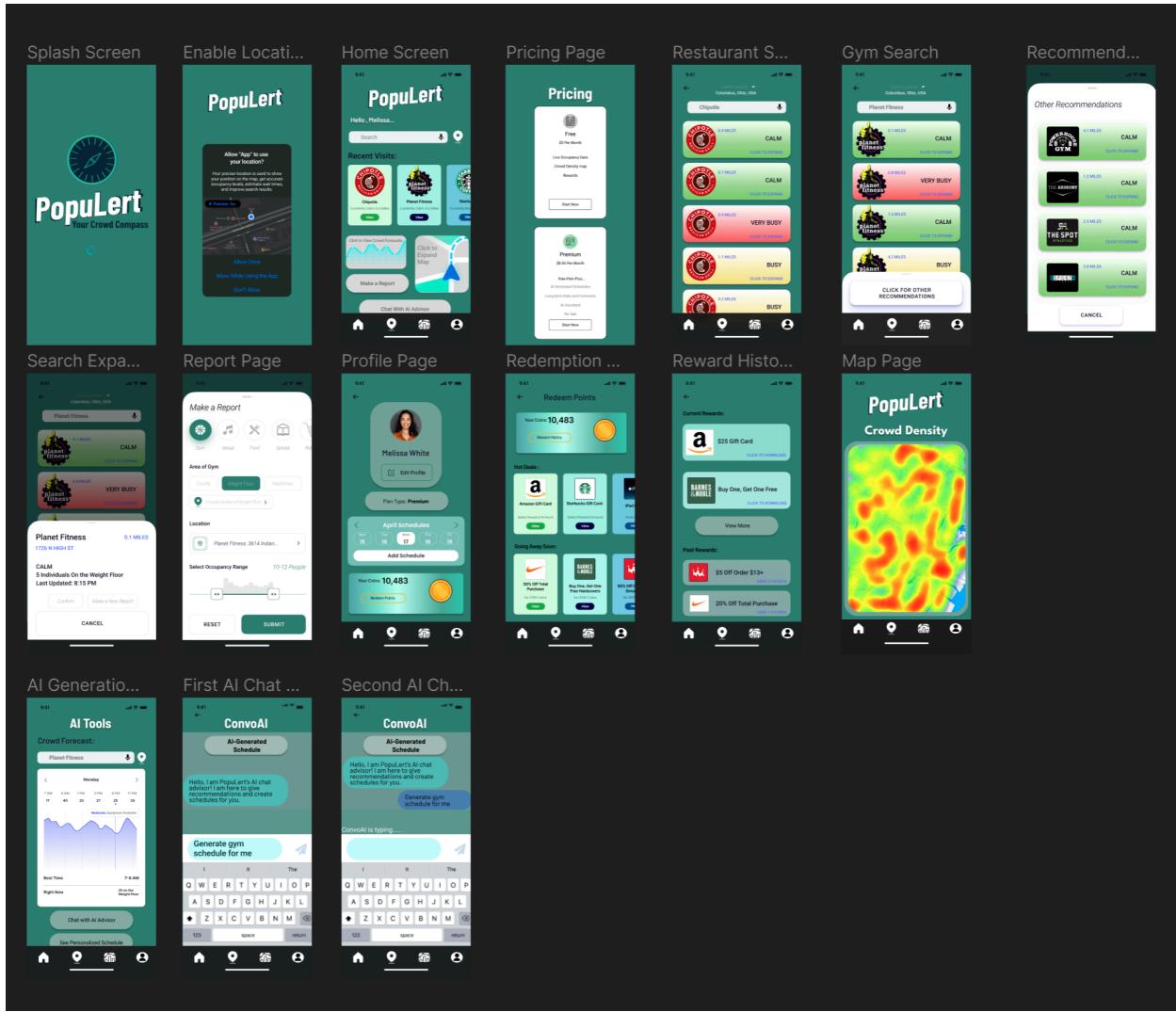


Figure 11: Final Figma Prototype - UI Design and Functionality

There were no real challenges or issues encountered when building the Figma prototype. The most important features were able to be designed and their UI functionality implemented. During further revisions, other features will be added, which are explained in the Revised Design area at the end of the Prototype section.

The full working Figma prototype, where functionality can be previewed and understood, is located in the GitHub repository which is linked in Appendix D at the end of this document.

Verification Plan

PopuLert's top three user requirements are the self-report system, the AI Chatbot, and the implementation of location services. As stated in the quantitative requirements table, the self-report system should have an accuracy between 85-100%. Numerous tests would need to be conducted at different establishments to verify. These tests include location tracking services

through Google Maps API and the check-in systems of each establishment. To reiterate, the self-report system is when the users would report what type of establishment they went to, the section of that establishment, the address of the establishment based on Google Maps API, and the occupancy range in that section. For instance, if a user goes to the gym, that user would report that he or she went to the weight floor section of the gym, the specific address of the gym, and the occupancy range of 10-12 people on the weight floor.

Populert's AI Chat Advisor should only have hallucination events of 3% and lower. This will be accomplished through the implementation of predetermined fields in the AI chatbot's computer program to monitor the AI's processing. To test the AI chatbot there will be a series of questions asked to check the amount of hallucinations produced. The total number will be compared to the intended goal. Finally, in terms of the accurate implementation of location services, users should appear within 15-20 feet away from their actual positions. This would be accomplished through an advanced computer program using Google Maps API or Apple's phone location system. Although improving the accuracy to 15-20 feet is challenging, it is possible through the utilization of GPS, Bluetooth positioning, and Wi-Fi. Additionally, Google Maps API provides geolocation services that give locations based on IP addresses when GPS is not available. Through these features of the Google Maps API or Apple's location tracking, the PopuLert team would be able to test and measure the accuracy of the location-tracking services of the app.

The next section expands upon the verification plan for the prototype by explaining the results of the test methods of the self-report system, AI chatbot, and the implementation of location services.

Verification Execution/Results

The testing methods were rigorously expanded upon and implemented to ensure a high efficacy for three requirements. The goal of the test for the self-report system was to have an accuracy between 85-100%. To test this the PopuLert team created a self-report system in Java, which is located in the appendix, that allowed users to report and check the occupancy level of any location at any time. This current system depends on the amount and frequency of the reports to provide an accurate reading of the crowd level. Assuming all the reports are accurate, with a frequency of 1 report per minute it can be deduced that the accuracy for that location will be near 100%. In the future, there will be more real-world testing done to account for the varying frequency and truthful responses. These tests will be done using beta testers which will be expanded on in later sections.

Understanding that AI is still in its early stages, PopuLert does not fully lean on its abilities. The goal of the AI chatbot was to provide accurate responses at least 97% of the time with less than 3% being hallucinations. A chatbot using OpenAI's API was created and can be found in the appendix. The chatbot was tested by asking it 100 responses and tallying the number

of incorrect responses. The tests produced 1 out of 100 responses resulting in a hallucination. The response observed was the creation of a schedule that included a time that had previously been mentioned as unavailable. These results are sufficient to meet our intended goals of less than 3%. In the future, beta testers will report additional hallucinations that will be compared against the total AI responses given, providing more accurate data.

The PopuLert team tested the location service's precision on an iPhone 15 pro. Since the application would be released in the Apple App Store, the application would ask the user if they would like to enable precise location services. This feature was added in 2020 and utilizes a chip that was introduced with the iPhone 11. This allows PopuLert to be given access to user location, which is shown to be accurate to 15-20 feet. This was proven by using Apple Maps and measuring the distance between the real location and the one on the map. Further testing will be done on Android phones and through Google Maps API or included location tracking. The next section will go through how the top three user needs are addressed with the software design.

Validation Plan - End Users

PopuLert's top three user needs are reliable data, functionality, and multiple locations. When unlimited resources are available, there are two methods to validate these user needs: volunteer trials and a free pilot program of the product in the Columbus area and Ohio State. Assuming the advertising campaign for the app is successful, larger volunteer trials for the app will occur, soliciting a greater amount of feedback to improve the user experience. Advertising would be aimed at our main end users of college students, healthcare professionals, and other essential workers, such as teachers, in urban areas through social media and engaging events hosted by the PopuLert team. The purpose of the advertising would be to encourage many individuals to participate in the volunteer trials. The free pilot program will be useful too because it will be offered to different businesses in one city, such as Columbus, which would help the PopuLert team gather feedback from a major metropolitan area in the United States. This program will also be offered to one campus, such as Ohio State, which is one of the largest institutions in the country. Through the free pilot program, the team will be able to gather feedback from many individuals, ranging from business owners to college students.

Finally, when unlimited resources are not available, a realistic test needs to be performed. In that case, Beta testing would be very useful. Beta testing will occur with three small groups of 3-4 individuals, based on the demographics of our end users: one group will be college students, another group will be healthcare professionals, and the final group will consist of other essential workers. With these small groups, technical bugs in the app's functionality will be closely monitored. When any bugs are encountered, the PopuLert team will gather important feedback or suggestions from the three small groups to improve the app.

With these validation methods, results were collected, causing the need for future refinement. The results of these methods of validation are explained in the next section.

Validation Execution/Results

The tests done focused on PopuLert's core user needs for reliable data, functionality, and multiple locations. Due to limited access to resources, PopuLert continued with a small group of 3 college students for beta testing instead of a pilot program. They were given access to the prototype implementations of the AI chatbot, Reward System, Self-Report System, and the Figma prototype. Users were prompted to report any technical bugs with any of the features. They were also asked for any feedback or suggestions on the functionality and clarity of the design. Lastly, they were asked about any usability concerns that are present or may arise in the foreseeable future.

The users reported a few hallucinations in the AI chatbot that resulted in responses that were not useful to them. They also reported a foreseeable inconvenience that the location names had to be case sensitive which resulted in them not being able to see the real occupancy level and sometimes the wrong name reported by the technology. The Figma prototype was reported to be well-designed and simple for any user.

After analyzing the feedback, the team identified areas for refinement to fix the inconveniences and built upon suggestions. To better meet the user need of having a reliable self-reporting system, the self-report system will be revised to not be case sensitive so users can report and check the same location even if the first letter is not capitalized. Furthermore, there will be a typo system implemented to catch any spelling mistakes. To reduce chatbot hallucinations, the team will implement pre-written selections that will keep customization features but not allow the user to get false responses from the AI. The next section will talk about more design changes that will be necessary before release.

Refined Design

Prior to the first product release, more code will need to be implemented. As of now, the minimum viable product (MVP) is complete, and even slightly advanced, for the UI side, but the code is not fully up to the same standard. In addition to the self-report system, AI chatbot, and location services, programs for a search feature and the results need to be written and executed. For the MVP to be complete and launch ready, the UI needs to be trimmed down and paired with the new code in a functional app format so that beta testing can begin prior to the pilot launch.

Once the first round of beta testing is complete and feedback is received, further revisions will occur and more advanced features will be coded and implemented, such as the full rewards system, the crowd density map, and even potentially a comprehensive side menu if users indicate a need for it. A second round of beta testing will occur and feedback will be used to make any further revisions prior to the full pilot launch. Continued revisions will occur throughout the entire lifespan of the software, and new features will be designed and implemented to maintain effectiveness and relevance for users and the task.

9. Business Model Canvas Summary:

Key Partners, Activities, and Resources

PopuLert's key partners will consist of software developers and engineers to assist with UI design, UX implementation, and third party technology integration. PopuLert's initial key activities include prototyping, writing code, and creating functional features. Once these objectives are complete, PopuLert will move on to fixing bugs, establishing servers, funding user rewards, and marketing to acquire new users. Some of the key resources for PopuLert will be third party softwares like Figma, Google Maps API, and Shopify. Additionally, basic software development and marketing skills will be valuable resources that contribute to the future of PopuLert.

Value Proposition and Channels

PopuLert's value is observable in its ability to allow individuals in urban environments to evaluate occupancy levels remotely. By doing so, users can eliminate wasted time and optimize their own personal schedules. PopuLert will allow for its users to have more free time, improved efficiency, and higher productivity. Notifications, social media, and online promotions will be some of the channels used to drive engagement for PopuLert.

Customer Relationships and Segments

To maintain our customer relationships, PopuLert plans to continue surveying users and businesses to create the most optimal application possible. SMEs, specifically software developers and scheduling experts, will be critical for implementing certain features and ensuring a positive customer experience. A semi-functional prototype will be available for potential users and interested parties, allowing them to explore PopuLert's features and provide valuable feedback. Advertising and social media engagement will be critical components of how PopuLert establishes customer relationships as well. PopuLert's end users reside in urban areas and the customer segments include college students, healthcare professionals, and essential workers.

Cost Structure and Revenue Streams

PopuLert's costs can be categorized as one-time or recurring. The one-time costs consist of outsourcing code for initial development and creating a beginning marketing budget. The recurring costs include renting servers, API keys, cybersecurity, Shopify, and Apple Store fees.

10. Financials:

Cost and Revenue Estimates

Table 7: Cost and Revenue Estimates listed with Assumptions

Business Amount:	35	User Amount:	1000	
Business Price:	\$44.95	Free Users:	900	
User Price:	\$8.95	Paid Users:	100	
Sales (Monthly)				
			Influencing Factors	Recurring?
	Consumer Subscriptions	\$895.00	Mercator Advisory Group Stats, 10-13%	Yes
	Business Subscriptions	\$1,573.25	Value-based Pricing	Yes
	Ad Revenue from Users	\$1,080.00	2 Ads Daily, \$0.02 Per Ad, 30 Days	Yes
	Consumer Data Revenue	\$960.00	Google Maps Comparison, \$0.96 Per User	Yes
	Sponsored Businesses Revenue	\$3,240.00	Spiceworks, \$0.06, 2 Ads per day	Yes
	Apple Store Fees	30%		Yes
Total			\$5,423.78	
Variable Costs Per Unit (Monthly)				
			Influencing Factors	Recurring?
	Server Rental	\$295.00	ServerMania	Yes, May Increase
	Outsourcing Code (Maintenance)	\$1,600.00	ARKA Softwares	Possibly
	Google Maps API Key	\$200.00	28,500 Maploads	Yes, May Increase
	OpenAI API Key	\$40.00	750,000 Words Input and Output Each	Yes, May Increase
Total			\$2,135.00	
Fixed Costs (Monthly)				
			Influencing Factors	Recurring?
	Outsourcing Code (Alpha)**	\$7,000.00	Quote for Development Inoxsoft	No, 6-9 Months
	Cyber Security	\$150.00	Splunk Enterprise	Yes, May Increase
	Marketing/CAC	\$324.00	HubSpot, 11% of Revenue	Yes, May Increase
	Shopify for Transactions	\$80.00	Price for Small Teams	Yes
Total			\$7,554.00	

PopuLert's pricing scheme derives from market-based pricing [13]. This allows consumers to pay \$8.95 per month for a premium membership. Apps with a subscription priced \$7 to \$20 have the highest customer conversion rates [12]. These conversion rates are nearly five times higher than both higher and lower alternatives. Pricing for businesses is more variable and derived from a value-based pricing strategy [13]. PopuLert believes that \$45 per establishment is a fair average price for businesses considering the value provided by PopuLert's data, paying for PopuLert's premium features, as about 10-13% of software and premium app consumers generally pay for subscriptions [14].

PopuLert's five revenue streams stem from consumer subscriptions, business subscriptions, general advertising, consumer data, and targeted advertising. As previously mentioned, to achieve a general understanding of the pricing model and revenue stream, monthly profit or loss on the Cost and Revenue Estimate is based on having 35 business clients and 1000 users. To calculate general advertising revenue, it was assumed that each free user would view

two ads each day. YouTube ads currently average about \$0.02 per view, which translates to about \$1.20 per free user each month [23]. Consumer data revenue was calculated based on competitor revenue, specifically Google Maps. Google Maps is estimated to achieve roughly \$11.5 billion in revenue this year [15]. This \$11.5 billion is generated by about 1 billion Google Maps users [16]. According to this data, Google generates roughly \$0.96 per month per user solely from location data. In PopuLert's estimation, this number was used in order to formulate an estimate for value generated by location data. Targeted advertising revenue was determined through similar logic as general advertising. In a 2009 study, advertisers were reported to be willing to pay roughly three times more for ads that were specifically targeted to certain consumers [21]. Assuming each free user views two targeted or sponsored ads each day, monthly revenue is triple that of regular advertising. Apple Store fees automatically deduct 30% of PopuLert's revenue.

PopuLert's monthly variable costs are expected to increase as user traffic increases. In the beginning stages of the company, it will be more effective to rent servers as opposed to owning. A high-end server with 1tb of storage and 64gb of ram can cost about \$300 per month [17]. Should PopuLert outsource any coding maintenance, at the minimum price listed on Arka Software's website, 25 hour work weeks would cost about \$1600 [19]. Google Maps API costs \$200 monthly, which will be necessary to implement a heat map feature [24]. OpenAI's API costs \$40 for 1 million input and output tokens with GPT-4 Turbo [25].

PopuLert's monthly fixed costs can be subject to change, but for the purposes of this estimation they will remain the same. Outsourcing code to create the app will be the largest cost, totalling about \$7,000 per month for 6-9 months [27]. According to Splunk Enterprise, cybersecurity can cost around \$150 each month [28]. Generally, startups spend about 11% of their revenue on marketing [26]. For PopuLert's marketing budget, 10% of revenue is allocated for customer acquisition and marketing. To handle online transactions, Shopify charges \$80 per month [29].

Break Even Analysis

Table 8: Break Even Analysis with 50:1 User to Business Ratio

Break Even Analysis (Monthly Cashflow)						
Total Users	0	100	200	1000	2000	2270
Total Businesses	0	2	4	20	40	45
Ad Revenue	\$0.00	\$12.00	\$24.00	\$120.00	\$240.00	\$272.40
User Subscriptions (10%)	\$0.00	\$89.50	\$179.00	\$895.00	\$1,790.00	\$2,031.65
Business Subscriptions	\$0.00	\$89.90	\$179.80	\$899.00	\$1,798.00	\$2,040.73
Consumer Data Revenue	\$0.00	\$96.00	\$192.00	\$960.00	\$1,920.00	\$2,179.20
Sponsored Business Revenue	\$0.00	\$324.00	\$648.00	\$3,240.00	\$6,480.00	\$7,354.80
Apple Store Fees	30%	30%	30%	30%	30%	30%
Fixed Costs Per Month	\$7,554.00	\$7,554.00	\$7,554.00	\$7,554.00	\$7,554.00	\$7,554.00
Variable Costs Per Month	\$2,135.00	\$2,135.00	\$2,135.00	\$2,135.00	\$2,135.00	\$2,135.00
Net Profit (loss)	-\$9,689.00	-\$9,261.02	-\$8,833.04	-\$5,409.20	-\$1,129.40	\$26.15
Break Even Point: 2270 Users, 45 Businesses						

PopuLert's break even analysis shows profit and loss at certain consumer and client business intervals. This table assumes that users will maintain a 50:1 ratio to businesses on the platform. The costs include the price of developing the app, which will no longer exist after 6-9 months. PopuLert's break-even point is at 2,270 users and 45 client businesses, making \$26.15 that month.

Quarterly Financial Projections

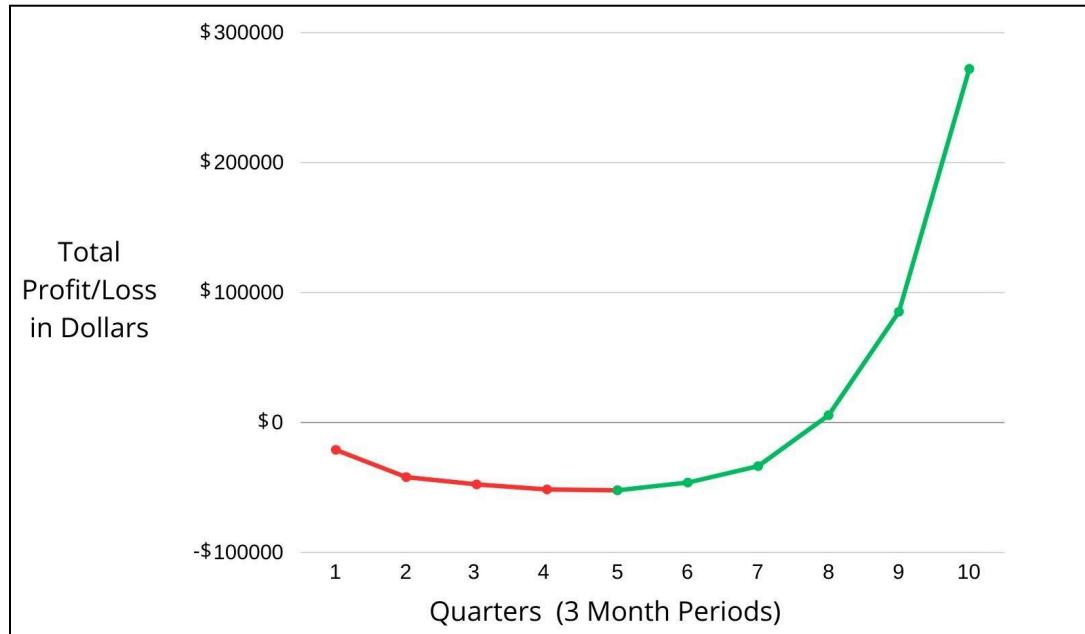


Figure 12: PopuLert Projected Profit/Loss for 2.5 Years

Table 9: Break Even Analysis with 50:1 User to Business Ratio

Quarterly Financial Timeline (Starting at 100 Users, 2 Businesses, 6% Weekly User Growth)										
Total Users	0	0	201	404	813	1636	3292	6624	13329	26820
Total Businesses	0	0	4	8	16	33	66	132	267	536
Ad Revenue	\$0.00	\$0.00	\$651.24	\$1,308.96	\$2,634.12	\$5,300.64	\$10,666.08	\$21,461.76	\$43,185.96	\$86,896.80
User Subscriptions (10%)	\$0.00	\$0.00	\$539.69	\$1,084.74	\$2,182.91	\$4,392.66	\$8,839.02	\$17,785.44	\$35,788.37	\$72,011.70
Business Subscriptions	\$0.00	\$0.00	\$271.05	\$544.79	\$1,096.33	\$2,206.15	\$4,439.26	\$8,932.46	\$17,974.16	\$36,166.77
Consumer Data Revenue	\$0.00	\$0.00	\$578.88	\$1,163.52	\$2,341.44	\$4,711.68	\$9,480.96	\$19,077.12	\$38,387.52	\$77,241.60
Sponsored Business Revenue	\$0.00	\$0.00	\$1,953.72	\$3,926.88	\$7,902.36	\$15,901.92	\$31,998.24	\$64,385.28	\$129,557.88	\$260,690.40
Apple Store Fees	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
Fixed Costs Per Month	\$21,000.00	\$21,000.00	\$1,888.37	\$3,098.67	\$5,537.15	\$10,443.91	\$20,317.07	\$40,182.62	\$80,158.16	\$160,592.18
Variable Costs Per Month	\$0.00	\$0.00	\$6,405.00	\$6,405.00	\$6,405.00	\$6,405.00	\$12,810.00	\$12,810.00	\$25,620.00	\$25,620.00
Net Profit (loss)	-\$21,000.00	-\$21,000.00	-\$5,497.17	-\$3,883.44	-\$632.14	\$5,910.22	\$12,669.42	\$39,156.83	\$79,647.55	\$186,892.91
Total	-\$21,000.00	-\$42,000.00	-\$47,497.17	-\$51,380.61	-\$52,012.75	-\$46,102.53	-\$33,433.11	\$5,723.72	\$85,371.27	\$272,264.18

PopuLert's quarterly projections are heavily reliant on the principle that start-ups should seek to grow by an average of 6% each week [22]. Additionally, the quarterly projections

maintain the same 50:1 individual user to client businesses ratio. Costs associated with outsourcing the creation of the app taper off after two quarters. PopuLert reaches its greatest level of debt during the 5th quarter at -\$52,012. Additionally, the 5th quarter is where PopuLert becomes profitable. At the 8th quarter or two year mark PopuLert breaks even and is no longer in debt. This overall financial projection also takes into account that businesses will receive one quarter of a free pilot in order to drive up the number of establishments involved with PopuLert.

11. Next Steps:

PopuLert has a bright future and has its sights set on accelerators and grants to obtain seed funding so as to make a full product launch a reality. The first next step is to continue to code and make revisions to fully develop the minimum viable product. Once the MVP is complete, two rounds of 3-5 week beta testing with industry professionals and top interested end users will take place with feedback being gathered and revisions/additions being made after each round. Once beta testing is complete and the MVP is refined and enhanced, a pilot launch will occur in Columbus with The Ohio State University as the main user hub. User feedback, data accuracy, and software performance will all be tracked so as to debug and make updates when necessary. After the pilot is complete, PopuLert will expand beyond Columbus area consumers to penetrate the larger market, eventually fully expanding from the B2C model to a B2B model, so as to potentially provide a completely free product to end users to continue growing the consumer base. PopuLert's end goal is to gain the attention of big tech, such as Google and/or Apple, and be presented with the opportunity to sell out, similar to how Waze sold to Google in 2013. With the large market and the comprehensiveness of PopuLert's business model, there exists great potential for PopuLert to make a large impact on individual end users, businesses, the economy, and the software industry as a whole.

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Appendix A

Interview Discussion and Listening Guide

1. Introduction

- Personal Introduction
- Purpose of Interview

2. General Questions

- Have you ever lived in an urban or rural environment?
 - If you have lived in both, which do you prefer?
- Do you frequently go to the gym or use a public physical activity facility?
 - How do you feel about the gym?
- How often do you order food or go out to eat?
 - What are your favorite places to eat?
 - Do you prefer to dine-in or get takeout and why?
- Have you ever used mobile ordering software like Grubhub, Doordash, or UberEats?
 - Do you consider these applications as an integral part of your day?
 - Why? (or Why not?)

3. Focusing on Overcrowding

- What are your major concerns relating to going to a public facility/business?
- Are there specific factors that affect which facilities or businesses you choose to interact with?
- How do you go about planning your day?
 - What factors impact this plan and does your daily plan change?
- What are your biggest challenges with going to a public space?
- How does the presence of other individuals in a public space affect your experience?
- What are the inconveniences that have an impact on your daily life?
 - What are your thoughts on overcrowding or busy environments?
 - Why do you feel this way?

4. Closing

- Is there anything else you'd like to share?
- Express Gratitude and Possible Future Contact

Figure 13: Discussion Guide

Table for Capturing Feedback from Potential Users:

Current User Experience	
Reaction to New Ideas(Likes/Dislikes)	
Frustrations/Compensating Behaviors	
New Thoughts or Ideas from Interview	

Figure 14: Listening Guide

Appendix B

Detailed Interview Results

Focus Task Area: Overcrowding in Public Spaces

Successes: People were willing to discuss their daily lives and enjoyed conversing about their inconveniences/frustrations. Everyone was happy to participate and give honest feedback. Our interviews gleaned insight into the main inconveniences people experienced in their daily lives (weather, overcrowding, long walks, lack of resources)

Difficulties: Occasionally, questions received the same answer, which may be due to the questions resembling each other too much. Also, some questions needed more detail or further elaboration to be answered, which could be remedied by providing further detail or ad-libbing.

- 1. College Student** (Representative of Avg. Person) - Max
- 2. Grubhub order establishment** (12th Ave) - Max
- 3. Off-Campus Dining Employee** (Playa) - Abby
- 4. Dining hall** (Scott) - Aayush
- 5. Consistent Gym-Goers** - Allen and Max
- 6. Athletes** (Football) - Abby

Link to Survey Responses:

<https://docs.google.com/spreadsheets/d/1jByIpW42ThZvEyh8QgP3wW1ODZ260Sy0GZdgnbtHM/edit?usp=sharing>

Aayush's Roommate #4

General Questions

- Have you ever lived in an urban or rural environment?
 - If you have lived in both, which do you prefer?
 - He has lived in both. As a student, he prefers to live in an urban area. However, when he has a full-time job, he prefers to live in a rural area so that he can easily travel around with his family.
- Do you frequently go to the gym or use a public physical activity facility?
 - How do you feel about the gym?
 - He feels like the gym is crowded during the day. This is why he goes in the night after dinner. Overall, it is a cool environment with different activities he can get involved in.
- How often do you order food or go out to eat?
 - What are your favorite places to eat?
 - He usually goes out to eat at Traditions at Scott and takes food from Morrill. However, he did go out to eat at a Chinese restaurant once on a

- high street.
- Do you prefer to dine in or get takeout and why?
 - He prefers to dine in because it is more convenient with the buffet style of Traditions.
 - Have you ever used mobile ordering software like Grubhub, Doordash, or UberEats?
 - Do you consider these applications as an integral part of your day?
 - Why? (or Why not?)
 - He has used Grubhub and UberEats before. However, he prefers to cook himself, so he does not consider these apps that important.

Focusing on Overcrowding

- What are your major concerns relating to going to a public facility/business?
 - Cleanliness, public transportation around that area, how good the service is, crowded, depends on employee/staff
- Are there specific factors that affect which facilities or businesses you choose to interact with?
 - Distance/transportation, times they are open
- How do you go about planning your day?
 - What factors impact this plan and does your daily plan change?
 - His daily plan is based on his class schedule each day.
- What are your biggest challenges with going to a public space?
 - Not really any challenges; when he was little, it may have been a problem because of the crowd(trouble communicating with strangers)
- How does the presence of other individuals in a public space affect your experience?
 - Hopefully, everyone follows the rules without a fight. For example, no one should cut in front of you in a line or talk in the movie theater.
- What are the inconveniences that have an impact on your daily life?
 - What are your thoughts on overcrowding or busy environments?
 - Why do you feel this way?
 - He goes to the gym at night because of the high crowd during the day. He sometimes has a problem finding a seat in the dining hall. Additionally, during classes, the instructor might not have the ability to pay attention to every student.

General Summary: Overall, this interview went well and was interesting. However, I could have looked less at the questions during the interview. I am planning to do that in my next interview by practicing the questions I will ask beforehand. This interview was based on the task of evaluating the crowdedness of public facilities and individual schedule planning. I got to know some interesting facts about my roommate. For instance, since the RPAC is crowded during the day, he goes to the RPAC at 10:00 at night. However, when it comes to food, although it is difficult for him to find a seat sometimes, he prefers to dine in because it is more convenient, especially because Traditions at Scott is a buffet. He also talked about how distance and

transportation can affect what facilities or businesses he interacts with. For instance, he goes to the RPAC instead of the North Recreation Center because he lives in Lincoln Tower on the West Campus.

Max's Roommate #5

General Questions

- Have you ever lived in an urban or rural environment?
 - If you have lived in both, which do you prefer?
 - Lived in a rural environment previously, but now lives in an urban area.
Prefers rural due to there being less people and more natural areas. Prefers rural lifestyle.
- Do you frequently go to the gym or use a public physical activity facility?
 - How do you feel about the gym?
 - Frequently uses public physical facilities. Feels strongly about going to the gym and enjoys working out. Hopes that more people will take advantage of the benefits of physical activity.
- How often do you order food or go out to eat?
 - What are your favorite places to eat?
 - Once or twice a week. Favorite places include Chipotle, Canes, and Adriaticos.
 - Do you prefer to dine-in or get takeout and why?
 - Depends on the situation, prefers dine-in when with a group. Gets takeout when dining halls are closed mainly.
- Have you ever used mobile ordering software like Grubhub, Doordash, or UberEats?
 - Do you consider these applications as an integral part of your day?
 - Why? (or Why not?)
 - Has used food ordering software. Does not consider this type of software to be an integral part of his day. Doesn't order food too often and isn't opposed to walking to the location.

Focusing on Overcrowding

- What are your major concerns relating to going to a public facility/business?
 - Worried about the weather and long/unsafe walks.
- Are there specific factors that affect which facilities or businesses you choose to interact with?
 - Price and hours. Distance also plays a role.
- How do you go about planning your day?
 - What factors impact this plan and does your daily plan change?
 - Structured around classes and the gym. Uses free time to go lift. Class

schedule impacts his plan and other extracurricular events. Daily plan changes slightly depending on previously mentioned structured events.

- What are your biggest challenges with going to a public space?
 - Mainly distance and weather. Long walks are a major inconvenience.
- How does the presence of other individuals in a public space affect your experience?
 - Makes it worse. If the gym is packed he doesn't want to be there. He Doesn't want to wait in long queues at a busy restaurant. Doesn't have an issue with people, just the level of busyness.
- What are the inconveniences that have an impact on your daily life?
 - What are your thoughts on overcrowding or busy environments?
 - Why do you feel this way?
 - Acclimate weather and overcrowding/waiting. Especially having to take a long time to get somewhere. Doesn't like overcrowding or busy environments, prefers to avoid altogether. He avoids crowded establishments because he feels like time is wasted and it is a major inefficiency. Makes him feel frustrated and impatient.

General Summary:

This individual prefers a more relaxed setting and frequently goes to the gym (daily). He considers the gym to be one of his biggest hobbies/interests. He tries to order food only when necessary and generally prefers to have a relaxing dine-in experience. Long walks seemed to be his biggest inconvenience, followed by bad weather and overcrowding. His day is impacted by how busy the gym is and as a result devotes a larger chunk of time for the gym. An important piece of information is that he feels "inefficient" and that he has "wasted time" when the gym is crowded.

Max's Friend #1

General Questions

- Have you ever lived in an urban or rural environment?
 - If you have lived in both, which do you prefer?
 - Lived in both. Prefers rural because life is slower paced and less chaotic. Urban areas are also dirtier.
- Do you frequently go to the gym or use a public physical activity facility?
 - How do you feel about the gym?
 - Yes, 2-4x per week. Doesn't like when the gym is busy, but enjoys a wide variety of exercise machines/options.
- How often do you order food or go out to eat?
 - What are your favorite places to eat?
 - Sometimes, 4-5x per week. Sloopy's Diner, Canes, Chick-Fil-A, and Taco Bell are the favorites.

- Do you prefer to dine-in or get takeout and why?
 - Depends on the situation. Takeout is more convenient if busy or if she wants to eat at home. Dining-In is preferable for special occasions or for group settings.
- Have you ever used mobile ordering software like Grubhub, Doordash, or UberEats?
 - Do you consider these applications as an integral part of your day?
 - Why? (or Why not?)
 - Yes, she uses them frequently. As a student she views these apps as necessary. Says she wouldn't use them otherwise. Views them as necessary with Ohio State's system.

Focusing on Overcrowding

- What are your major concerns relating to going to a public facility/business?
 - Concerned about the weather, conditions outside. Safety is a concern too.
- Are there specific factors that affect which facilities or businesses you choose to interact with?
 - How far the walk is and the time of day. Crowds are a concern for certain establishments/facilities.
- How do you go about planning your day?
 - What factors impact this plan and does your daily plan change?
 - Day depends on how much schoolwork needs to be done and what classes she has. Plans with friends can impact how she schedules her day. Her daily plans normally don't change drastically.
- What are your biggest challenges with going to a public space?
 - The crowds. Trying to find a seat somewhere or find an open spot in the gym to workout.
- How does the presence of other individuals in a public space affect your experience?
 - Worries about others taking up the available resources such as space, machines, etc.
- What are the inconveniences that have an impact on your daily life?
 - What are your thoughts on overcrowding or busy environments?
 - Why do you feel this way?
 - Crowds are the main inconvenience that she deals with. Rain, snow, and poor weather conditions have an impact too. Annoyed by crowds and busy environments. Feels a need to fend for herself. Feels this way because it's not as easy to get what you need.

General Summary:

This person generally preferred less crowded and chaotic environments. They use mobile ordering a significant amount. This person was most inconvenienced by overcrowding and weather conditions. She said that crowds made her feel like "She had to fend for herself", which I believe is a perfect way to phrase the problem. Also stated that crowds make it difficult to get what you need/want. She has a fairly strict daily regimen and tends to plan more. Crowding at

the gym is one of her major concerns with working out.

Allen's Roommate #5

General Questions

- Have you ever lived in an urban or rural environment?
 - If you have lived in both, which do you prefer?
 - Lived in a suburban environment in Ohio his whole life. He prefers the suburban to a urban environment because he's able to drive places he wants no matter the weather or time of day
- Do you frequently go to the gym or use a public physical activity facility?
 - How do you feel about the gym?
 - He goes to the gym 6 times a day for the past 2 years. He enjoys going everyday and seeing the progress. Likes that he is able to stay healthy by going to the gym consistently
- How often do you order food or go out to eat?
 - What are your favorite places to eat?
 - He likes going to chinese restaurants to eat dinner. He also enjoys getting skyline and chickfila.
 - Do you prefer to dine-in or get takeout and why?
 - He prefers to eat take out because he can just eat alone and not worry about interaction with anyone else. Take out also takes away extra costs like tips.
- Have you ever used mobile ordering software like Grubhub, Doordash, or UberEats?
 - Do you consider these applications as an integral part of your day?
 - Why? (or Why not?)
 - He considers them way more useful now that he goes to OSU since they use grubhub to order all his food on campus. He did not like to use the in the past because he found it easier and cheaper to just grab the food himself rather than paying the extra fees. The free grubhub plus entices him to use it more since that gets rid of some of those things.

Focusing on Overcrowding

- What are your major concerns relating to going to a public facility/business?
 - The foot traffic in the gyms here are so heavy it puts him off from going sometimes. Not everyone also uses the disinfectant spray which causes him to have to spray before and after his workouts just to be sure. He wishes that there were clear lines for the machines instead of constantly having to ask if people are waiting for a certain machine.

- Are there specific factors that affect which facilities or businesses you choose to interact with?
 - He likes to go to the RPAC because it is the closest to his dorm, lincoln tower. The RPAC also has Juice 2 which he gets a smoothie from everyday after his workout. The RPAC is also the biggest gym on campus and lets him customize his workouts much more since there is a surplus of different machines other gyms dont have. But being the biggest gym on campus also leads it to be one of the busiest ones at all times of the day.
- How do you go about planning your day?
 - What factors impact this plan and does your daily plan change?
 - The biggest factors that go into picking a time to workout are my classes and the busyness of the gym. If he has a break in between classes he is still hesitant to go workout since the gym may be extremely busy at the time.
- What are your biggest challenges with going to a public space?
 - He has to wait in line for machines and interact with other people while he waits. He also has to make sure the machines are clean since so many people use them in a public space.
- How does the presence of other individuals in a public space affect your experience?
 - He finds himself wasting majority of his workout on waiting for the next machine. A workout that might have taken an hour quickly turns into two hours because of the crowd. This causes him to waste time that he needs to study or work.
- What are the inconveniences that have an impact on your daily life?
 - What are your thoughts on overcrowding or busy environments?
 - Why do you feel this way?
 - This causes him to struggle to plan to go to the gym and often leads to him skipping the gym because he missed the window of the gym not being super busy. He finds it annoying because he wants to be efficient with his time but he has no resources to be able to do that efficiently.

General Summary:

The person I interviewed was my roommate who frequently goes to the gym. His main issues with the gyms on campus is the heavy foot traffic and inconsistent use of disinfectant spray. He also finds that the lack of clear spots to wait in line at the gym causes confusion at times. The issue he finds the most annoying is the heavy foot traffic and it created the challenge of finding a convenient time to work out amidst an already busy schedule as a college student. Despite being the largest facility on campus and all the amenities it offers, he doesn't find it worth it to go to the gym sometimes because of how busy it gets. He finds himself skipping constantly because he feels he missed the only possible window where he wouldn't have to wait for hours. Overall he does not feel he has the resources to plan around the busyness of the gym and it creates a strain on his daily schedule trying to get around it.

Appendix C

Team Charter



Team Members and Contact Information

Max Muckley: 330-217-9780

Aayush Paul: 513-496-8296

Allen Thomas: 513-799-3995

Abby Theobald: 513-505-3661

1. Purpose

The purpose of this charter is to outline a foundation for the team's functioning this semester. The charter will outline the roles and responsibilities of each team member and will aid in each member's understanding of their expected contributions for the project. The charter will serve as a formal commitment to effort-filled and productive work for each team member.

2. General Team Member Expectations (Ground Rules)

- Respond to messages in a timely manner as seen as necessary.
- Fulfill responsibilities on time.
- Establish expectations/deadlines for group/individual work as a team.
- Work collaboratively and cooperatively.
- Agree upon times/locations to meet outside of class as seen as necessary.

3. Individual Team Member Roles & Responsibilities

- I. Chief Executive Officer (CEO) Expectations
 - A. Overall project leader in charge of managing team.
 - B. Lead product design.
 - C. Lead CAD documentation.
 - D. Lead and develop the project's vision and goals.
- II. Chief Financial Officer (CFO) Expectations
 - A. Tracks all purchases made.
 - B. Tracks all money received.
 - C. Leading the creation of a financial business model.
 - D. Lead the pricing of the product.
- III. Human Resource (HR) Officer Expectations
 - A. Handle any conflicts.
 - B. Manage team meetings.
 - C. Report team performance.

- IV. Head of Marketing Expectations
 - A. Handle lead role for pitches, presentations, and general marketing.
 - B. Lead public relations and social responsibilities.
 - C. Serve as a social intermediary for the team.
 - D. Responsible for outside contact for the group (other companies/groups)
 - E. Lead interviewing process
- V. [Optional if needed] Other Role Expectations
 - A. Other roles (i.e doc/ppt editor & meeting leader) will be rotated.
 - B. Be prepared and ready to perform the role when it is your turn.
 - C. The leader of brainstorming sessions will be Max.
 - D. The leader of manufacturing will be Aayush.

4. Team Communication

- Communicate on iMessage.
- Listen to ideas respectfully.
- Respond to the group in a timely manner.
- Be open to suggestions/feedback on role performance.

5. Conflict Resolution

- Allow all perspectives and opinions to be vocalized.
- Utilize group discussion to evaluate the pros/cons of each idea/decision.
- Evaluate all possible outcomes of conflict (potential compromises/resolutions).
- Seek third-party mitigation and advice (TAs or Professors).

6. Team Signatures

Max Muckley

Team Member 1

Abby Theobald

Team Member 2

Allen Thomas

Team Member 3

Aayush Paul

Team Member 4

7. Team Role Changes

- The Human Resource(HR) Officer role was changed to the Chief Technology Officer(CTO) role.
- The Head of Marketing role was changed to the Chief Information Officer(CIO) role.

Appendix D

GitHub Repository

[Link to Repository](#)

Content

Code:

- Main implementation in Java and Javascript.
- Reporting System implementation.
- Reward System implementation.
- AI Chatbot implementation.
- Unit tests ensure code quality and reliability.

UML Diagram:

- Illustrates user-system interactions.
- Provides a structural overview of classes and relationships.
- Demonstrates the sequence of object interactions.

Figma Prototype:

- Full working prototype designed with Figma.
- Includes screenshot and prototype link.

User Documentation:

- Concise operating instructions for effective interaction with PopuLert.

Marketing Materials:

- Promotional flyers showcasing key features and benefits.

Appendix E

Business Model Canvas

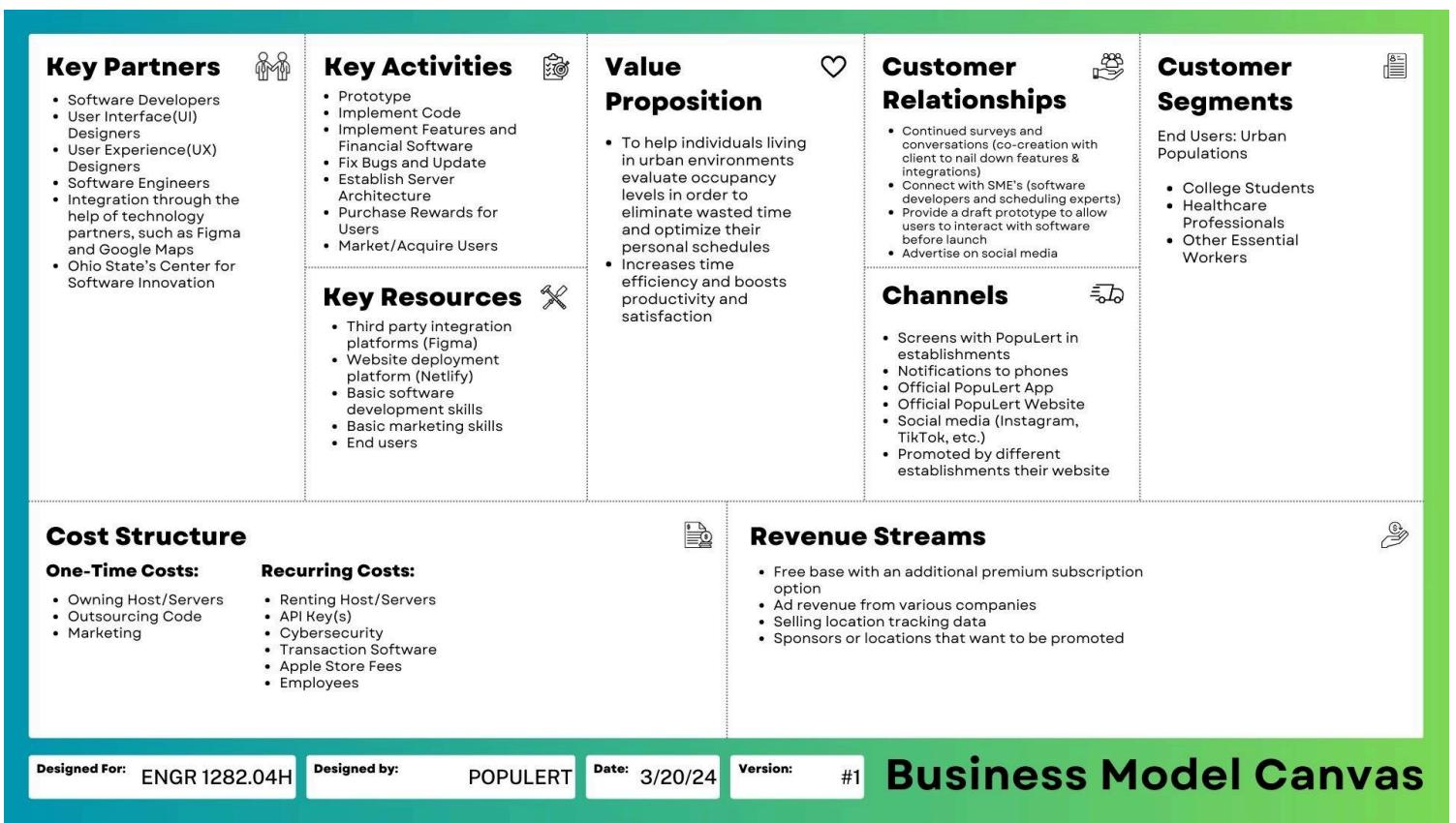


Figure 15: PopuLert Business Model Canvas

Appendix F

Additional Concept Design Sketches

The Live Camera concept is a combination of hardware and software where cameras would be used to track the occupancy and crowd levels of certain areas inside establishments. This concept would be best used in gym locations or large retail facilities as most already have security cameras installed and because they often have the most sections to keep track of.

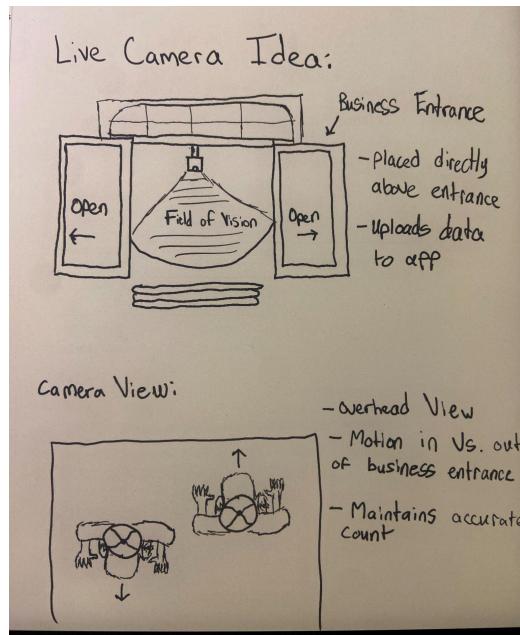


Figure 16: Design Concept 4 - Live Camera

The monetization concept is designed to increase the profitability of the software. Multiple memberships would exist behind a “Freemium” business model, which would allow users to gain access to some of the more advanced features, such as AI integration, and could also allow businesses to gain access to certain areas of the software’s data to boost their own scheduling and performance methods.

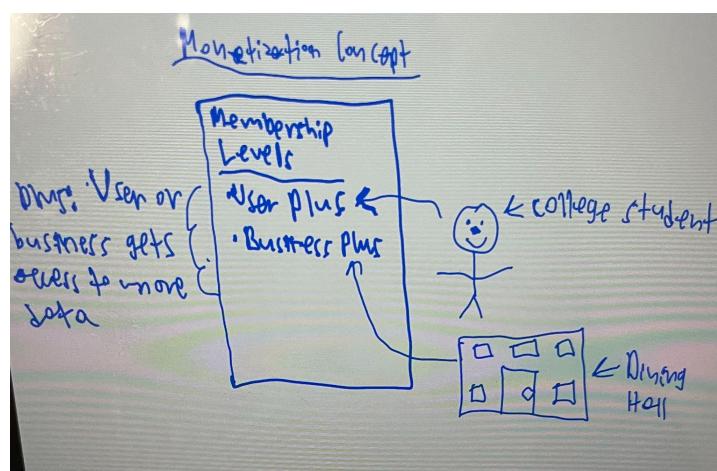


Figure 17: Design Concept 5 - Monetization based on Membership Levels

The final concept is a gym-specific design where each machine and piece of equipment would be tracked and the use would be reported through the installation of hardware (buttons/kiosks) and its connection to the software. However, this design is limiting and would prove to be costly to install in each location.

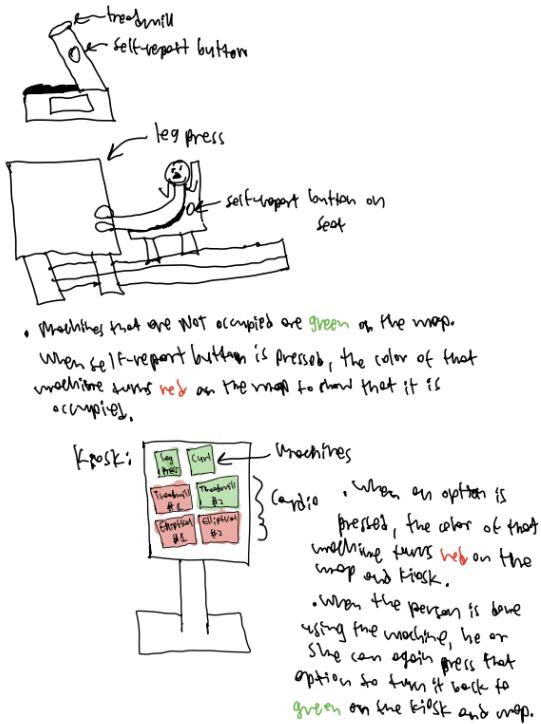


Figure 18: Design Concept 6 - Self-Reporting System at Gyms