Reducing Viral Transmission in Public Gyms Via a Comprehensive App

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Author's Declaration

We hereby declare that we are the sole authors of this report.

Abstract

This report summarizes a design sprint that was done throughout the past 9 weeks, as part of the graduate course *SYDE 600*. The report will go through the chosen problem, identified stakeholders, brainstormed solutions, the built prototype, conducted user testing and user interviews, and finally a discussion of the findings and next steps (if the project were to be continued past the duration of the course).

Throughout the past weeks, the project followed the process outlined in *Sprint: How to Solve Big Problems and Test New Ideas in Just Five Days*, under the supervision of Dr. John Zelek. The chosen theme that inspired the project problem was how to return safely from COVID-19 in an indoor-gym environment. The findings revealed complex bottlenecks and loopholes in the systems of gyms (especially at the University of Waterloo) that cause the capacity to run at lower than government restrictions allow, as well as many other inefficiencies. We present our suggestions and recommendations at the end of the report.

Acknowledgements

We would like to express our deep sense of gratitude to Prof. John Zelek and all six interviewees, whose names we will leave anonymous for privacy reasons, in helping us develop the project through their continuous guidance as well as constructive comments and feedback.

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1.1 Introduction

For a large portion of the population, public indoor gyms are important to living healthy lifestyles through maintaining appropriate levels of physical and cardiorespiratory fitness, as well as mental health. However, the recent events regarding viral transmission of respiratory diseases have led to the portrayal of public fitness centers as “dangerous” to personal and public health [1]. Although increased vaccination rates and vaccine mandates in public spaces have contributed to the re-opening of public indoor gyms with loosened restrictions, the risk of viral transmission of respiratory disease is still a concern for the future. Whether it is through seasonal influenza, future pandemics, or fast evolving COVID-19 variants (Delta, Omicron), respiratory diseases will continue to propagate. Therefore, it is imperative to proactively design solutions aimed at minimizing the transmission of respiratory diseases in public indoor gyms that can be readily implemented in future events. As such, the goal is to create a solution that will further reduce the spread of respiratory diseases within public indoor gyms compared to recently implemented methods as well as avoid full establishment closures. The project goal would be achieved once the rate of viral transmission slows down inside gyms, and gyms are able to remain fully open safely. To achieve this goal, important stakeholders will be considered, such as student athletes, casual and avid gym goers, gym staffs, and gym owners.

1.2 Literature Review

Over the course of the recent COVID-19 global pandemic, public indoor gyms had to revamp their approach to providing a safe environment for their customers to perform their exercise routines. Public indoor gyms had to adhere to public health guidelines within their regions by drawing safety plans considering capacity limits, health screening, floor layouts allowing proper social distancing, mask wearing policies, physical barriers between workers and patrons, and more recently, proof of COVID-

19 vaccinations [2]. These requirements were put in place so that the transmission of the COVID-19 virus could be minimized in indoor gym environments. In order to design a novel solution aimed at mitigating the spread of respiratory diseases in public indoor gyms, it is important to first review the state of the art in the current measures being taken, and the methods designed to implement these measures.

As reported by the Centers for Disease Control and Prevention (CDC), the main route by which the COVID-19 virus spreads is through respiratory droplets. To ensure a safe environment, public indoor gyms have taken various measures to limit interactions between patrons and workers, between patrons and patrons, and between workers and workers [3]. These have included locker room closures, halted group classes, spaced out equipment, mandatory 6-foot social distancing, no equipment sharing, and visual clues for standing positions and traffic direction. In addition, the CDC did also recommend increased distances between patrons and front desk assistants, limited access to common areas for employees, and the creation of small group of workers who can work recurrently as a team. Although a minority, there has also been reports of big upscale gyms taking advantage of large square footage, hospital grade air-cleaning units, and even ultraviolet robots deployed for cleaning and temperature checks [1] [4].

Although some gyms have opted for a total halt on group fitness classes, other organizations such as YMCA have found creative ways to provide their services. This includes the development of outdoor spin classes in parking lots, as well as Pilates on rooftops [5]. Other fitness centers have started offering live streamed classes and on-demand workouts with no viewing limit, thereby attempting to offer the indoor gym experience while minimizing in-person contact [6]. For some, fitness classes through digital modalities have been well-received, with 46% of a survey respondent intending to

continue integrating virtual classes even upon the reopening of fitness studios [7]. Fitness center operators stress the importance of keeping members connected and engaged, mentioning social media as a great tool to that affect [6]. The importance of staying connected to customers is reflected in a survey which found that 59% of Americans did not plan on renewing their gym membership upon the end of the COVID-19 pandemic [8].

With technology at the forefront of our society, digital applications made available on smartphones have been proposed to alleviate members concerns and enhancing their gym experience. Some proposals have included time and exercise booking features to better manage indoor traffic and optimize the training floor, and immunity-boosting exercise routines, thereby addressing two major concerns highlighted by customers: social distancing and a compromised immune system [9]. Additionally, the increased development of wearable technology capable of monitoring physiological functions such as heart rate, breathing rate, and skin temperature may prove useful to monitor individuals for symptoms, which could be advantageous to consider within proactive solutions aimed at minimizing viral transmissions of respiratory illnesses [10] [11] [12].

1.3 Design Ideas

The team brainstormed multiple ways to approach this problem. Table A1 in Appendix A summarizes the pros and cons of each idea. These were inspired by real life existing solutions to other problems and can be grouped into three main categories. Ideas that involved reducing transmission through contact depended on reducing interactions by potentially setting a time limit on the person being in a certain gym area. Ideas in this category needed ways to notify patrons when their time limit was reached with audio/visual cues. Thus, things like a timecard, a no guess rice cooker etc. were considered. Secondly, solutions that targeted transmission through large drops depended on

sanitization and involved ideas like overhead sprays, GUV lamps installed at each station, or anti-microbial paint on gym equipment. Lastly, solutions that involved reducing airborne transmission involved ideas like specialized ventilation systems and increasing distance between patrons.

1.4 Final Design

The team decided to prototype an app to limit the number of people inside the gym, the contact between gym patrons, and thus the spread of viruses in the gym. The app would allow users to book the time, date, and areas of the gym they are working out in. A visual heatmap of the gym will be used in the app to let patrons know what areas of the gym they should avoid before entering. This way, they will know what areas they can use and what their workout will look like before they arrive at the gym. Gym patrons will also be allowed to set their own time limits on the zones within the gym they are planning to workout in. This way, their workout can move forward without interference from arbitrary time limits or interference from other gym members using the machines that they want to use. Along with this gym app, a COVID-19 or viral questionnaire will be included every time a patron wants to schedule their workout in order to adhere to public health guidelines.

With this scheduler, gym staff will be able to set capacity restrictions or time limits on the whole gym as well as certain areas of the gym. This will allow gym staff to easily adhere to the ever-evolving government regulations surrounding public restrictions, as well as track everyone who has been in their gym.

The app was chosen as it would allow customizable options, restrictions, and features for individual gyms. This means that gyms could add capacity restrictions to certain rooms, areas, or machines in the gym. If there was an area of the gym people generally spent a longer than usual amount of time at, a time restriction could be put in place to keep people moving in and out of the gym. An app

was specifically chosen as 88.1% of Canadians have a smartphone and 58% of smartphone users already use a phone to track their workouts [10] [11]. This high percentage of people already using their smartphone for health tracking allows easy integration into how people approach the gym.

1.5 Prototype

The prototype was designed to provide an easy-to-use experience for the patrons to book their time slots in particular zones within the gym. The app makes users login and provides some health tips integrated with COVID-19 screening questions. The patron then selects a date and time they want to work out. The graph underneath the selected time and date indicates how busy the zones are during the selected time (considering everyone already booked for that time). Once the time and date are chosen, the user is presented with three options: a pre-curated set of workouts to account for patrons who do not go with a specific workout plan in mind, a saved set of workouts that users have already entered previously and lastly, an option to create a new workout. The last option (create new option) presents users with a floor plan of the gym, overlayed with a heat map denoting how busy those zones are. This informs them of the capacity status so they can plan their workouts around this information. Once the user selects the zones, the app routes and optimizes their paths inside the gym. The other two options skip this step and jump directly to confirming time needed in each zone. If a zone is at capacity, the user is given options to either come back at another time or presented with alternative exercise modalities that target the same muscle group in a less busy zone of the gym. Figure 1 summarizes a walk-through of the prototype app. The information architecture of the app can be found in Appendix B Figure B1.

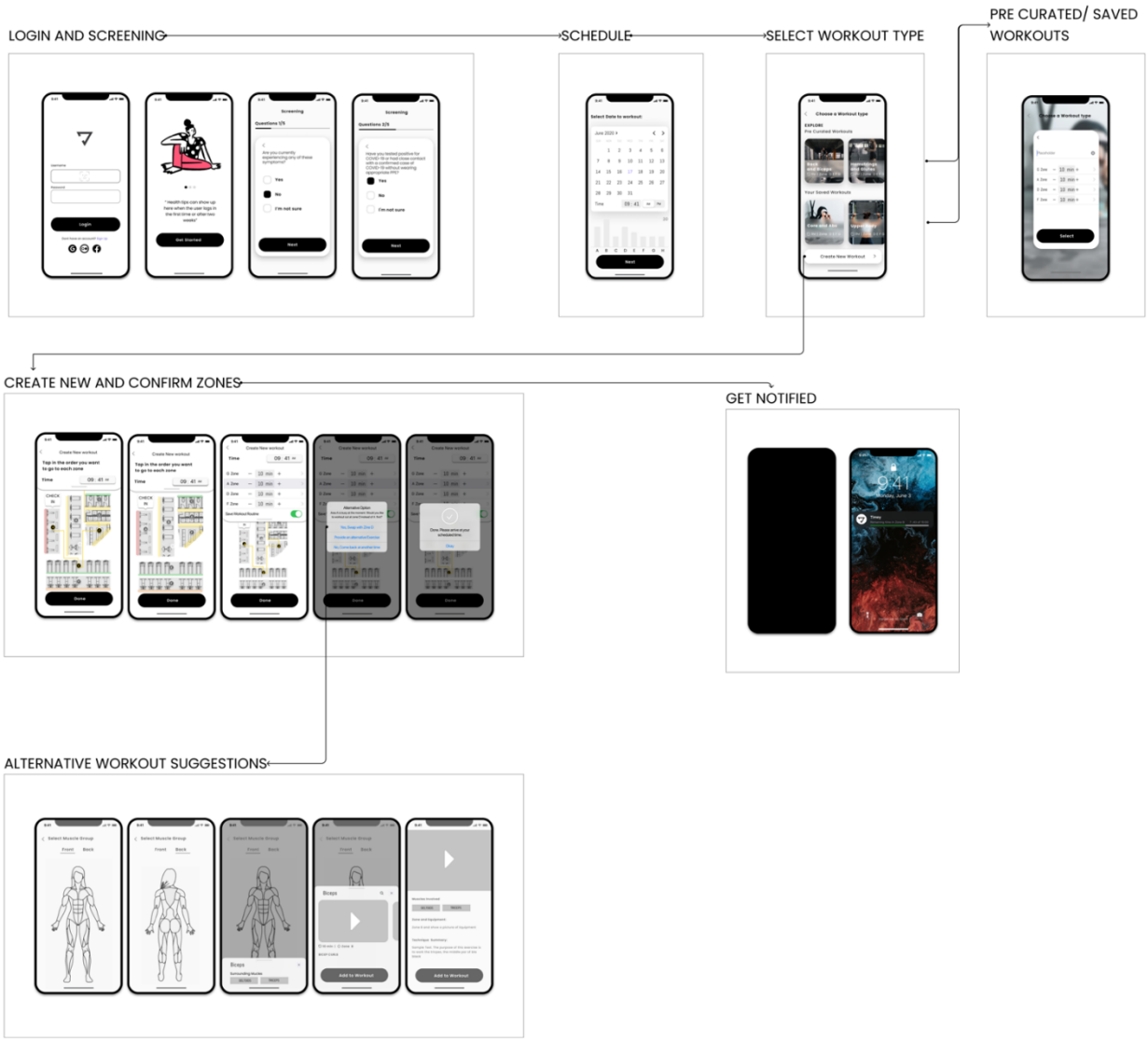

Figure 1: Walk through of the prototype

1.6 User Testing and Feedback

Gym staff as well as a variety of gym goers were interviewed to get an all-rounded perspective of the situation. Due to time and location constraints, four out of the six interviewees were associated with the PAC gym at the University of Waterloo.

1.6.1 Gym Staff

A general staff member at the PAC gym reported a few shortcomings in the scheduling and registration process already in place over the duration of the pandemic lockdown. As areas of the gym had to be pre-booked, members would sign up for areas that were typically open, only to derail and enter more popular areas where spots would fill up quickly in the pre-booking process. As a result, the PAC staff had to micromanage gym goers via security cameras and physical intervention. Furthermore, the gym experienced a bottleneck at check-in due to delays in confirming proof of vaccination and personal identification for each gym member. This took about 5 minutes per person during busy gym hours. Gym goers expressed dissatisfaction with the wait times.

A senior staff member at the PAC reported that the online scheduling system faced a technological burden where digital bots would flood the system and pre-book spots for specific gym members rapidly. The University IT Department reported that as spots opened on the hour, people were getting through 7 pages of manual data entry in less than 15 seconds. As a result, manual controls had to be set up to counteract the flooding and any individual associated with bot usage would be flagged.

Upon explaining the app idea and presenting the solution prototype to both interviewees, feedback was given regarding the COVID screening questionnaire. The general staff member reported that many people lie on the screening questionnaire due to the large number of questions being asked and the simplicity in selecting “No” for consecutive questions. One proposed solution for this is to have a screening questionnaire consisting of only one question that asks the user whether they are experiencing any of the COVID-19 symptoms with a simple “Yes” or “No” answer selection. Less data entry might improve the chances of an individual reading the question in its entirety and answering

honestly. The general staff member believed that screening questionnaires are not an effective public health measure as they are more of a legal protective measure for the gym to ensure they are not liable if someone lies about their symptoms, thus why their implementation has not changed regardless of the efficacy.

Furthermore, the senior staff member mentioned that the COVID questionnaire should be answered 18 hours prior to the member entering the gym as per government regulations, thus the scheduling process should restrict how early a gym member can book a spot.

Both interviewees expressed concerns regarding the ease of which the app would integrate with the gym experience for the customer. Pre-scheduling is a good measure if everyone sticks to the plan that they had scheduled. However, as experienced throughout lockdown, humans will deviate from a planned route if they see other options – particularly novice gym members who are not familiar with the gym environment or the equipment. Due to time constraints and the rapidly changing public health mandates for lockdown during the pandemic, the staff at PAC had to reduce capacity limits even more than the approved capacity limits by the government. This ensured that even though people were not following their pre-scheduled workouts, the capacities were low enough to increase social distancing and prevent grouping in specific areas of the gym. While these measures were approved on the fly by senior staff, they limited the gym experience for many members. Both interviewees suggested to think about how the app would integrate within a workflow in the gym while optimizing the gym experience for each member. It was also suggested to incorporate a feature into the app that would allow gym staff to keep members abreast on current gym measures as well as why they are being enforced. This increases transparency between gym staff and gym members which might improve the chances of gym members following the rules.

1.6.2 Gym Goers

Four gym goers were interviewed for the user testing process. Of these four people, two of them were avid gym goers and two of them were casual gym goers. The avid gym goers attended the gym 5-6 times a week and always had their workouts planned before coming to the gym. The casual gym goers showed up to the gym 2-3 times a week and would not have a plan before entering the gym.

Starting with the avid gym goers, they liked the idea of the app. One thing that they liked was the ability to schedule zones. Often, popular machines are crowded with a queue of people waiting to use them. The interviewees saw the app as a way to avoid this queuing and being able to get the workout done efficiently without waiting around. These interviewees did not like the idea of having an alarm when it is time to change stations. They pointed out that if everyone were to have alarms, this could become extremely annoying in a full gym, or it would be annoying to have an alarm in your headphones. One suggestion was to have this notification to switch stations be a vibration, and make sure that is cannot be an alarm. This would remove the ringing of an alarm, but still notify people that it is time to switch machines. Another suggestion that these avid gym goers had was to include a countdown timer and a buffer period to clean the machines. This way, people would be able to wrap up their workouts as they know their time is coming to an end and clean the stations before they leave.

The casual gym goers also had a positive reaction to the app. They liked being able to book zones in the app. They did not believe booking individual machines would be something that would interest them. Overall, they liked being able to move from machine to machine within a zone that has machines that workout similar body parts. These interviewees were also okay if the app made suggestions to their workout if the area, they were trying to book was busy. One suggestion these casual gym goers had was to create some sort of performance tracking tool to integrate with the scheduling app. If they could

track their workouts and performance in the app, they believed it would be an app that they would be more likely to want to use.

1.7 Discussion and Next Steps

From the analysis we did on the system, the brainstorming and prototyping, as well as finally interviewing different stakeholders and user testing, there were three key negative loops that emerged as takeaways as follows:

1. Multiple bottlenecks exist in the system
2. Multiple loopholes that enabled cheating, and was hard to police
3. What incentives must be in place in order to use another app (gym owners, & gym goers)?

A detailed diagram of the negative loops in the system can be found in Appendix C, Figure C1.

Based on the takeaways listed above, next steps have been identified as outlined in this section.

1.7.1 Addressing Pain Points in the System

The interviews shed some light on the gaps between some of the analysis performed by the team, and what was found to be the case based on the interviewee's experiences (fully discussed in Appendix D). The main pain points that were identified were:

- Bottlenecks that randomly occur, such as long lines of students entering the gym at the same time (can take up to 50 mins per student), or long lines of students using the same machine at the same time
- Loopholes that enabled cheating, such as students using bots to automatically and unfairly book time slots. These loopholes were hard to police from the owner/staff
- Slowness from the owner/staff in reacting to changes (like sudden government mandates, and technical updates on the website) due to lack of expertise or understaffing

These pain points are explained in further detail in Appendix D Figure D1.

1.7.2 Integrating a New Solution into an Existing Solution

Introducing "another" technological solution to staff that have a hard time dealing with the existing technology would be insensible. Similarly, introducing another "step" for the students going to the gym would be merely annoying. Thus, what is needed are the following criteria (expanded further in Appendix D):

- a solution that integrates with the existing process
- a solution that does not add another pain point
- a solution that solves/removes at least one or more pain points

1.7.3 Breaking Down Prototyping & Separating Targets

The chosen target of "Gym Owners" required the study of another target "Gym Goers". Both targets were in fact intertwined in the problems they faced (Appendix D Figure D1), which made it difficult to prototype and test for in depth. This requires a refocusing of the problem definition (for example, choosing to re-focus the problem on one of the bottlenecks, which has both the "owners" and the students involved), as well as having two sets of prototyping that focus on specific problems for their respective targets (Appendix D Figure D2).

1.7.4 App Alternatives

It is sometimes far too easy to depend on fancy technology, that does not end up solving the problems it was meant to solve. All of these solutions or features in the app can and should be tested using non-technological methods, in order to stress-test if they really solve the problem or not. Some of the ways we will stress-test these solutions non-technologically are as follows:

Pen and paper – for testing out ways to remove the bottlenecks at the busy machines

Old school phone-calls – similar to above, plus for the screening process and booking time slots

One-on-one interactions – similar to above

Emails (or other forms of non-real-time messaging) – similar to above

Finally, in order not to add technological stress that can overwhelm the system and its users, the question becomes, *"How can the solution move away from the app to alternative modalities to give the same experience to the users?"*. A brainstorming of the many possible methods to get to the same solution without any technology as alternatives will be required. This will also serve as a backup plan for any time a technical problem occurs, as the system should be able to maintain itself without too any hiccups.

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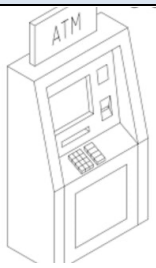
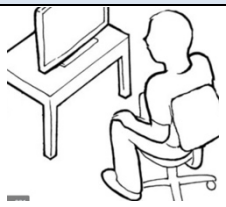
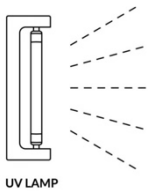
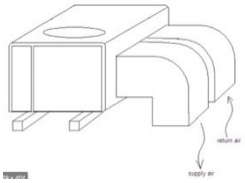
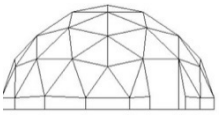
Appendix A – Preliminary Design Ideas

Table A1: List of preliminary design ideas with associated pros and cons

IDEA	POSITIVES	NEGATIVES
Contact: Limiting interactions through timed rotations with audio/visual cues		
	Time card: Takes responsibility of the patrons, so they know exactly when time is up and card is returned for them to move to the next machine	Will need new installation on each machine and can become very costly
	Drive through: Allowing one person to be served at a time so limits interaction	Not feasible for large gyms when there are many patrons wanting to use the gym
	Sanitizing concepts installed at each machine.	Can be costly to install and may not work for free weights
	No guess rice-cooker: Tells users when their time is up. Takes responsibility of the patrons	–
Large drops: Prevention through limiting contact		
	Creation of bubbles like streamed lectures: May be beneficial to allow more people to benefit from open gyms and not be limited to capacity restrictions	Not ideal for people who need equipment to workout.

	GUV lamps can be very efficient in reducing viral transmissions	Can be very costly to install
	Anti-microbial paint: Easily possible to paint within one short gym closure	Will not be possible on equipment that has cloth material like benches
Airborne - HVAC systems for increased air flow		
	Easy to manipulate HVAC systems	Not possible to implement for older gyms
	Outdoor domes can spread out equipment more, the more distance, the lower the risk of transmission.	Not possible for privately owned gyms with small budgets or even gyms which are situated in dense cities.

Appendix B – Workflow of the App

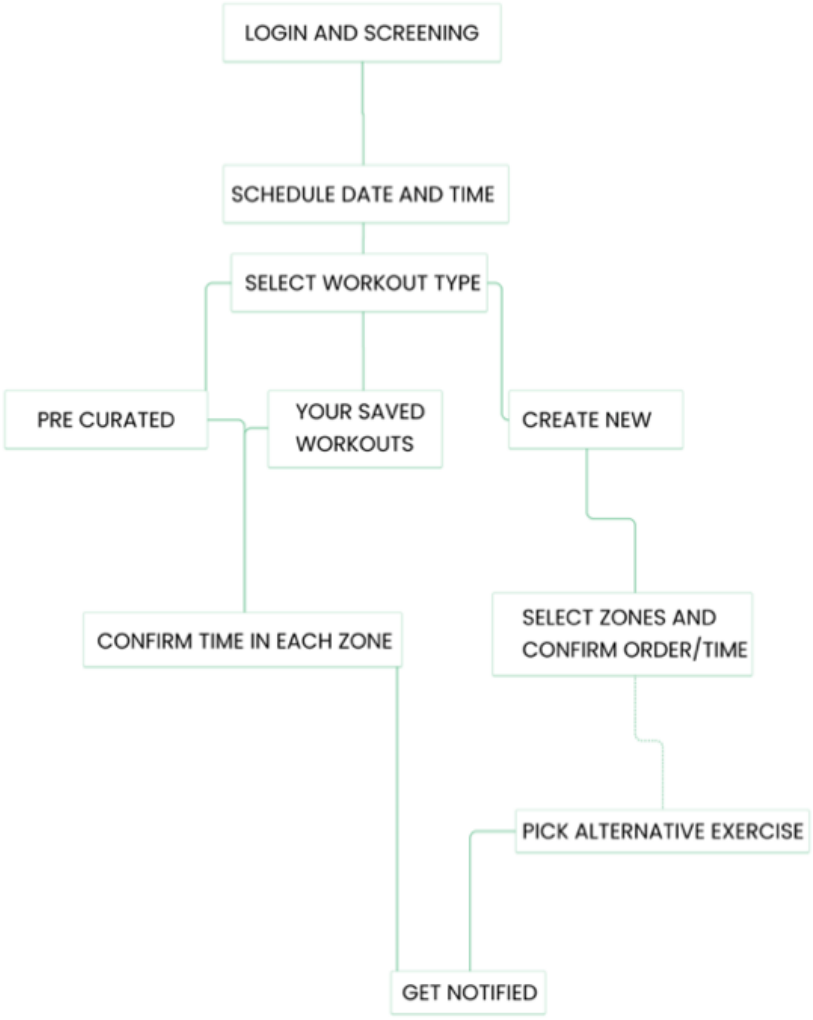


Figure B1: Information architecture of the prototype

Appendix C – Negative Loops in the System

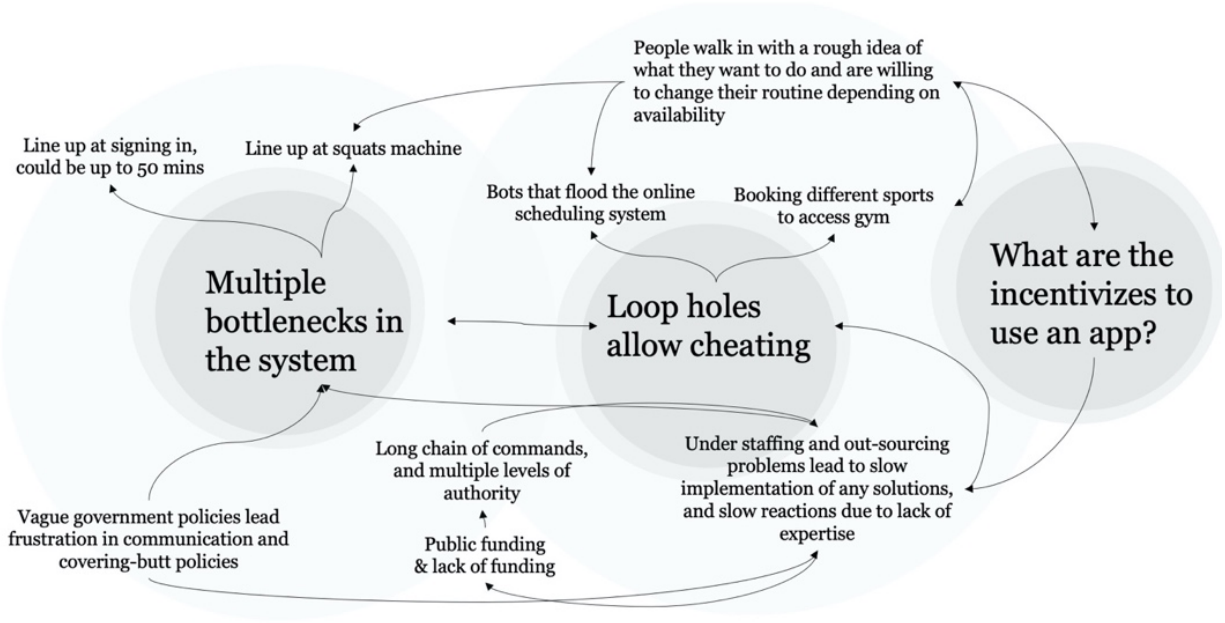


Figure C1: An overview of the negatives loops in the gym system

Appendix D – Detailed Explanation of Pain Points and Next Steps

Addressing pain points in the system, based on what our interviewees brought up

It became quite clear from user testing that there was a gap between some of the analysis, and what was found to be true based on our interviewees' experiences. That gap was to be expected, given the nature of the Sprint methodology itself, which starts with an existing company and its employees, and builds on ones' experiences with customers and users (something which was not true in the student group).

The main pain points that were identified were:

- Bottlenecks: Often at different parts of the system, random bottlenecks would occur. For example, at the registration (users going to the gym) sometimes there is a long line of students that form, pushing the wait time to get into the gym from 5 mins (average) to up to 50 mins to the last students (assuming there are 10 students waiting, which we were told is common). The reason for this specific bottleneck tends to be random, as sometimes it occurs due to technical difficulties (internet down) and sometimes out of the blue. Similarly, there seems to be lineups at different machines (like the squat machine, or the deadlift machine) and it happens randomly.
- Loopholes: The gym staff often found themselves dealing with students cheating the system and had trouble policing them. For example, they had multiple instances where students would "flood" the signup system by booking multiple activities 15 seconds after they become available online, which the team was told is impossible to do given how the system works (so the assumption was that a bot was used to book these activities). Similarly, students often

would get around an activity not available (say swimming) by signing up for another activity (say squash) then sneak in to the first activity they weren't able to sign up for. Gym staff often responded by lowering the entire number of students allowed in their facilities to accommodate for the cheaters, which made it more restrictive for students and created more incentive for the cheating to happen.

- Slowness: The gym staff despite their best efforts, found themselves slow, understaffed, and inexperienced on how to deal with any changes. This is because these changes often required them to work with new vague and ill-defined government policy (outside of their expertise) or updating and building technologies to cope with the new policies (like their website, which is outsourced to another company, and often required them dealing with student's data and privacy-specific issues which they were not equipped to deal with).

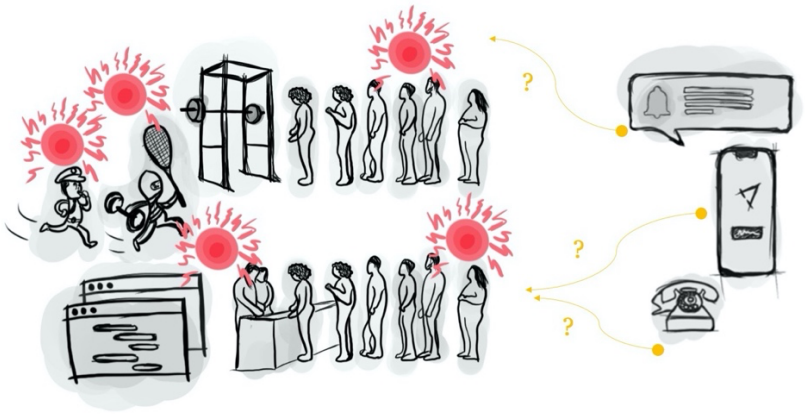


Figure D1: Pain points in the gym-system

Integrate new solution into existing solution

When the team first came up with their initial solutions and prototypes, a lot of it was based on preliminary research (mostly internet-based research or based on the team's own experience). A lot of these assumptions were true, however the team also found out a lot of it was incomplete in terms of the specifics the team came to realize afterwards. Take the prototype for example, which is mostly built around an app. Introducing "another" technological solution to a staff that has a hard time dealing with the existing technology would be insensible. Similarly, introducing another "step" for the students going to the gym would be merely annoying. Thus, what is needed to be iterated on has to have the following criteria:

- is a solution that integrates with the existing process,
- doesn't add another pain point,
- solves/removes at least one or more pain points

Figure D2: Breaking Prototyping and refocusing/separating targets

Breakdown prototyping & separate targets

When this project was started, the team was required to pick a "target problem" to dive into and solve. This makes sense, it is a great way to focus on a problem and go in depth to understand it, and it is a great way to build a focused solution that is simple. However, what the team soon came to

realize is that the chosen target “Gym Owners” required the team to study another target: “Gym Goers”. This complicated the user testing and prototyping. It also kept the team from diving deep into the problem and prototyping specific focused solutions to test it (for example: although the gym owners were shown the prototype, it made more sense for gym goers to test is as they would be the group using it).

There are two ways to deal with this problem. The first, is to re-focus the target and the problem definition. For example, the team could choose to work on solving the technical problem the “gym owners” tend to have, and if our team worked for a company this might perhaps make the most business sense). On the other hand, the team could choose another problem that would require both user targets involvement and thus would require two sets of prototyping that focus on specific problems for their respective targets (for example: the team could choose to focus on one of the bottleneck problems, which has both the “owners” and the students involved). The latter is the direction the team had chosen, simply because it is the more complex problem, and the team has no business motivation given it’s a school project.

Not every problem can be solved with an app

It is easy for engineers and designers to be caught up in the process of building, without first having an honest review of whether a solution is needed or not. Building is our passion, it is our interest, and it is what we are good at. However, often the best solutions can come in the simplest and non-technological form. It can be a bummer for the team, given that a lot of our skills may not be used, but it is often the solution needed to solve a problem.

Although not entirely focused on an app (for example: the team spent quite a bit of time figuring out the gym area-zoning, the screening process, the timeslot signup, etc.) the solution eventually was in

the form of an app which merely stemmed out of how simple it is to build and how easy it is to later test. However, all these solutions or features in the app can and should be tested using non-technological methods in order to stress-test if they really solve the problems or not. Some of the ways this solution can be stress-tested are as follows:

- Pen and paper – this can be used for testing out ways to remove the bottlenecks at the busy machines
- Use old school phone-calls – similar to above, plus can be used for the screening process, and booking time slots
- Use one-on-one interactions between users – similar to above
- Use emails (or other forms of non-real-time messaging) – similar to above

Finally, in order not to add technological stress that can overwhelm the system and its users (being focused mainly on the “gym owners” and the “gym goers”), the question is how can the solution move away from an app to alternative modalities to give the same experience to the users? The team will brainstorm possible methods to solve the problem without any technology in hopes of finding alternatives. This will also be useful, for when technical problems occur as the system should be able to maintain itself without too many hiccups.