Simon Fraser University
School of Engineering Science | Burnaby, BC | V5A 1S6

January 19, 2009

Dr. Patrick Leung
School of Engineering Science
Simon Fraser University
Burnaby, British Columbia
V5A 1S6

Re: ENSC 440 Project Proposal for CarSim (Motion Sensing Remote Controlled Vehicle)

Dear Dr. Leung:

The attached document, *Proposal for CarSim*, outlines our project for ENSC 440 (Engineering Capstone Project). Our goal is to design and implement a motion sensing remote control vehicle with collision detection, collision notification, and real time video streaming with the use of Bluetooth communication protocol.

The purpose of this proposal is to provide an overview of our proposed products, design considerations, a list of product features, a tentative projected budget and scheduling, team organizations, and company profile. This document also explores the feasibility of revising remote control vehicle's market potential.

Ron KittenBruan Technologies Ltd. consists of five diverse, motivated, innovative, and talented engineering students: Austen Chan, Brian Cheung, Bruce Wong, Rongen Cheng, and Wing Kit Lee. If you have any questions or concerns about our proposal, please feel free to contact me by phone at (778)862-0982 or email me at rongenc@sfu.ca.

Sincerely,

Rongen Cheng,
CEO
Ron KittenBruan Technologies Ltd.

Proposal for CarSim (Motion Sensor Remote Controlled Vehicle)

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Submitted to: Dr. Patrick Leung – ENSC 440
Steve Whitemore – ENSC 305
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Executive Summary

15 years ago, Mike would get off Elementary School and go race with his friends using his newly bought remote cont car. Now, Mike would go home after his ENSC 305 class and play Gran Tourismo 5 on his Playstation 3. The old remote control toy and the new motion sensing racing game both brought tremendous joy, excitement, and satisfaction into Mike's life. What would it be like if the 2 entertainment is combined together?

Motion sensing has become a very popular topic in the last few years, whether it is in the Gaming, Sports, or Educational Industry. Nintendo Wii based its system mainly on its motion controller, and Sony Playstation 3 included a 6-axis motion sensor in its controller. It seems that almost everyone has Wii, PS3, or some other products that have motion sensing features or involved motion sensing in its development phase.

Back in the 90s, remote control vehicles were once a very popular toy; not just for kids, but for teenagers and adults as well. However, the attractiveness of control cars have deterred significantly in the last decade. This downturn is due partly to the emergence of other high-tech toys/devices, but more importantly, because of the lack of innovative ways on how to control the vehicles. New remote control vehicles and those that were built 20 years ago have similar controllers that involved only a remote with some buttons and toggles to maneuver the vehicle. This document proposes developing a remote-controlled vehicle that was motion sensing, in 3 axes and 6 degrees of freedom, to control the speed and direction. This project is not to just design and implement a remote control vehicle, but one that have collision detection, collision notification, and real time video streaming.

Ron KittenBruan (RKB) Technologies Ltd. consists of 5 final year engineering science students with experiences in signal processing, image processing, mechanical design, embedded system programming, electronic design, and documentation. RKB have members in systems engineering, biomedical engineering, electronics engineering, and engineering physics, and this diversity allows us to have a wide range of knowledge in various areas.

The engineering cycle for this project will encompass research, design, implementation, and testing. The cycle will span in a 12 week period. The first 5 weeks are for research and design, and the next 4 weeks are dedicated to the implementation phase. Weeks 10-12 are for final product testing, and project documentations. The entire project is tentatively budgeted to be $600, and the money will come from ESSEF funding and personal savings.

Table of Contents

Executive Summary ii
Introduction 1
System Overview 2
Design Solution and Features 3
Natural mapping control 3
Collision detection 3
Real time video streaming 3
Collision prevention 4
Budget and Funding 5
Schedule 6
Team Organization 7
Company Profile 8
Conclusion 9
References 10

Introduction

Motion sensing driver entertainments have penetrated many market segments in the last few years. A great example is the Nintendo Wii. People of all ages and all backgrounds can come together and enjoy a video gaming experience which was originally owned mainly by the teenagers. This is very similar to what remote control cars once were; although different ages focused on different classes of remote control cars, but they all were attracted to the racing excitement of remote control vehicles. Currently, all the remote control cars out in the market use traditional controllers that provide indirect mappings and ordinary controls. Therefore, combining the hot technology of motion sensing with remote control vehicles, which was once widely popular, will definitely stir up a new wave and trend of remote control vehicles.

The objective of this project is to combine motion sensing and remote control vehicles together with additional features such as collision detection, collision notification, and real time video streaming. The new revolutionizing motion sensing controller will not only give a realistic feeling of controlling a vehicle, but it also offers a more comfortable controlling motion with it's natural mapping. With the collision detection and notification, it prevents the collision and damaging of the vehicle. Moreover, the natural mapping controller can serves as a pre-school driving lesson for children, and the collision notification provides a positive message to children that driving safety is important. Lastly, the real time video streaming allows the user to monitor and control the vehicle in environments where visual information is minimal, and to use the vehicle to search in harsh or unreachable areas.

This document is a proposal providing an overview of our products, design considerations, product features, project scheduling, budgeting, team organizations, and company profile. Various designs and features will be outlined in details, and projected financial requirements and budgeting are illustrated using Gantt Charts. Lastly, team organizations and members' qualities will be listed in details. Skills to complete this project are sufficient as member's experiences and expertise are diverse, and team communications are excellent as meetings are organized and well managed.

System Overview

CarSim consists of a remote-control car and a LCD-embedded controller. The remote-control car is built with a collision detection mechanism for educational purposes and a camera for real-time video streaming capability, where the controller employs the 6-axis control mechanism with vibration capability for real life like driving experience (1) (2).

The user steers the car by doing the steering motion while holding the controller, and then the corresponding signal is sent to the car wirelessly using Bluetooth. This information is then processed in the microprocessor and the orientation of the wheels is adjusted accordingly.

Two modes of operation are given to the user: safe mode or normal mode. Despite which mode the user chooses, the LCD (on the controller) can be enabled or disabled depending if the user wants to know what is ahead of the car or not.

Operating under safe mode disables the accelerometer and enables the Infra-Red sensors. The sensors determine the distance between the car and the obstacles in front of or behind the car. In this case, the control of the car is uninterrupted until the distance determined is less than 10 centimetres, the sensor triggers a signal to the microprocessor, where it interrupts the user's control and signals the motor to turn in the reverse direction.

Operating under normal mode disables the Infra-Red sensors and enables the accelerometer, which determines if a collision has occurred. In this case, the control of the car is uninterrupted until a collision is detected, the accelerometer triggers a signal to the microprocessor, where it interrupts the user's control and signals the motor to halt for 1 second and meanwhile, it sends a signal to the controller enabling vibration of the controller.

Design Solution and Features

Nowadays, there are many driving and racing games, however, some wrong moral messages on driving behaviors were transferred to the players inevitably. (3) (4) For example, the cars are able to run properly after they run into accidents. After playing such games, the players, especially the children and the teenagers might unconsciously receive such a wrong moral message. As a result, they may not pay attention to the road safety when they are actually driving. However, CarSim is different from such virtual driving games. It provides some features that can simulate the reality of driving so that the players can learn how to be safe drivers while having fun. Furthermore, additional features are added on for exploration purpose.

Natural mapping control

By comparing with the traditional remote control (RC) car, a natural mapping control system is more convenient and realistic to the users. (5) It usually takes time for users to practice the usage of the traditional remote controller. The RC car accelerates when users press the trigger on the controller, and it turns when users adjust the turning knob. Users will get used to this controlling system after a period of time, but it will take times to practice using the controller again after they leave the remote control car behind for too long. However, this problem can be solved when the natural mapping concept is applied. The car will turn when the users turn the controller, and it accelerates when the controller is turned forward. The speed and turning angel of the RC car are depending on how far the controller turns with respect to its original position. It takes no time to learn the controlling because this controlling style is the human natural reaction to driving.

Collision detection

To simulate a real collision of the vehicle, a collision detection feature is added to the remote control car. When the remote control car runs into an obstacle, such as a wall, then a vibration signal will be sent from the car to the controller. The controller will then vibrate and notify the users that an accident has occurred. Moreover, the RC car will be immobile for a short period of time to avoid further damage to it.

Real time video streaming

An onboard camera is implemented on the remote control car. The real time video will be displayed on the LCD module which is connected to the controller. This feature helps the users to understand the environment around the RC car when it runs into a place where is not reachable for the users. Moreover, LED head lights are installed along with the real time video steaming feature so that users feel more comfortable when controlling the RC car in a minimal visual environment.

Collision prevention

An onboard sensor (Infra-Red or Ultrasound) will be installed. The sensor can detect any object that is on the driving path of the RC car, and the RC car will stop automatically if it runs too close to the object. This feature prevents collision from occurring in an environment with minimal visual ability, when the users are unable to respond to the up-coming obstacle. This is also a useful feature for the driving learners. They have limited experience in driving, and will most likely run into accidents and damage the RC car. The collision prevention feature can reduce damages to the RC car. Finally, users have the choice to switch between collision prevention mode and collision detection mode.

Budget and Funding

Table 1 - Esitmated Component Cost

Equipment	Model	Estimated Cost (USD)
IR Sensor (2 units)	Sharp Microelectronics GP2D12J0000F	$80
Remote Car	Tamiya Remote Car	$80
Bluetooth Microporcessor	National Semiconductor CP3CN17	$100
Accelerometer (2 units)	Freescale Semiconductor MMA7360L	$60
Camera	Logitech QuickCam Connect	$50
H-Bridge Driving Motor (2 units)	Rohm BD6211F-E2	$40
Controller	Playstation 3 Dualshock 3	$60
Monitor	Zopid 2.4' LCD Mini Digital Photo Frame	$50
Camera Adapter	nGear USB2.0 Device Cable A to Mini 5Pin B M/M 6 ft	$6
Subtotal		**$526**
Contingencies (15%)		$78.90
Total		**$605**

The prices were extracted online from websites of company who offer to sell those parts. The costs of shipping are included in the estimation as well as a 15% contingency in case we need extra money. The costs of tools are not included because we have access to the free resources of tools in school. We have carefully estimated our costs, and we believe that this budget estimation provides an accurate estimate of our project cost.

Due to the high cost of our project, we have applied for the Engineering Science Student Endowment Fund of **$500**. Each of our team members have agreed to share the remaining financial cost equally. All financial transactions must be kept and recorded to ensure the proper reimbursement to members.

Schedule

The following table contains the tasks that are required to complete this project as well as their expected start and finish dates. Free slack times were allocated to some tasks to ensure enough days have been allocated for the task.

Task Name	Start	Finish
Research	Thu 1/8/09	Wed 2/18/09
Proposal/Funding	Tue 1/13/09	Mon 1/19/09
Progress Report	Wed 1/28/09	Mon 2/2/09
Functional Specification	Mon 1/19/09	Mon 2/16/09
Design Specification	Mon 1/19/09	Mon 3/2/09
Software Development	Wed 1/21/09	Tue 3/24/09
Module Test and Assembly	Mon 3/2/09	Wed 4/1/09
Debugging/Prototype Modificatio	Wed 3/4/09	Wed 4/1/09
Presentation, Report and Demo	Thu 3/26/09	Wed 4/1/09

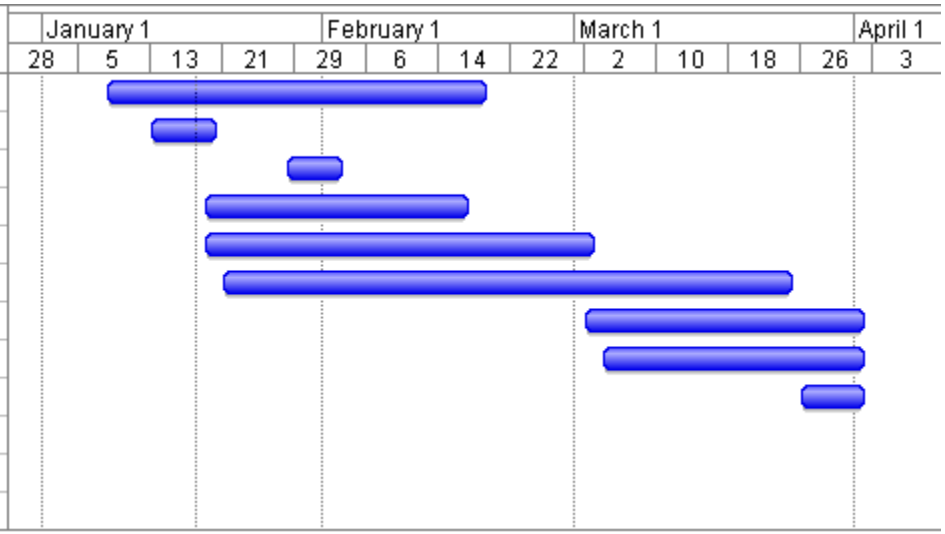

Figure 1 - Proposal Project Gantt chart

Team Organization

Five engineers, Austen Chan, Brian Cheung, Bruce Wong, Wingkit Lee, and Rongen Cheng, from Simon Fraser University have formed an innovative company, Ron Kittenbruan Technologies Ltd. As all of us are final-year engineering undergraduate students, experiences in different fields provide a strong foundationto our organization. With members in different specializations, each of us will contribute his specific expertise towards our completion of this project. Each member's background will be highlighted in the next section, Company Profile.

In Ron Kittenbruan Technologies Ltd., each member is responsible for a specific role in the company. With a size of 5, prioritized works will be distributed based on ones experience and interest. Rongen Cheng, President and Chief Executive Officer (CEO), takes over the overall progress of the project and prioritizes specific tasks. Austen Chan, Chief Technical Officer (CTO), provides technical supervision and alternative solution to technical specified issues. Brian Cheung, Production Director, monitors the project progression according to our implementation schedule mention in previous section. Bruce Wong, Manufacturing Director, is in charge of the fabrication of our product and components selection. Wingkit Lee, Chief Financial Officer (CFO), manages the overall budget, marketing and financing issues.

Assuring a proper communication throughout the group, weekly meeting is scheduled to report and discuss the current progress of the tasks. To avoid unnecessary conflicts, each member can provide "not offensive" opinions during the meeting. Every meeting will first be a reporting section which everyone will report the current progress of ones assigned task. Towards the end of each meeting, any necessary task rescheduling will be informed and updated to our project Gantt chart to ensure the flow of development will not be disturbed.

Since we have a wide range of expertise, task assignation will be based upon member's strength and interest. Each specific task is generally solo performed unless extra resource is required during weekly meeting discussion. Once a task is facing an issue, team members are expected to provide sufficient help for solving the problem. As all of us are having other courses during this semester, workload of each member will be distributed to avoid overloading during his exam period or other necessary course preparation.

As team work and group dynamics play an enormous role in this course, we believe that our flexible yet organized team structure allows us to tackle any issue involving both technological and social nature, hence, a successful completion of our project.

Company Profile

Rongen Cheng – Chief Executive Officer (CEO)
Studying in Biomedical Engineering at Simon Fraser University, my expertise is a combination of hardware, and management skill from my previous work experience. Currently performing research in Angular Domain Imaging (ADI) under Professor Glenn Chapman's supervision, I have exposed to different types of hardware components and technical specifications/requirements. On the other hand, in my previous co-op terms, I have worked in HSBC (Hong Kong) under internet banking division's project management team. This provides me extensive experience on project planning, team communication, and project coordination.

Austen Chan – Chief Technical Officer (CTO)
I am a final year of electronics engineering student at Simon Fraser University. I have experience working as an electrical engineering assistant at Analytic Systems Ltd. I provided assistant to the electrical engineer on populating, debugging and testing the prototype products. I am also good at searching for suitable components for projects, printed circuit board design and soldering.

Brian Cheung – Production Director
I am currently working on my last academic semester. My experience in telecommunication network in Research In Motion (RIM), and software integration and testing while working in Macdonald and Dettwiller Associate (MDA) allowed me to build up many skills. I am also doing my Business Minor in SFU. Through my previous project and work experiences, I have developed substantial knowledge in project management, team communication and product marketing.

Bruce Wong – Manufacturing Director
As an engineering physics student and a previous participant in the fabrication of the MIROHOT project supervised by Professor Shahram Payendah in SFU provides me with adequate knowledge on fabrication processes. I also have debugging experience from various team projects I have done in SFU which involve software and assembly debugging.

Wing Kit Lee – Chief Financial Officer (CFO)
Currently, I am in the last year of my Systems Engineering in Simon Fraser University. I have previous experience in mechanical designs, 3D modeling, and documentation from my jobs from OGCIO and Analytic Systems. I have done a special project lab with Professor Shahram Payandeh on Micro Robot Hockey and am currently writing a thesis on the mechanical and electronic designs of the robot. In addition, I have finished my Business Minor degree in SFU; and consequently, I have the knowledge in business and finance to succeed in my position of Chief Financial Officer.

Conclusion

Ron KittenBruan Technologies is dedicated to applying technology to enhance the functionality and gaming experience with remote control vehicles. The result of our project will bring benefits in areas of entertainment, education, and social.

Our proposed remote control vehicle combines the entertainment brought of with remote control vehicles along with the widely popular trend of motion sensing. Our proposed project is innovative, and there is no similar remote control vehicle that uses similar controlling techniques as us. In addition, collision detection, collision notification, and real time video streaming are integrated into our remote control vehicle which further enhances functionality and usefulness.

We are certain that by the end of March 31st, 2009, Mike will be able to revive his memories with his remote control car and enjoy it at a much higher degree with our new motion sensing controller. And be bale to use it for a few more functions too!

References

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