KAEFI

September 21, 2011

Dr. Andrew Rawicz
School of Engineering Science
Simon Fraser University
Burnaby, BC
V5A 1S6

Re: ENSC 440 Project Proposal for an Office Automated Delivery Robot

Dear Dr. Rawicz,

Five enthusiastic and passionate engineers from KAEFI (Kanada Engineering Firm) are devoted to develop a secure office delivery robot which is cost effective and intuitive. In busy office environment where time is money, our automation robot will serve employees to offer better work efficiency.

In this proposal, we include informative contents; system overview, existing design solutions, proposed design solutions, sources of information, overall budget, funding, project mile-stone, team organization, and executive profile.

KAEFI is composed of five senior engineering students with experiences through numerous coops in industry and research project. We strongly believe that our product will not only be educational but competitive and beneficial. We are Gyu Han David Choi (CEO), Jin Sun Ahn (CTO), Hongbae Sam Park (CFO), Kyu Seo Lee (CMO), and Yongho Choi (COO). Should you have any question about our robot, attached proposal, or KAEFI, please contact us by email at kaefi-support@sfu.ca.

Sincerely,

Gyu Han David Choi

KAEFI, Chief Executive Officer

Project Proposal

For An Office Automated Delivery Robot

Dr. Andrew Rawicz – ENSC 440
Mr. Mike Sjoerdsma – ENSC 305

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Executive Summary

We live in a world of efficiency; where vast advances have been made in various fields to increase the speed of just about anything and decrease the downtime of any automated machine. Higher efficiency not only works for environmentalists, it also means a lot on many firms' behalf.

Time managing is an effective way to increase efficiency. Thanks to rapidly changing modern economy, time has become synonymous to money. Companies do as much on their part to "capitalize" on time; their production lines roll out products at a faster-than-ever rate to generate more revenue for a given period of time. They prefer workers with higher education and more training, because those workers tend to have better productivity which in turn boosts company efficiency. However, it's not just about working harder and working longer hours any more. Unlike traditional workers, today's workers are protected against over-labour so well from human rights laws that companies now tend to focus on time management rather than just assigning workers with more workers and preventing them from going home.

Our robot encourages workers use their work hours more efficiently. It helps workers focus on their works by processing unnecessary works such as delivery for them. It also facilitates exchange of office materials such as prototypes and classified materials between departments. Our robot is like a background process in operating systems; it handles its job silently but effectively that its users – primarily the office workers- can go on about doing their works without having to leave their stations and lose focus. The potential that this robot is capable of are not limited to just within office space delivering documents and mails. It could be also used to deliver specimens and supplies at hospitals and also act as a way-finding aid in building complexes.

The total cost of all product development stages is estimated at $720. We have applied for funding of the proposed project, and of the $720, $500 is receivable from ESSEF. The rest of the budget and any unforeseen spending will be covered and divided evenly between the KAEFI members. If patent is pursued in the future, the legal and other costs of applying patent will be also covered by the KAEFI team, either entirely or with the aid from SFU's patent board.

Our research shows there are no direct competitors in the market at this point. However there are robots that offer similar functionality in hospitals that uses other methods of way-finding. One example would be the TUG robot commissioned by Aethon Corporation. The biggest advantages over any of the currently commercialized robots would be the cost and the simplicity of design.

The helm at KAEFI is firmly handled by a team of five very motivated and brilliant engineering prospects. We have known each other for many years and develop close bonds between each other. Our combined skills span microelectronics, analogue and digital circuit design, IC fabrication, micro-fabrication, computer language programming, wireless communications, and CAD.

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Introduction

Companies strive to raise efficiency of its operations and save time to cut expenditures and increase profitability. Our solution tackles just that, to increase office efficiency. It can be applied to any medium to large sized offices (10 workers or more), and can aid in increasing worker productivity by relieving workers of certain avoidable tasks such as delivering documents from department to department, thus employees can focus on their tasks without having to leave their stations. The robot can be considered as a public secretary who can "run errands" for every workers.

Our robot can not only deliver objects from point A to point B, it does it smart and securely. Users can request a delivery in a first come first serve basis; requests will be queued and processed by the central server. It can run for nine hours continuously, nine hours because most offices are open between 9 am to 5 pm, and on top, 2 hours as a safe margin for its operations. It is also capable of self-charging, so if the battery performance falls below certain critical level, the robot will automatically find a charging station to charge itself. The charging time would really depend on the type of battery used and charging method, but we would expect 6 to 12 hours if an automotive deep cycle battery is used. The recharging time will not be a critical pullback on the robot's performance as long as it is kept under 12 hours, because the robot has all the time in the world to replenish its battery while office is closed during the night. Of course, customers can spend little more on bigger and better batteries if they opt for longer operation time and faster recharging time. The physical space of the battery compartment within the robot and the customers' budget would be the only constraints in this case.

System Overview

Our system can be integrated into the wireless network infrastructure which already exists within an office space. The server can be simply migrated onto the existing server, or separate network dedicated for secure office automation system can be installed. The basic idea of communication is shown in Figure 1.

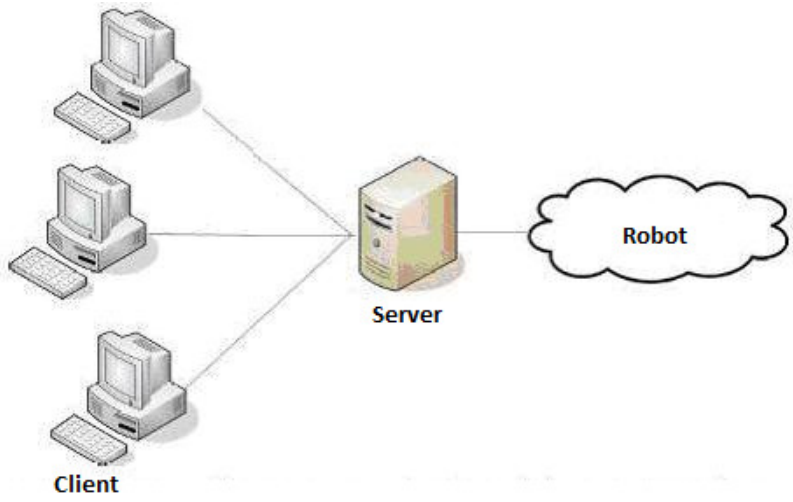

Figure 1 : Server Client Communication with Robot

From the clients, the delivery request information is sent to the server. Then, from the server, all the queries are set and sent to the robot to compute the efficient distance for pickup and delivery. When the robot receives the inquiries, it sends the status of the robot including its current location and the status of packages being delivered. With the data received from the robot, the main server sends the status back to the client as shown in Figure 2.

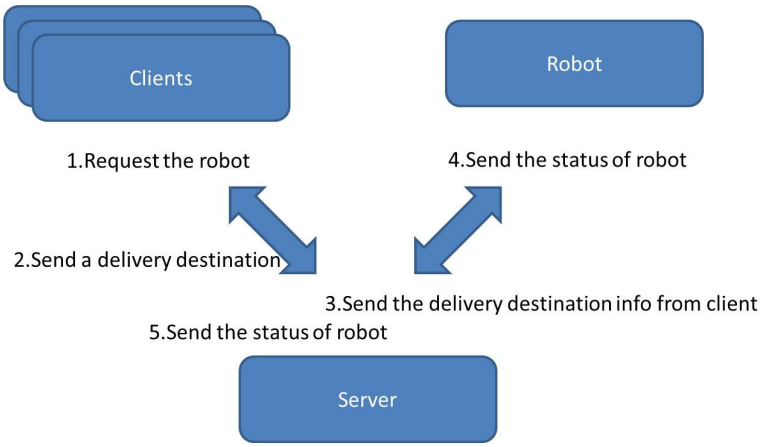

Figure 2 : System Communication Diagram

Design Solutions

Existing Design Solutions

KIVA Systems

One of the commercialized and successful delivery robots is built by KIVA Systems. They build autonomous mobile robot and sophisticated control software for certain spaces such as warehouse and factory. Their robot is used to carry and deliver heavy materials within certain spaces. Without using remote controller, their robot's movement is automated. They use motion tracking technique with barcode and barcode scanner. The only downside to their robot is that they use large maps of barcodes on the ground to move their robot around spaces and it will ends up getting more installation fees. The main usage of this product is to store and retrieve items efficiently in the warehouse.

Fujitsu

Fujitsu Frontech Limited and Fujitsu Laboratories Ltd developed service robot called 'Enon' in 2005. Enon can assist in tasks such as providing guidance, escorting visitors, transporting objects, and security patrolling. However, Fujitsu announced to sell limited quantity in 2005. Fujitsu once again developed another office delivery robot with Yokohama National University and the University of Electro-Communications in 2009. However, the robot didn't pass the next phase of funding, and Fujitsu has no plans to commercialize it.

Proposed Design Solution

Our proposed solution would be *Secured Office Automated Delivery Robot.* This would be suitable to the objective of the problem we are facing. This product will reduce unnecessary movements of the employees during working hours and is beneficial to efficient time management. Most of the existing design solutions consider more about lifting heavy loads on warehouse or serving beverages to people in small office-space. However, our solution with *Secured Office Automated Delivery Robot* will be applicable to an office and/or a warehouse.

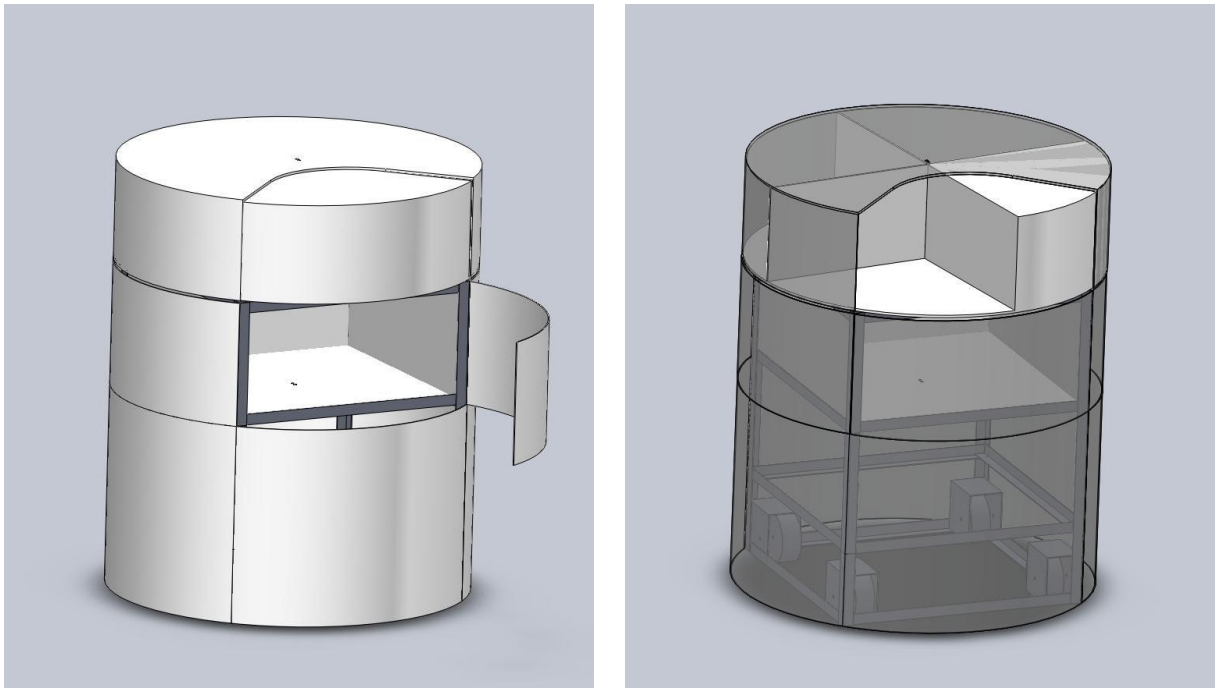

Figure 3 : Conceptual Design of the robot

To minimize time consumption on implementing and integrating each part, this product will be integrated with a portable computer such as a laptop to simplify the functional implementation of the system. With the laptop mounted on the robot, the server and the robot functionality can be combined. For tracing the movement and the location, QR code technology is used. With the information scanned from the QR barcode, the robot computes the distance that needs to reach the destination. Then, the computed data is passed onto the motor through the microcontroller to make a physical movement of the robot.

Most of the constraints that would be considered are mainly the motor implementation. Motor needs to be precise and accurate so that the robot does not run off the designated or computed route. This would be the primary concentration to be manipulated. Other than the motor implementation, the battery life or re-charging point of the robot would be another constraint we may need to resolve in the future.

Sources of Information

Researchers and developers from KAEFI will collect sufficient amount of information to create secure office automation robot. Sources can be gathered from educational institutions and manufacture customer supports of the electronic components used in our project.

For general guide lines of the overall project, Dr. Andrew Rawicz has showed our team with interest and is willing to advise us throughout the development stages. On technical side of the project, we would like to get feedback from professors in the university. Component specific issues may be dealt with the part manufacturer directly. Along with offline sources, we will also excavate trustworthy information from internet as needed.

Budget and Funding

Budget

Table 1 shows an estimated cost of our robot at the early stage. Since the robot is still in the design stage, the actual budget may vary at the end of development cycle. All prices exclude taxes and shipping costs, but over-estimated by at least 15% for contingency.

Equipment List	Estimated Cost
Webcam – Logitech C260	$40
Micro-controller – MICROCHIP dsPIC33FJ64MC802	$25 * 2 = $50
Proximity Sensor	$20
Banebots FIRST CIM 12V 5280RPM Brushed DC Motor	$30 * 2 = $60
Wheels	$60
Gears	$40
Polycarbonate board	$50
Plywood	$50
Aluminum Frame	$150
Battery, bolts, nuts, etc…	$200
Approximated Total Cost	**$720**

Table 1 : Estimated Budget for Prototype Robot

Funding

We have applied for funding offered by Engineering Science Student Endowment Fund (ESSEF) and we will be receiving $500 from ESSEF. But we must provide the ESSS with a cheque in amount of $250 which will be returned to us after we donate valuable components to ESSS.

Since amount we will be receiving from ESSEF is not enough for our project, we will apply for financial assistance from the Weighton Engineering Development Fund.

In the event that our financial resources fall short to the demands of the project, we are willing to share the extraneous costs equally among the group members. All receipts, invoices, and an accurate account of funds spent will be kept to ensure proper reimbursement and distribution of costs.

Ultimate goal of the project is to design the robot at a minimal cost, so that our robot is affordable and can appeal to the market.

Schedule

Gantt chart

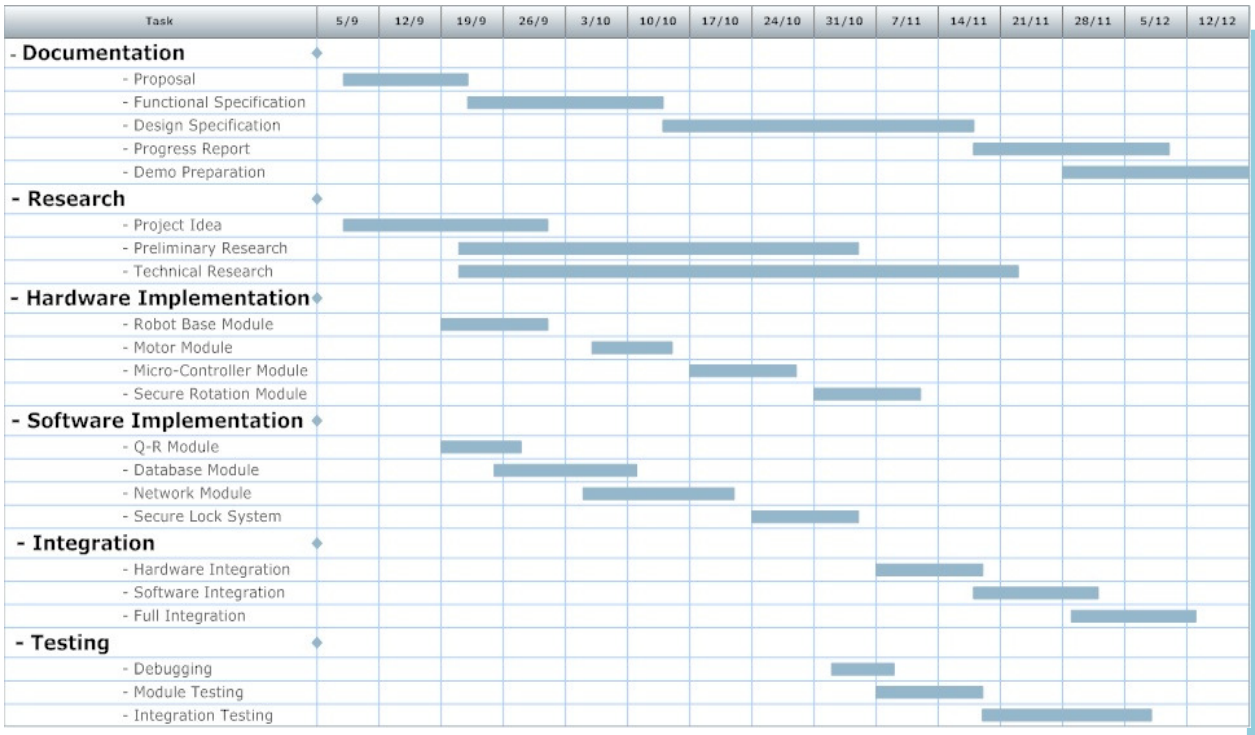

Figure 4 : Gantt Chart of expected date

Figure 4 and 5 (on next page) illustrate the proposed project Gantt chart based on each required assignment. The duration of the project is approximately 4 months, but unexpected issues may cause delay. We hope that the presence of project time guideline will create scheduled environment for the project to progress in an organized fashion. The final objective of the project is having a fully functional prototype.

Milestone chart

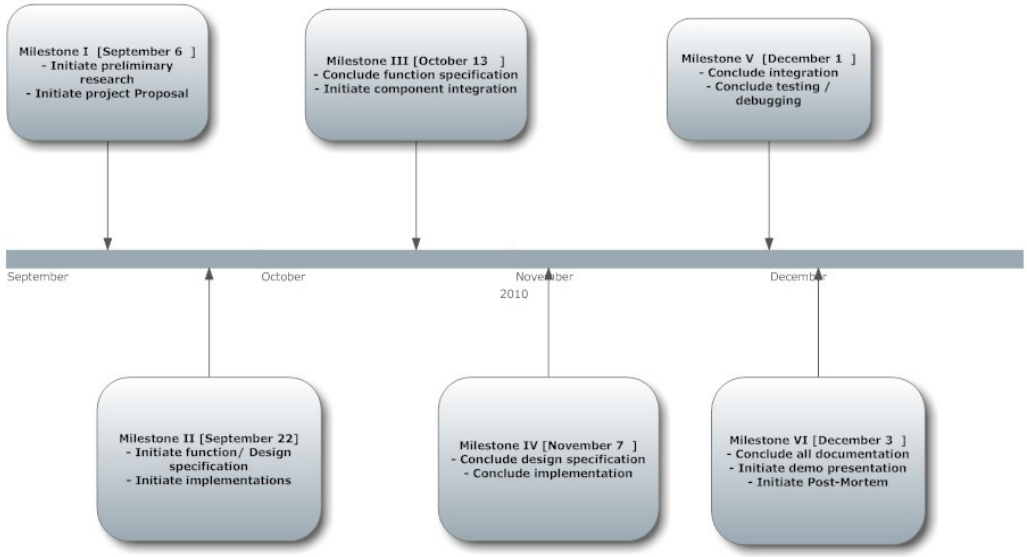

Figure 5 : Milestone Chart

About Us

About Company

KAEFI (Kanada Engineering Firm Inc.) consists of five intelligent and motivated engineering students; a collective of young and collaborative Korean-Canadian students who are ambitious and willing to overcome any challenges to accomplish this project successfully. With confidence in each one of us and strong urge for creating an innovative technology, we are proud of our first marketable product and establishment of our company, KAEFI.

Since this project involves wide variety of tasks within such a short time frame, each team member will be evenly assigned with specific tasks for a fair work distribution. We realize that the team members need to be united, need to focus and familiarize themselves with every bit of details of the overall project, to meet the deadline and achieve our goal.

Team Organization

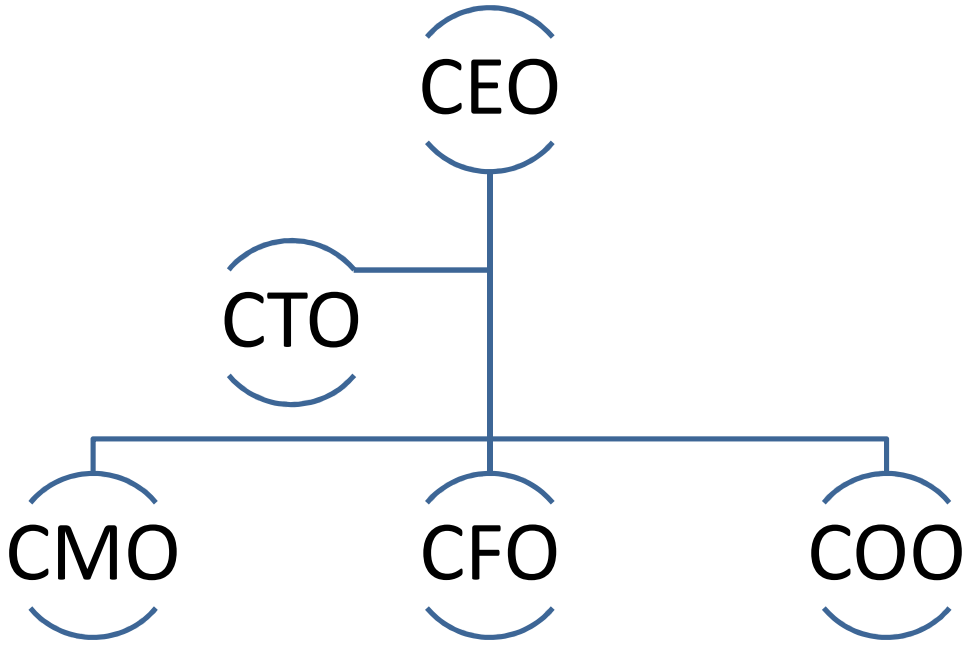

Figure 6 : Company Organization Chart

The KAEFI members have already gone through many difficult projects and known each other for a long time that we have formed a close bond between us. However, it is important to treat one another in a respectful manner and motivate each other to complete this project. Our KAEFI Chief Executive Officer, Gyu Han David Choi, is in charge of professional management of the company and will make sure that all group members are well informed and support team members to finish their tasks on time. Jin Sun Ahn, Chief Technical Officer and Yong Ho Choi, Chief Operation Officer will be in charge of technical and operational issues of the project. Since the project requires a smooth interaction between team members, they will also sustain clear communication during activities such as integration, discussion, and feedback. Hong Bae Park, Chief Financial Officer and Kyu Seo Lee, Chief Marketing Officer, are responsible for managing funds from external/internal sources and to up to date budgets. Furthermore, they concentrate on the analysis of product's potential in the market. Together, we are responsible of providing efficient, productive, and secure office automation robot for the future market.

Company Policy

In order to communicate well, KAEFI have decided to have small presentation in our weekly meetings, so that we can discuss our technical issues and give suggestions to any issues. We have created a Facebook "CAPSTONE PROJECT" group forum to discuss our updates and problems, and applied repository system to check out the final revision of the source code and update our team members simultaneously.

Executive Profile

Chief Executive Officer – Gyu Han David Choi

Gyu Han David Choi is into fourth year in Simon Fraser University's Electronics Engineering program. He has gained valuable experience as a software test associate and an embedded software developer at Research In Motion. Combined with strong communication skills and enthusiasm toward this project, he will take a role as Chief Executive Officer of KAEFI. His previous role of managing a project with technical knowledge will be crucial in decision making within the company. He is experienced in embedded systems and project management.

Chief Technical Officer – Jin Sun Ahn

Jin Sun Ahn is in his last semester of his undergraduate studies for Electronics Engineering in Simon Fraser University. With Jin Sun's major program of the studies, he will succeed as a role of Chief Technical Officer in both software and hardware architecture. His past co-op experience has been completed as an embedded software developer in Research In Motion. In addition, with his experience, he will take an advantage of releasing product prototype before the deadline based on his knowledge of product development cycle. He is experienced in software programming with C/C++ and electronic hardware circuit design.

Chief Financial Officer – Hongbae Sam Park

Hongbae Sam Park is a sixth year student majoring in Systems Engineering. He has wide experiences in computer language programming such as C/C++, JAVA, and VHDL, and also knowledgeable in electronic circuit design and hardware analysis. He also has a useful experience in micro-fabrication. Hongbae Has completed a Co-op in Dr. Albert Leung's laboratory where he was responsible or involved in hardware and software development of a micro-scale gyroscope.

Chief Marketing Officer – Kyu Seo Sam Lee

Kyu Seo Sam Lee is a sixth year Systems Engineering student at Simon Fraser University with 3 of Co-op in Fujitsu Korea. From past courses and co-op, he has experienced valuable skills in variety of fields. Through his previous co-op terms, He has become knowledgeable in programming and also became expert in database analysis. He has a good leadership skills, good teamwork, good communication toward others with a respect, and always enthusiastic toward his given duty. From his various experiences in business, academic activities, and projects that he participated, he has learned to resolve problems from engineering perspective as well as business perspective. He would like to use those skills toward improving KAFEI's product.

Chief Operation Officer – Yongho Choi

Yongho Choi is in his final stages of Systems Engineering Science at Simon Fraser University (SFU). His program has helped him to learn both hardware and software development. Yongho's previous experiences include one research coop term regarding image processing with Professor Glenn Chapman in SFU. He completed two work terms at Broadcom Canada as a member of a Software Support Team. Also, he completed two work terms at Research In Motion as a Software Designer Associate. Hence, he

was able to enrich his C/C++ programming skills through all his experiences. With his work and life experiences, he will be beneficial for KAEFI.

Concluding Remarks

KAEFI is a capable robotics engineering company. At KAEFI, our chief commitment is to provide solutions that not only meets specifications required by customers but also could exceed their expectations, and our team will diligently work and sweat to meet the prime objective. We also make a commitment to minimize any environmental impacts that may ensue any of the projects that are commissioned by KAEFI and our customers. The information provided in this proposal, such as technical and financial break-down of the project, exhibits that KAEFI has a firm goal to achieve. The estimated timeline is provided in the Gantt chart.

Our robot is inexpensive, simple yet capable of providing the same complexity and functionality as some of the other commercialized robots, and also easy to use. The endpoint of the project is to produce a working model that has a full functionality as proposed in the proposal and also able to demonstrate the functionalities.

Our future roadmap includes continuous and further development to perfect the solution, and while doing so, we would also like to apply for a patent. KAEFI has great energy and momentum to bring the project into reality. We are proud of our team, and with such a passionate team, we will succeed.

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