FANtastique Inc.

PROJECT PROPOSAL

For

FANTOM

AIRFLOW OF THE FUTURE

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Executive Summary

FANtastique Inc.'s product, FANTOM, is a desk fan that is capable of automatically tracking individuals in its vicinity and provide cooling constantly by changing its direction to face the individual whether they are stationary or moving. The fan will be fully automated and will have features such as tracking individuals within its perimeter through thermal sensor, providing different levels of cooling intensity based on the user preference, ability to turn off when no one is present inside the room to save energy, and an accompanying app that will provide the user with more control of the fan and its custom features.

The fan grating will house an infrared camera that will take snapshots of the space in front of it at regular intervals. These snapshots will be sent to a microprocessor unit (MCU) that is placed in the base mounting structure. The MCU will process these snapshots and attempt to locate people in its vicinity. If it finds a person, it will rotate and point at the person automatically. The fan's rotation will be realized through a stepper motor that will receive control signals from the MCU. The MCU will be able to give the motor a precise angle through which it will turn. The blade motor will be a DC motor that can be linearly controlled by the MCU (i.e. it can increase or decrease speed smoothly, as opposed to discrete steps as with most desk fans).

We at FANtastique Inc. believe that our fan product will provide an affordable and environmentally conscious alternative in the fan industry with a low power consumption compared to other fan products. The information presented in this document will describe the background and scope of the project, as well as the risks and benefits of the project, as well as the market analysis of the air conditioning/cooling industry. It will also discuss the finances related to the project as possible funding sources. Lastly, it will detail the scheduling of the project with regards to the Proof of Concept and give a high level overview of the scheduling with regards to the Final Prototype.

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Glossary

Name	Description
PoC	Proof-of-Concept

Table 1. Glossary

1. Introduction

1.1 Background

The effect of global warming on our planet has grown to be an issue that has many people concerned and looking to reduce their carbon footprint. Many cooling and air conditioning systems that are commercially available consume a considerable amount of energy. This problem is amplified in places where the climate tends to be both hotter and drier throughout most of the year. In addition, most of the cooling systems require physical user interaction and input in order to perform basic functions such as turning on or changing the

intensity, which often leads to people leaving their systems turned on throughout the day out of convenience which results in a lot of energy consumption . All of these functions can be automated however, through the use of sensors where the device will only operate if a person or multiple people are present in a room. Through implementation of the fan automation, we create a cooling system that elevates user experience by requiring less user input for the fan to operate and also at the same time presents a modern, environmentally friendly and energy efficient alternative in todays fan industry.

We at FANtastique Inc. believe that our tracking fan (referred to as the device from here on) can be the next step in improving the cooling systems in the industry. Our device is an automated fan that is capable of turning on/off by sensing people's presence within its perimeter or in a room where it is installed. As the individual moves around in between rooms the fan in the room where the person is not present will turn off, and the fan where the person just entered will turn on. This feature is implemented to optimize energy consumption, and prevent fans from wasting power when cooling in a room is not needed. In addition, the fan will also be able to track the person in the room and rotate to provide constant cooling without the user manually changing its direction as they move in the room. Accompanying the fan is an app that can provide the user the ability to control the fan wirelessly, as well as change modes or intensities. Through the app, the user can control the speed of the fan, or its position, or simply turn it on and off.

2. Product Overview

2.1 Scope

This document will be detailing the project scheduling, finances, risks and market analysis of our project. The goal of our project is to design an affordable and environmentally friendly cooling system that not only provides more functionality in terms of its automation and customization features for the user but also will be efficient when it comes to energy consumption. For our product we are utilizing an infrared sensor, that is attached on our

device, to detect the presence of a person, and also using DC motor and stepper motor for powering our device and rotating it around 360 degrees for full detection of the surrounding. The sustainability of the product will be considered throughout the design process and safety features applicable to each system will be outlined. This document will not be going over the more advanced features that may be implemented in the future, nor will it explain the technology or the methodology that will be used to implement these said features.

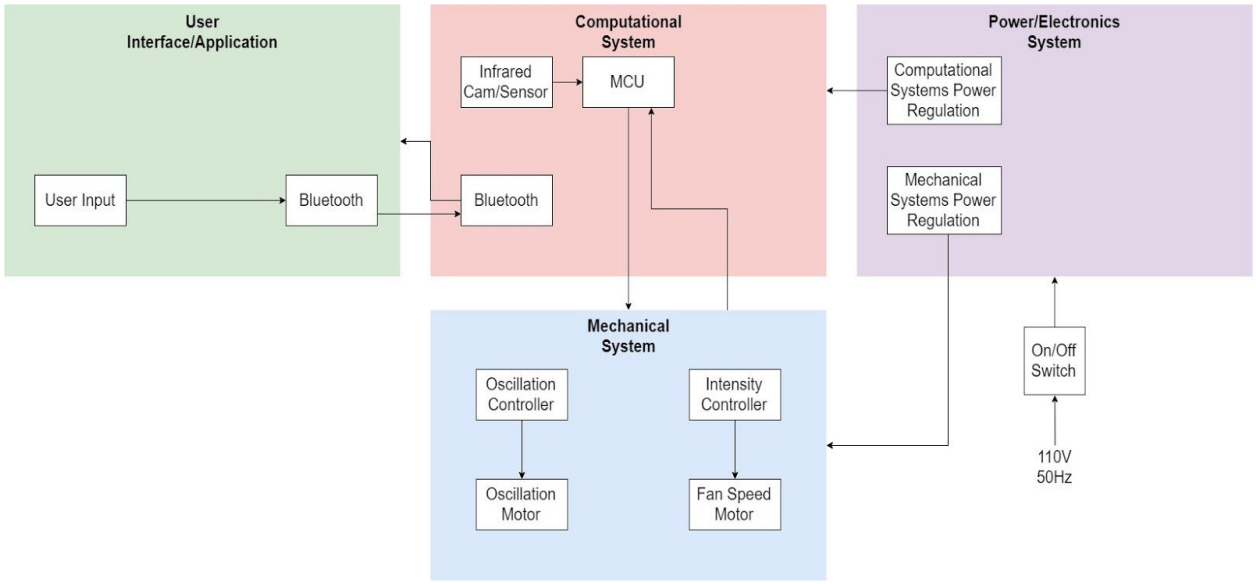

Figure 1. Overview of the system and its subsystems

3. Product Justification

3.1 Risks

The device does not pose any significant risks to neither the designers, nor the end users. All its components are low power, and power from a wall outlet will immediately be converted to 12V in the power supply. As such, any risks of electrocution are mitigated. The primary risks associated with our product largely stem from daily use of the device, and will be discussed as follows:

3.1.1 General Usage Risks

The device is largely designed to be used in a small to medium sized house which has walls that are within the range of detection of the sensor. Usage outside of these parameters, such as in a large house or in an office, could result in unreliable behaviour of the device. This is a concern that will be addressed through an algorithm in the final prototype.

Conversely, it is also designed to be used in an area that has adequate space for the fan to be able to oscillate in 360. Obstruction of the fan can cause the motor to strain excessively to turn the fan, which could result in damage to the motor. This is mitigated in the PoC through an algorithm that will detect when the fan's angle has not changed over a period of time, despite control signals being issued to it. The algorithm will then stop the fan from turning any longer.

Lastly, both the PoC and the Final Prototype will feature a maximum blade rotation speed that is greater than 1500 RPM. The Final Prototype's speed has yet to be decided, but the PoC's speed will be capped at 2400 RPM due to it's smaller size. The speed of these fans during rotation could pose a hazard to users who place their appendages inside the fan. However, the fan blades will be covered with a grating that will prevent immediate access to the blades. For the Final Prototype, we are working on developing an interlock that prevents the fan from turning on or operating while the grating has been taken off.

3.1.2 Construction/Assembly Risks

For our PoC, the biggest risk is posed during assembly of the base mounting structure. This requires access and usage of hand and power tools such as a drill, saw, screw drivers, and wood. To mitigate these risks, only personnel who are qualified to use these tools will be involved in the construction process. Furthermore, construction will take place in the appropriate environment, i.e. the SFU workshop. All tools will be inspected prior to use and tools that show signs of degradation will not be used.

Another risk is that of potential electric shocks when trying working to integrate the power supply with the rest of the electronics and hardware. Any form of electrocution will not be fatal, due to the fact that only 12V and 2A will be running through the hardware at most. Insulative equipment will be worn when assembling the hardware to prevent electrocutions, which will also have the added benefit of protecting the hardware components from static shock damage. Additionally, given that the circuitry will be constructed on a breadboard, there is the risk of forming a short circuit that could potentially damage the hardware components. To mitigate this risk, all exposed leads will be eliminated where possible, or kept to a minimum.

3.2 Benefits

The design and the goal behind our fan device is to deliver a cooling system that adds a new and innovative changes to the already existing cooling systems in the market, and through that create new features that become industry standards for a variety of cooling systems.

The FANTOM device is accompanied by an app that provides a user interface and customizable features that enhances the user experience with the fan. Some of these features include the ability to control the intensity of airflow, or being able to turn the fan on/off remotely.

One of the strong benefits of the FANTOM is that it is designed to be a fully automated device that can turn on/off without any user input and operates by detecting individuals within its perimeter and rotating toward their direction to provide cooling. This feature will allow the person within the environment where the fan is located to receive cooling immediately once detected by the sensor. This is not only true when the person is stationary in the vicinity of the fan, but also when the person is moving around within the range of the sensor as well, which is done by fan's tracking ability. Furthermore, the fan is capable of changing its intensity of blowing wind through the user customization. If one person enjoys

a more rapid flow of wind from the fan they can customize and control the flow intensity of the fan through the companion app.

Aside from the automation features, FANTOM is designed to be an energy efficient device. FANTOM has a low power consumption, and additionally it automatically turns off when no individual is present in a room; thus saving a lot of energy that otherwise could have been wasted in case if the user forgets to turn the cooling system off. Overall, FANTOM is designed to be an environmentally friendly device and a replacement for cooling systems that are detrimental to the environment and contribute greatly to the global warming. This is even more true in the case of arid and high temperature countries where cooling systems are less environmentally friendly and have high power consumption. In these instances, FANTOM can be an effective solution as a cooling system, since is both low on power consumption and environmentally friendly as a whole.

Through development of FANTOM, one of the goals that our team had in mind was to create a cooling system that is affordable compared to other cooling systems in today's industry. In today's market, many high end cooling systems could cost the customers thousands of dollars, and with that in mind our aim was to create a cooling system that is far more affordable compared to the high end cooling systems that exists in the market and also at the same time introduce innovative and modern features that would make our cooling system practical and convenient to use for customers. Building an affordable cooling system is a goal that we keep mind through the process of building the FANTOM device.

3.3 Market Analysis

The market analysis takes into fact the ongoing trend of the global climate on Earth. The average temperature has risen by approximately 0.9 degrees Celsius (or 1.62 degrees Fahrenheit) since the late 19th century. This also happens to be around the time that early forms of industrialization were beginning to take shape. An excess amount of carbon dioxides and other human created emissions began pouring into the atmosphere. It is a

general understanding that the planet has been slowly becoming warmer over the past few decades as a result of such industrialization and expansion of metropolitan areas all over the world. While the mentioned figures seems negligible, it is enough for some areas of the globe to be experiencing a major change in the seasons such as longer dry periods, more frequent storms and rising sea levels.

There really isn't a single place on Earth that has not seen their temperatures rise. A natural consequence of such a phenomena is that humans want to stay cool and comfortable by using devices such as fans and air conditioning. Such appliances are already a common sight in many households and commercial spaces, but the advancement of technology is leading to a new generation of these products that are able to reduce their overall energy consumption while increasing their efficiency and usage. Dubbed "smart cooling solutions", it is projected that by the year 2022, these products will account of $137.548 trillion in revenue on the market. Between the years 2016 and 2022, the Compound Annual Growth Rate (or CAGR) will increase by an astounding 52.4%. These figures don't just encompass fans and air conditioners exclusively, but also smart refrigerators and other similar appliances.

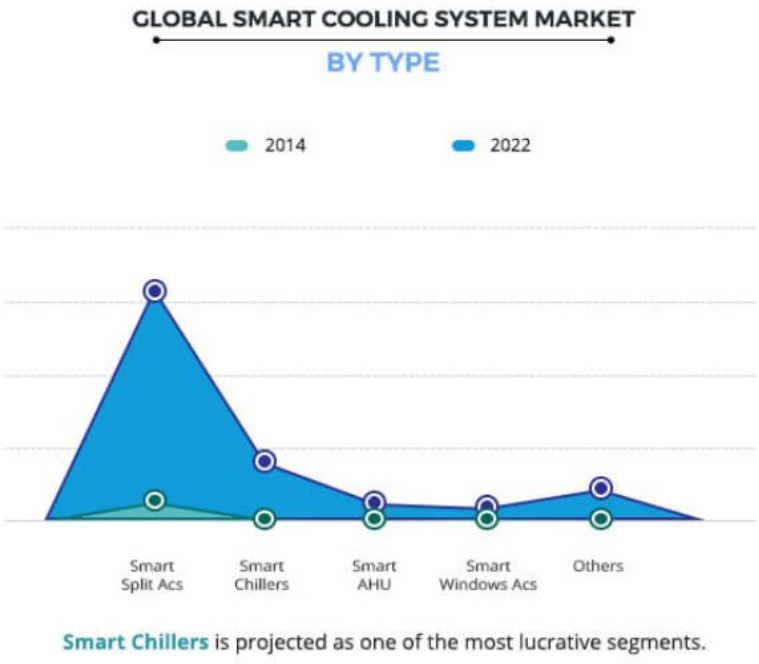

Figure 2. Projected Market demand for smart cooling systems

From the figure above, we can see that the market for smart cooling systems is divided into several categories. It makes sense that the demand for all types will increase over the next few years given the progression of our climate. Additionally, other factors such as population and geography would contribute to a local area. In the figure below, we can see that the market is split into different regions, with the Asia-Pacific regions projected to have the highest growth in CAGR between 2016 and 2022. This makes sense when taking into account the population and geography as previously mentioned that this region of the world is not only the most populous but also the harshest with extremely humid weather.

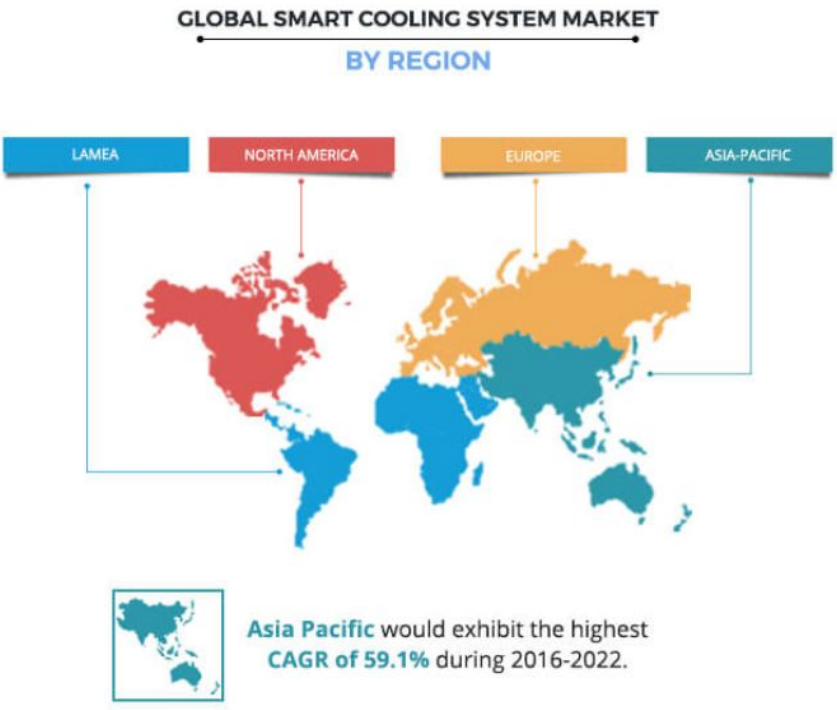

Figure 3. Markets for smart cooling systems by region

The trends and predictions mentioned will be supplemented by the contributions of major companies that have already proven to be a key market player. These include technology giants such as Samsung Electronics Co. Ltd. and LG Electronics Ltd. to more mainstream commercial appliance firms like Mitsubishi Electric Corporation and Fujitsu General Ltd. As time moves forward and the cost to research, manufacture and distribute these products

decreases, the increase in affordability means that more consumers will be able to get their hands on these items.

3.4 Competition

Competition is a tricky topic to deal with. At FANtastique, we want to make our product, the FANTOM, accessible to as many people as possible. In order to achieve this, we want to be able to offer it at an affordable price point while providing the most essential smart functions the consumers expect from higher end, more elaborate choices.

We can split our competition into two groups; non-smart and smart devices. The non-smart group will encompass products that are not controllable by an application or use sensors to regular their operation. Such products include the generic fans that are available to purchase in most stores today, as well as many air conditioning units. These units are not very efficient in terms of minimizing the consumption of energy as they typically are kept on at one setting throughout the entirety of the day. Even worse is that people tend to leave such systems running, even when there is nobody in the vicinity. This is where the FANTOM outclasses the competition in that it does incorporate an array of sensors and custom hardware to regulate its airflow. The direct result of this is smart use of energy and more applicability to spaces with a wide range of foot traffic. The one downside is that because of the added technology to make FANTOM smart, the cost is naturally higher than generic fans and standard air conditioners.

Shifting our focus to smart devices, we believe that the price point of the FANTOM is what will be the major deciding factor for consumers. Most smart cooling systems are still in their infancy, implementing basic features such as temperature regulation but commanding a high cost of entry to have the privilege of owning such devices. It also does not help that most of these higher end systems are developed by major corporations such as Dyson, Samsung and LG whose brand name drives up the retail cost. For some people, this is not of concern as the

name suggests a proven and reliable device, but for many others, the cost of an inadmissible factor.

Sliding in between these two groups will be the FANTOM. More advanced then basic generic cooling solutions but also more affordable than the big box systems, the FANTOM will bridge the gap with a new, greener choice in the market space.

4. Finances

As part of the making our idea to a functioning prototype we have to raise money to build our prototype. There are a lot of off the shelf parts we can use which make the process of initial development easier, but they are also more expensive than their production grade counterparts. This is mainly due to the low quantity of parts we need for the prototype, and they are more general purpose. The price of our product will be lower in general production than the price of the parts listed below.

4.1 Cost Analysis

The cost of the fan can be broken down into components listed in the table below:

Name	Unit Price	Quantity	Sub-Total
Arduino	$52.07	1	$52.07
Step Motor +driver	$30.57	1	$30.57
Fan	$20.99	1	$20.99
Power Supply	$15.99	1	$15.99
Sensor	$101.23	1	$101.23
MOSFETs	$1.10	1	$1.10
Structural and Electrical Component	$10.00	1	$10.00

Total	**$231.95**

Table 2. List of Materials and Costs

All the pricing listed above includes sales taxes. Also, the parts listed above are ones that are used in the Proof of Concept device of our product.

4.2 Funding

In order to gather fund for our project, we looked into all the possible methods available to us. At the end we decided our main sources of money is going to the Wighton Engineering Development Fund and The Engineering Science Student Endowment Fund. We chose these because historically they have funded many capstone project and our project is a good fit for their application criteria.

The Wighton Engineering Development Fund focuses on providing financial support to projects that benefiting society. In the cause of our product, it helps saving electricity while providing optimal comfort for the people who are going to be using it.

The Engineering Science Student Endowment Fund focuses on providing equipment for the student body to learn and experiment. After we finish building the proof of concept/ prototype, most of the parts we used can be recycled to the ESSS parts library for future projects. This reduces the cost for funding other capstone groups in the future.

The alternative method if we do not get enough funding from the this two method is to pay for the required parts ourselves which average to less $50 per person. This can only be achieved because of our commitment for making the FANTOM as affordable as possible.

5. Project Scheduling

5.1 Gantt Chart

Figure 4, below, demonstrates the Gantt Chart that visualises the scheduling of the project for ENSC 405 (May - August). Scheduling includes meetings, milestones and timeline for particular aspects of the project.

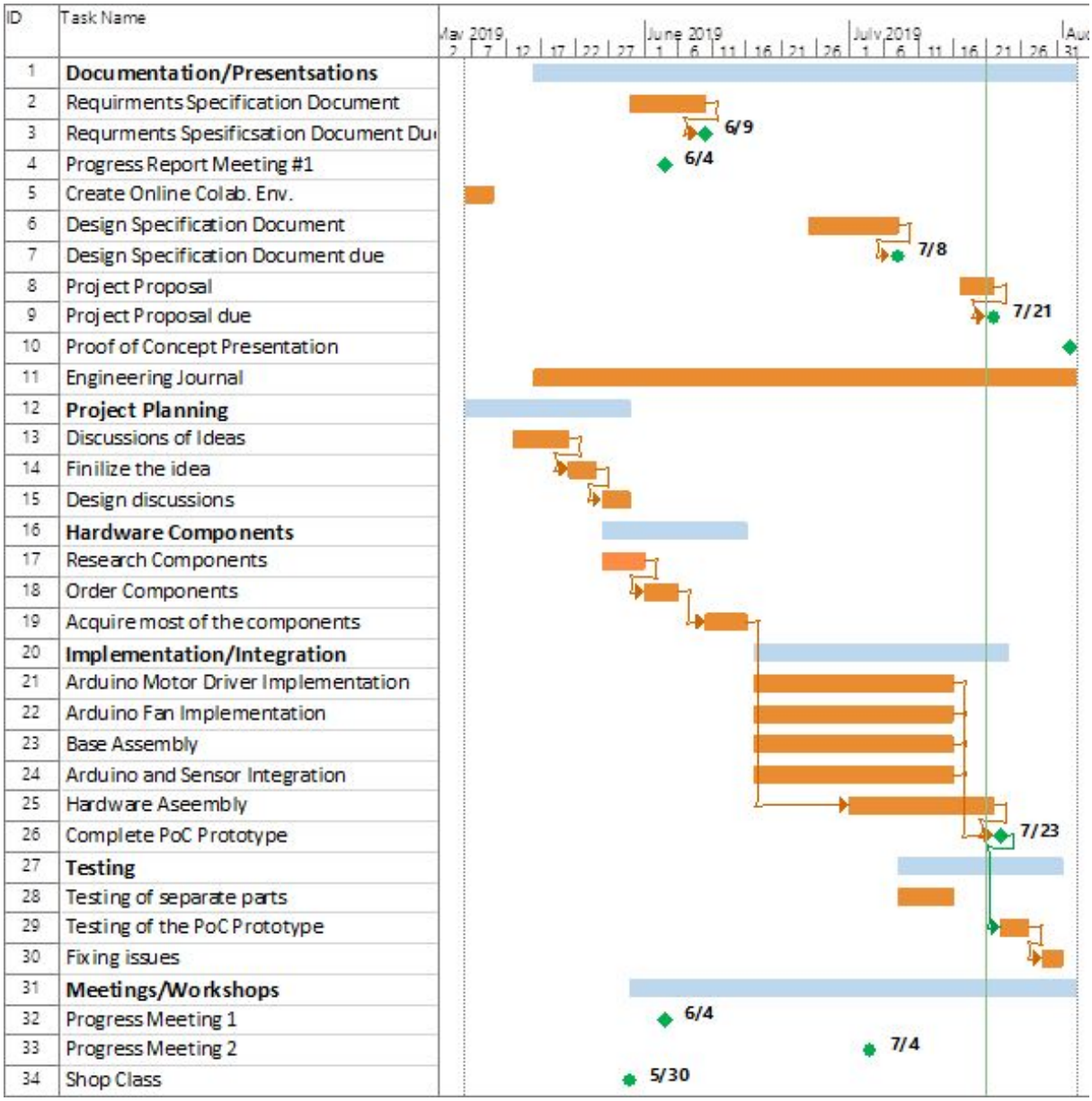

Figure 4. Gantt Chart

6. Company Overview

Behind the innovative doors of FANtastique is a group of inspiring, young engineers who dream of using their knowledge to contribute positively to the world. Each member is very well aware of the harm that humans are causing to the Earth, which happens to be our only home. With this in mind, the people at FANtastique share the ideology to reduce our energy impact on the globe. Each person has a story to tell and ideas to share. We are committed to making sure that every blade of every fan that we produce meets the expectations of our customers for years to come.

6.1 The Team

Karina Kartanovich: CEO

Karina Khartanovich is a fifth year Systems Engineering student at Simon Fraser University. Her expertise includes system design, some aspects of biomedical engineering along with electrical design. Having completed three terms of Co-Op, Karina has experience working in a team as well as completing tasks individually. Karina has strong leadership skills and she loves working with people. In her free time you can find her hiking, dancing or snowboarding. .

Jehaan Jacob Joseph: CCO

Jehaan is a sixth year Systems Engineering student at Simon Fraser University. He has expertise in mechanical, electronic and digital systems. He has previously held coop positions at CIBC and Dynamic Attractions Ltd., as a QA Analyst and a Front End Prototyper Tester respectively. In his spare time, Jehaan enjoys reading, cooking and saving the environment.

Ardavan Mohseni-Javid: CFO

Ardavan is a sixth year Electronics Engineering student at Simon Fraser University with an interest in electronics and researching and reading about fuel cell technologies. He strives to

keep the cost of the project down by looking for affordable tools and devices needed for the project and help the development of the project in a cost effective manner.

Shafin Rehman: CTO

Shafin is a Systems Engineering student currently at the end of his sixth year at Simon Fraser University. He loves being hands on and strives to be a contributing member of his team, of which he holds to the utmost respect. He is currently also doing an internship as a Project Engineer at Seaspan. Some of his hobbies include hiking, camping, boating, working on his own car, travelling and learning new things. Chances are, if nobody has seen him in a while, he has probably left the city in search of adventure and will return when he misses his bed.

Roy Zhao: CIO

Roy is a Computer Engineering student currently at the end of his sixth year at Simon Fraser University. He enjoys solving problems related to programming strives to improve this coding skills. He always like to search out quality parts and tools to solve the problem at hand, though sometimes they are more expensive than the funding permits.

7. Conclusion

We at FANtastique Inc. believe that FANTOM will be a groundbreaking product when it comes to fan and air conditioning systems in the market. With its affordable and low cost compared to other cooling systems in today's market and its energy efficient and environmentally friendly focus, FANTOM can be a great choice for many customers that are looking for new cooling systems for their homes or their offices; even more today as the awareness for global warming and the presence of carbon footprints in the industry is rising. In addition, our goal is to deliver a product that will provide a convenient cooling system for the users, and it was this objective that motivated us to make FANTOM fully automated and customizable for the users, such as being able to target the user and blow wind in the direction of the user automatically without any user input or turning off automatically when

no user is present in the room to preserve energy. We believe that our device has the edge and uniqueness to make an impact on the cooling market and become a viable product.

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