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August 2, 2022

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Dear Mr. Darren Stolz,

Hi, my name is Chris Jung. I am a 4th-year UBC Computer Science student and an active powerlifter frequently working out at the UBC Birdcoop Fitness Centre. I send this mail to propose an implementation of an electronic queuing system in Birdcoop Fitness Centre.

After the COVID restriction was lifted, an increasing number of students are visiting the UBC Birdcoop Fitness Centre. Thus, popular equipment in the gym forms an excessively long waiting line. However, there is currently no systemic way of waiting for equipment in the gym and the traditional way of waiting is wasting many users' time in the gym and often causes trouble among users.

The attached file is my formal report containing an analysis of the problem with the current waiting system in the gym and a proposal for a potential solution to the problem. I analyzed the current situation through surveys and interviews with the users and the staff of the gym. Based on the analysis, I made this formal report including the installation plan and the budget. As it provides a detailed explanation of how the digitization of queuing system will resolve the current issue regarding waiting in the gym, I hope you find this report useful and ask to consider introducing a new waiting system in the UBC Birdcoop Fitness Centre.

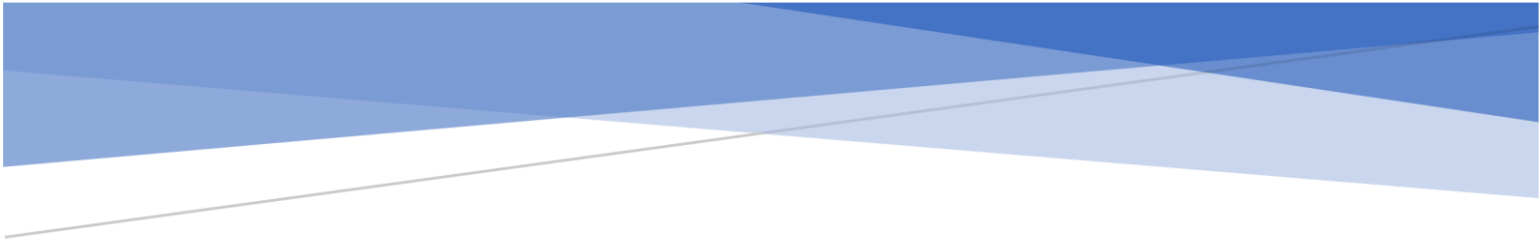
Thank you for your time reading my mail and report. If there are any questions, please contact me at eunhocj@student.ubc.ca.

Sincerely,

Chris Jung

Enclosure:

Formal Report on Implementing an Electronic Queuing System in the UBC Birdcoop Fitness Centre.pdf



IMPLEMENTING AN ELECTRONIC QUEUING SYSTEM IN THE UBC BIRDCOOP FITNESS CENTRE

**Prepared for Darren Stolz, Facility & Equipment
Coordinator of UBC Recreation Centre**

August 2, 2022

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Abstract

As an increasing number of students are visiting the UBC Birdcoop Fitness Centre after the ease of the COVID restriction, popular equipment in the gym forms serious congestion of people waiting to use it. However, there is currently no systemic way of waiting for equipment in the gym. The traditional way of waiting is wasting many users' time in the gym and often causes trouble among users. This report thoroughly analyzes the current situation with the data gained from a survey and an interview with the users and the staff of the gym. Based on the analysis, the report advises an electronic queuing system to resolve this problem with the installation plan and the budget. Also, it provides a detailed explanation of how the digitization of queuing system will resolve the problem as well.

I. Introduction

A. Background

The UBC Recreation Centre plays a significant role in many UBC students' lives. It helps the students strengthen their physical health and boost their mental health (Mayo Clinic, 2017) during the intensive study period at UBC. This could potentially lead to the better academic performance of many UBC students as well (Cappelen, 2017). As the COVID restriction is being eased, more students visit UBC Recreation Centre, especially the Birdcoop Fitness Centre which is known for its weightlifting equipment. However, the increase in the number of visitors to Birdcoop Fitness Centre causes a shortage of popular gym equipment such as squat racks, bench racks, and lifting platforms. Thus, more users of the gym have to wait for an uncertain amount of time standing next to the equipment before using popular equipment.

B. Statement of Problem

There are currently four bench racks, five squat racks, and six lifting platforms in Birdcoop. It may seem that they are a lot, but the demand for them is also very high as these three kinds of gym equipment are used for five core exercises in weightlifting (Bench Press, Squat, Deadlifting, Overhead Press, and Barbell Row) (Prater, 2018). Although waiting for the popular equipment in Birdcoop Fitness Centre has become more frequent, there is no systemic way of queueing for equipment at the gym. The traditional way of waiting for equipment is just to stand near the equipment until the current user finishes exercising with the equipment. This way of queueing wastes users' time spent in the gym by making them stay at one spot not being able to exercise. Also, this way of waiting creates conflicts between users because it is often not clear who started to wait first or how many people are waiting to use the equipment.

C. Purpose of Report

This report aims to provide an accurate analysis of the current issues with the waiting system in Birdcoop Fitness Centre and to propose an electronic queueing system as a feasible solution to resolve the problem.

D. Scope of Inquiry

This report investigates the following eight questions to precisely investigate the current problem and provide an effective solution to it:

- How many people are having difficulties caused by the current waiting system in Birdcoop Fitness Centre?
- How much time can be saved for each student approximately by not waiting near the equipment when they want to wait for it?
- What are the kinds of equipment in Birdcoop that are most popular but short in supply?
- What is the average/appropriate using time of the popular equipment in Birdcoop?

- How much would it cost to implement the entire electronic queuing system?
- How many gym users agree with implementing a new electronic queuing system?

E. Data Sources

1. Survey

The primary data source of this report is the actual experiences of the users of the gym. Thirty-five users of Birdcoop Fitness Centre responded to an anonymous online survey designed to analyze the demand and waiting for the gym equipment as well as gauge interest in a potential electronic queuing solution (Appendix A).

2. Interview

An interview with the staff who has been working as a staff of Birdcoop Fitness Centre for the last 23 months was also conducted to ask to get information about the change in the number of visitors after the ease of COVID restriction and conflicts between users due to the waiting for gym equipment in Birdcoop Fitness Centre (Appendix B).

3. Others: Observation & Web Search

As secondary data sources, long-term observations of the Birdcoop Fitness Centre by the writer, an active user of the Gym, were included in the report. Also, some data was collected online to calculate an accurate budget for the implementation of an electronic queuing system.

II. Data Section

A. Cause 1: Popular Gym Equipment in Birdcoop Fitness Centre

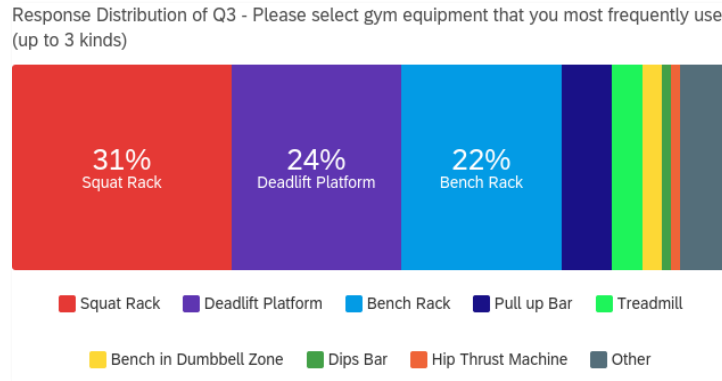


Figure 1. Result of Survey – Q3

Figure 1. shows that squat rack, deadlift platform, and bench rack are by far the three most frequently used types of gym equipment in Birdcoop Fitness Centre. This implies that many users visit Birdcoop Fitness Centre to use its facility specialized in weightlifting.

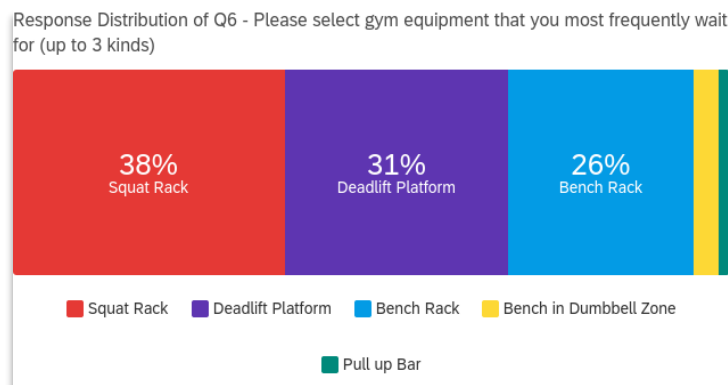


Figure 2. Result of Survey – Q6

Figure 2. strikingly shows that squat rack, deadlift platform, and bench rack are the gym facilities that are not just popular but that are most waited for in the gym as well. Combining the two results, it is shown that the demands for the three kinds of gym equipment are much higher than

the capacity of the gym. This high demand over the capacity for those three kinds of facilities causes the users to spend more time waiting in the gym.

B. Cause 2: Increasing Number of Visitors to Birdcoop Fitness Centre

After the COVID restriction was lifted, more people are visiting the Birdcoop Fitness Centre to enjoy the gym which was not easy to do during the COVID period. From the interview conducted with a staff of Birdcoop Fitness Centre, the interviewee answered that “The number of visitors to the gym approximately doubled during the peak time of the day after COVID restriction was lifted.” This response also complies with the fact that there is always a line to enter the gym during peak time (from 5 pm to 7 pm) but the maximum capacity of the gym was increased to 75 people from 30 people at the same time after the COVID restriction was relieved.

C. Problem 1: Amount of Time Spent Waiting for Equipment

In the current waiting system in the gym, users should stay near the equipment they want to use until it becomes available. Someone else may take the equipment if the original waiter is not there at the moment it becomes available. Thus, most of the time waiting for equipment is purely wasted standing nearby it unless the waiters luckily have another exercise to do with equipment near the one they wait for.

Average time spent in Birdcoop Fitness Centre	
1) Average time spent in the gym per visit	73.8 mins
2) Average time spent waiting per visit	11.2 mins
3) Percentage of time spent waiting per visit	15.2%
4) Average number of visits per week	3.1 times
5) Average wasted time per week	34.7 mins

Table 1. Summary of time spent in Birdcoop Fitness Centre

Table 1. is the summary of users' time spent and wasted in the gym calculated from the responses from Q1), Q2), and Q3) of the survey. It turned out that about 15% of users' time was wasted while waiting for the gym equipment they want to use in the Birdcoop Fitness Centre. Also, when converted into the time spent per week, about 35 minutes on average was wasted just waiting for gym equipment every week by each user. This is a huge loss both for the gym and for the users of the gym. To put it another way, Birdcoop Fitness Centre can increase its capacity up to about 15% by reducing the users' time spent waiting. In terms of users' benefits, they can save about 35 minutes every week by effectively managing the time wasted waiting in the gym.

D. Problem 2: Conflicts Between Users Caused by Ambiguous Waiting System

Wasted time in the gym is not the only problem caused by the current waiting system. The traditional waiting system also brings unnecessary conflicts between users of Birdcoop Fitness Centre. The current waiting system does not record anything about the waiting. Thus, it is not clear how many people are waiting for certain equipment, who started the waiting first, or how long the current user is using the equipment. This ambiguity of the waiting often causes trouble among users especially when the gym is filled at its peak time. For example, one common conflict between two waiters is caused because the order of waiting is not clear. From the survey conducted with the users, about 57.7% of respondents answered that they have experienced or watched a conflict between users caused by waiting for gym equipment in Birdcoop Fitness Centre. Since any conflict between users can negatively affect many other users' experiences in the gym, this kind of conflict should be prevented. Also, the staff of the gym in the interview responded that he "frequently witnesses conflicts caused by waiting for gym equipment, and this kind of conflict comprises about 80% of all human-caused troubles in the gym.". For this reason,

it is necessary to introduce a clear queuing system to prevent this kind of unnecessary trouble in Birdcoop Fitness Centre.

E. Solution: Electronic Queuing System Using a UBC Card

1. Electronic ID Checking System Using a UBC Card in the UBC

In the UBC, one can easily verify their identity electronically using a UBC card by simply tapping the card on a card reader. The process of electronic identification using a UBC card is very simple. The card reader reads a unique id stored in the card, sends the scanned id to a computer, and the computer finally verifies the id by comparing the id with the information stored in the online UBC system. This electronic identification is widely used to enter restricted areas in the UBC including Birdcoop Fitness Centre. As all users of the gym possess a UBC card, an electronic waiting system in the gym can be created just by replacing the last step with putting the user onto a queuing system.

2. Components and Process of the Proposed Electronic Queuing System

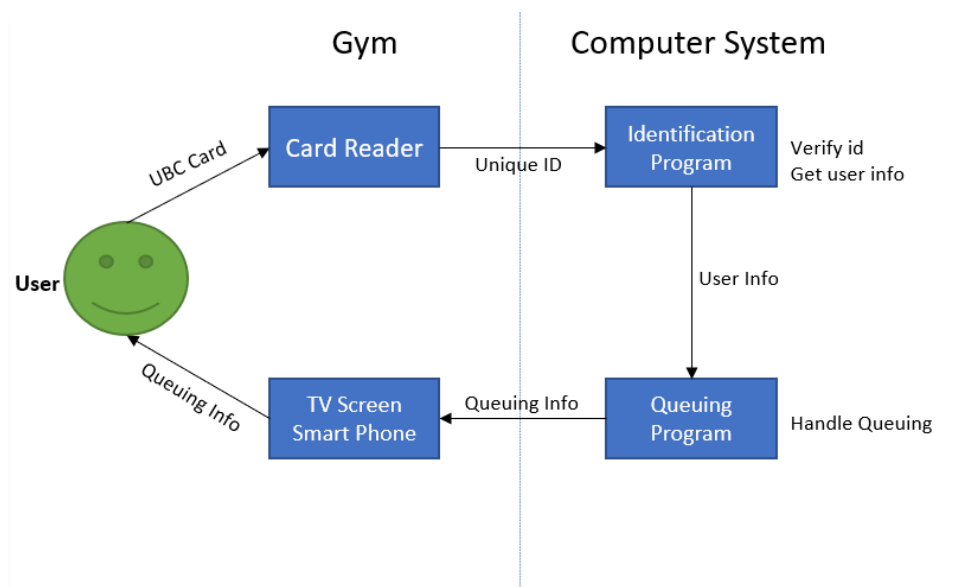


Figure 3. Process of the Electronic Queuing System

The proposed electronic queuing system is comprised of four major components: Card reader, identification program, queuing program, and display. Among the four components, only extra card readers and a queuing program are required to be installed as the other two components already exist in the gym.

The process of the system is very similar to other identification processes used on the UBC campus. Figure 3. shows a simple visualization of the process. Each piece of equipment has a designated card reader on one side of the gym. When a user taps their UBC card on the reader, it reads the user id stored in the card and sends it to the computer in the gym. The computer has an identification program used to identify people entering the gym. From the identification program, the PC gets the user information and sends the user information to the queuing program. The queuing program handles everything related to queuing including enqueueing, dequeuing, and sending queuing information to the TV screen in the gym or to the user's smartphone. For example, when a person taps the reader with their UBC card, the program puts the person at the end of the queue, and it dequeues the user if the user taps again. When the current user of equipment taps the reader, it terminates the user's occupancy of the equipment and sets the person on the queue as a current user. Finally, users can check these changes in the status of queuing from their smartphone or TV screens installed in the gym.

3. Expected Advantages

The electronic queuing system resolves both problems caused by the current waiting system in Birdcoop Fitness Centre. First, users can exercise with other equipment while waiting for equipment as the electronic queuing system displays the current waiting status on screens around the gym. This could potentially save about 15% of users' time spent in the gym by removing the reason to stand near the equipment just to wait for it. Also, because the system clearly shows the

order of the queue for each piece of equipment, unnecessary conflicts between users due to ambiguous orders of waiting for equipment can be prevented in the gym. This could improve the quality of the gym experience for everyone using the gym.

4. Users' Demand for an Electronic Queuing System

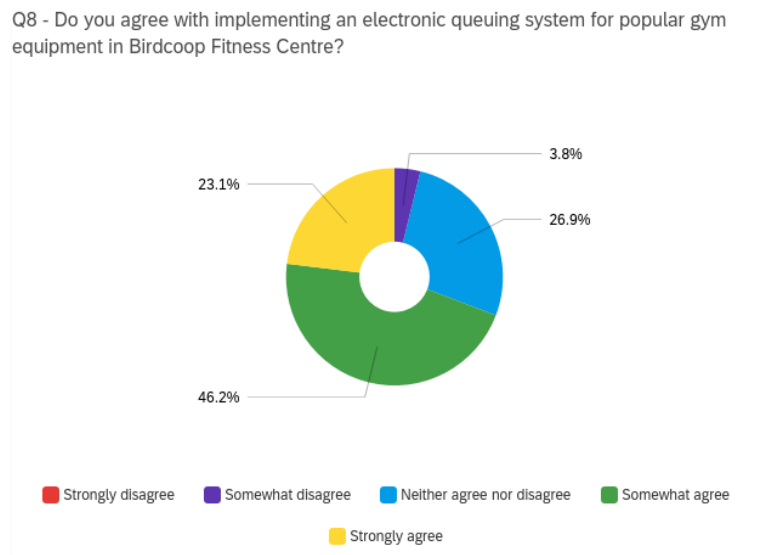


Figure 4. Survey Result on Implementing an Electronic Queuing System

The necessity for an electronic queuing system in the gym is also revealed in the survey conducted with users. As shown in Figure 4., about 70% of the users answered that they either 'strongly agree' or 'somewhat agree' to the question asking whether they agree with implementing an electronic queuing system in Birdcoop Fitness Centre. Only 3.8% of the respondents disagreed with implementing the new waiting system. This indicates that the majority of the users of Birdcoop Fitness Centre experienced a similar inconvenience from the current waiting system and have strong demand for an electronic queuing system in the gym.

F. Installation Plan

1. Card Reader

Fifteen new card readers are required to implement the proposed queuing system to designate one reader for one piece of equipment. The readers are fixed on the wall near the equipment they are designated for. The standard card reader used on the UBC campus iCLASS SE R10 model manufactured by HID. When it is bought from an online website CDW, one piece of the device costs 110 dollars and the delivery is expected to take about one week (cdw.ca, 2022). The physical installation can be done in cooperation with the UBC Facility and Maintenance Department. The department can install standard UBC card readers at request via their website (UBC Building Operation, 2022). Once the date is arranged with the department, the installation of 15 card readers is expected to be done in a one-day operation closing the minimum area of the gym near the wall.

2. Software Development

The system requires a program to manage the queueing for fifteen gym equipment pieces. However, the level of difficulty is quite low as the logic for queueing systems is well-known. From the perspective of a 4th-year student in Computer Science (the proposer himself), about 20 hours of programming by an intermediate programmer would be sufficient to develop a working software for this system. Considering the preliminary research and bug-fix process after installation, the total expected time for the software installation is 5 days which can be done in parallel with the hardware (card reader) installation. In total, the entire renovation will take less than two weeks including a few days of unexpected troubleshooting while installation.

3. Budget

Item	Price per unit	Number of units	Item Price
Card Reader (iCLASS SE R10)	\$182.56/ea.	15 ea.	\$2,738.40
Software Development	\$45.00/hr	20 hr	\$900.00
Total Price			\$3,638.40

Table 2. Budget for Electronic Queuing System

Table 2. shows that the budget for implementing the proposed electronic queuing system is a total of 3618.4 dollars. Assuming that there is no available card reader in the UBC Recreation Centre, a maximum of 2,738 dollars is required to purchase 15 new card readers. The average salary of intermediate software developers in Vancouver is about 43.2 dollars per hour (Job Bank, 2022). The hourly rate was rounded up to 44 dollars per hour to include miscellaneous fees in the hiring process. Based on this number the software development can be done within approximately 900 dollars of budget. To sum up, the entire cost of implementing the proposed electronic queuing system is estimated at 3638.4 dollars.

III. Conclusion

A. Summary of Findings

This study has found that an increasing number of visitors to the UBC Birdcoop Fitness Centre are causing an excessive waiting time for the three popular gym facilities, squat racks, deadlift platforms, and bench press machines. Under the current waiting system, users must stand near the equipment to wait for it while doing so without a clear waiting order among the waiters. The survey and interview results show that this ineffective way of waiting takes about 15% of users' time in the gym solely for waiting and the ambiguity of the current system makes unpleasant troubles among users. Thus, it is vital to introduce a better waiting system in the gym and strong demand for the new system was also found in the same survey of the gym users. The required resources to implement a new system are simpler than expected. The UBC Recreation Centre

needs to pay for two kinds of installation, one for the card readers and the other for the queuing software development. In total, the estimated budget for the whole project is about 3638.4 dollars. As a result of the implementation, the gym users will be able to save up to 15% of their time in the gym by simply putting themselves on the waitlist using their UBC cards and doing other exercises while the equipment becomes available. Also, this solution will prevent unnecessary conflicts between users coming due to unclear orders of waiting from happening.

B. Recommendations

The problem with the current waiting system is worsening the users' experience in the UBC Birdcoop Fitness. Thus, a corresponding action is required to resolve the situation. Digitalization of the waiting system in the gym can effectively solve the current issues with a minimum amount of resources. With less than 3700 dollars and 2 weeks period, the entire implementation can be completed and will permanently increase the users' satisfaction with Birdcoop Fitness Centre. This will eventually lead to boosting the UBC students' health overall. this report highly recommends the UBC Recreation Centre implement an electronic queuing system proposed in the report.

Work Cited

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Appendix A: Survey Questions

- Q1) On average, how many days do you exercise at the UBC Birdcoop Fitness Centre in a week?
- Q2) On average, how much time do you spend in one visit to Birdcoop Fitness Centre?
- Q3) Please select gym equipment that you most frequently use (up to 3 kinds)
- Q4) Have you ever waited for gym equipment in Birdcoop Fitness Centre?
- Q5) (If the response from Q4 is “yes”) On average, how much time do you spend waiting for gym equipment in one visit to Birdcoop Fitness Centre?
- Q6) (If the response from Q4 is “yes”) Please select the gym equipment that you most frequently wait for (up to 3 kinds).
- Q7) Have you ever experienced or watched a conflict caused by waiting for equipment between users of Birdcoop Fitness Centre?
- Q8) Do you agree with implementing an electronic queuing system for popular gym equipment in Birdcoop Fitness Centre?
- Please enter the reason for your answer for Q8

Appendix B: Interview Questions

- Q1) Was there any change in the number of visitors to the gym after the COVID restriction was lifted compared to before?
- Q2) Have you ever witnessed or resolved conflicts between users caused by waiting for gym equipment?