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January 18, 2010

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

Re: ENSC 440 Project Proposal for a Musical Carpet

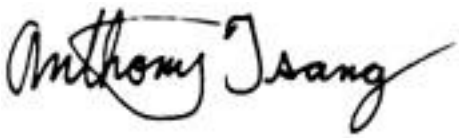
Dear Dr. Rawicz:

The enclosed document, *Proposal for a Musical Carpet*, is our comprehensive project proposal for ENSC 440. We hope to create an educational and entertaining device that can be used to help educate young children about music.

The following proposal further explains our goals and reasons for pursuing this project. It also contains our preliminary designs, our projected milestones as well as our plans to obtain funding. The proposal also includes information about our company and why we believe we'll be successful in this venture.

MusEd Technologies is a team of four driven and skilled individuals: Anthony Tsang, Anton Ayzikovsky, Danny Jiang and Payam Norouzi. If you would like to contact us with questions or comments, please contact Anton Ayzikovsky via e-mail at aaa75@sfu.ca.

Sincerely,



Anthony Tsang
MusEd Technologies Inc.

Enclosure: Proposal for a Musical Carpet

PROPOSAL FOR A MUSICAL CARPET

Project Team: Anthony Tsang
Anton Ayzikovsky
Danny Jiang
Payam Norouzi

Contact Person: Anton Ayzikovsky
aaa75@sfu.ca

Submitted to: Dr. Andrew Rawicz – ENSC 440
Steve Whitmore – ENSC 305
School of Engineering Science
Simon Fraser University

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EXECTIVE SUMMARY

Many studies have been performed linking the healthy development of children and music. There has been some controversy over the legitimacy of these studies. But even if those studies are in question, anecdotal evidence suggests that music is beneficial regardless of whether it can make your child smarter or not. Music is often a highly influential factor in people's lives and we hope to be able to continue this in future generations.

The device we intend to develop is a large floor mat that contains a keyboard. Devices similar to the one we are proposing do exist, such as the giant floor keyboard at the Telus World of Science. However, we intend to expand the feature set by providing the ability to adjust the sound for various instruments as well as a play and sing feature which will indicate whether your pitch while singing is higher or lower than the played note. We also intend to create a marketable product, which can be sold to preschools or kindergartens to teach children about music.

The members of MusEd Technologies form a well-rounded team that combines hardware and software knowledge. We have experience in sensors, microcontrollers, real time systems, and software development. We also have the development life cycle knowledge to manage the project within the short time period given.

We have planned the development cycle for the proposed project starting from conception to a working model over 13 weeks, ending April 3, 2010. We have budgeted $500 to pay for our building materials and we intend to obtain funding to cover the costs.

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1. INTRODUCTION

The Musical Carpet is a great way to bring music to children's ears and let them be creative with it. It can also be used in a teaching environment to bring a fun experience and make children more comfortable in the teaching environment in general.

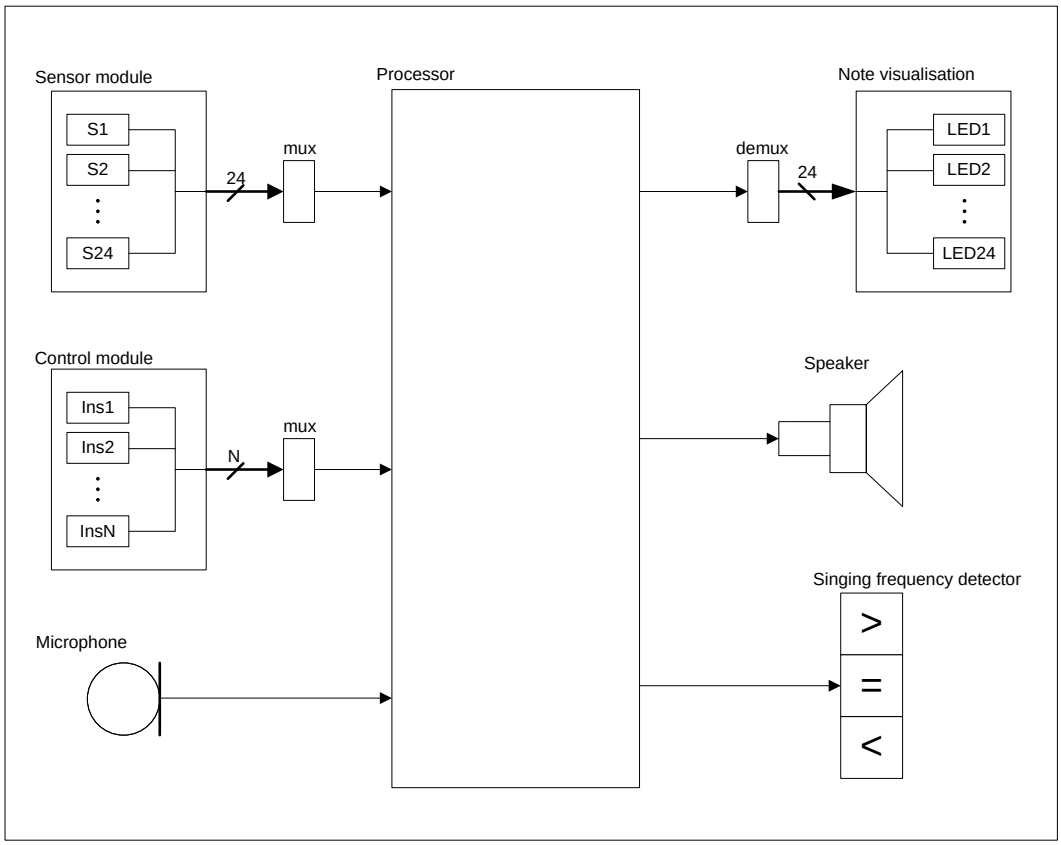
The carpet has embedded contact switches that will react to the pressure applied by the user's footsteps. There is also a voice detection unit to recognize if the voice is out of tune with the note being played.

This proposal discusses an overview of our device, design guidelines, resources and financial requirements. We consider previous devices in our target market as well as alternative designs for our proposed product. Lastly, out development cycle and other timeline constraints are covered.

2. SYSTEM OVERVIEW

The system consists of a set of step-operated pushbuttons embedded into a carpet, which are connected to the main control unit. The processor sends pre-recorded sound samples of the corresponding frequency out to the speaker system. Consequently, the voice recognition system is enabled. The system filters out the sound of the device itself and compares the user's voice frequency with the frequency of the note being played. The LED indicator shows if the user sings too low, too high or in perfect pitch, providing a perfect voice-training assistant. The system design is shown in figure 2-1.

Figure 2-1. System Schematic diagram



The above diagram shows the main features of the product. The twenty-four sensors and corresponding twenty-four LEDs represent the two octaves of notes – white (Do Re Mi Fa So La Ti) and black keys on the piano. The control module is a set of pushbuttons located on the control board and used for selection of the instrument sound desired by the user. The microphone (when enabled) is used to sense the user's voice, which gets

compared to the note played and the result is the output from the singing frequency detection module. Power to the system is supplied through a regular AC outlet to avoid battery changing/recharging.

3. POSSIBLE DESIGN SOLUTIONS

Singing is a form of art that has existed for as long as ancient humans have used their voice, so naturally many ways to learn it exist in the world. A music teacher is definitely the best way to learn to sing. For the cost of lessons, student gets the feedback and advice no technical gadget can substitute. A software vocal tuner is another alternative that is one of the cheapest yet is an advanced system. Professional musicians and amateur singers use it and it provides various ways to analyze and alter the vocal parts. Stand-alone devices are also available. Ranging from very simple one-note tonometers to advanced instruments with CD playback, voice muting, speed/pitch change functions. However, we do not aim at professional training, rather at the playful beginner learning by means of a basic 2-octave interactive device, which can be used for fun, education or simply interior design purposes.

3.1 SENSING MODULE

For our step sensor, we can use factory-made sensors, such as piezo-electric, strain gauge or tactile types. However, this would be expensive and it would be restricting the shape of our carpet because the shape of the carpet must be chosen based on the sensor's size, shape and thickness. Another solution is to create our own sensor. This can be made by having two aluminum foils sheet and one sheet of paper. We then cut some small strips out of the paper and finally glue foil sheets on both sides of the paper [5]. When force is applied, the two foils sheet will contact each other. The details of our implementation will be given in the design specification document.

3.2 TONE DECTECTOR

One of the interesting features of our musical carpet is that users can sing after they step on a note and our system will indicate whether your pitch while singing is higher or lower than the played note. We currently have two approaches to accomplish that feature. The first approach is we can write a speech recognition algorithm. The second approach is simply using a frequency comparator. The first approach is more complex but it can be modified to include more features. The second approach is cheaper and easier to implement.

3.3 USER INTERFACE MODULE

The user interface module could have been realized using a touch-screen LCD display, however, considering the simplicity of the required controls and the high price of LCD displays, an implementation option using simple switches and LEDs was adopted.

4. PROPOSED DESIGN SOLUTIONS

Our vocal tuner is designed primarily for entertainment purposes. It has been decided to implement the sensor module in the form of a carpet, thus adding the decorative aspect to the device's functionality.

The control unit will be constructed in form of an art installation. It will consist of a 3-D picture with features that can be pressed and will be used for selecting an instrument and enabling the microphone.

The sensors will be designed and build by our team, mostly due to financial reasons, but also to be able to fit the specifications to our needs with more flexibility and gain experience in tactile sensor design.

Our product will be a great addition to any kindergarten music room, a kid's bedroom, entertainment corner, music shop or simply corridor art. Colorful and functional, it is destined for success on the global market.

5. SOURCE OF INFORMATION

Our project requires many technical skills from various areas including analog/digital circuit design, programming and a basic understanding of music. Throughout this project, we will obtain information from course textbooks, manufacturer's datasheets, online tutorials and other sources. Preliminary research shows that this product is not currently in the market. However, there are many different kinds of products for learning music out there. We will also analyze those products to learn from their strengths and improve on their weaknesses.

Course textbooks relating to sensors and online tutorials about how to make "step" sensors would definitely help us create our own sensors. There are great professors at SFU such as Albert Leung, Patrick Leung and Andrew Rawicz and colleagues who are experts in this field that would like to give us feedback.

This is a music related project. It is very important to contact musicians to give us suggestions to make it a better product. In addition, kindergarten students are our main target customers. We will go to their music classes to seek additional features we can add for our project. All these resources will help us to create a better entertaining and educational device.

6. BUDGET AND FUNDING

6.1 BUDGET

Table 6.1 shows a tentative budget for the prototype of musical carpet. The actual costs will about 1/5 of the prototype since we are buying an expensive development board and trying out new features.

Table 6-1. Tentative Budget

Components	Estimated Cost
Microcontroller Development kit	$150
Step sensors x 24	$100
Electronic Parts (opamp, transistors, etc)	$70
Microphone	$30
Carpet material	$100
Building material	$50
Miscellaneous	$40
Total Cost	$540

6.2 FUNDING

We have applied to the Engineering Science Student Endowment Fund (ESSEF) and we expect to get around $500 funding from them. If the funding is not sufficient for this project, our team members have agreed to divide the remaining costs or seek out additional funds.

7. SCHEDULE

The proposed schedule is shown in Figure 7-1. It describes the approximate start date, duration and end date for each project task.

Figure 7-1. Gantt Chart for Musical Carpet Project

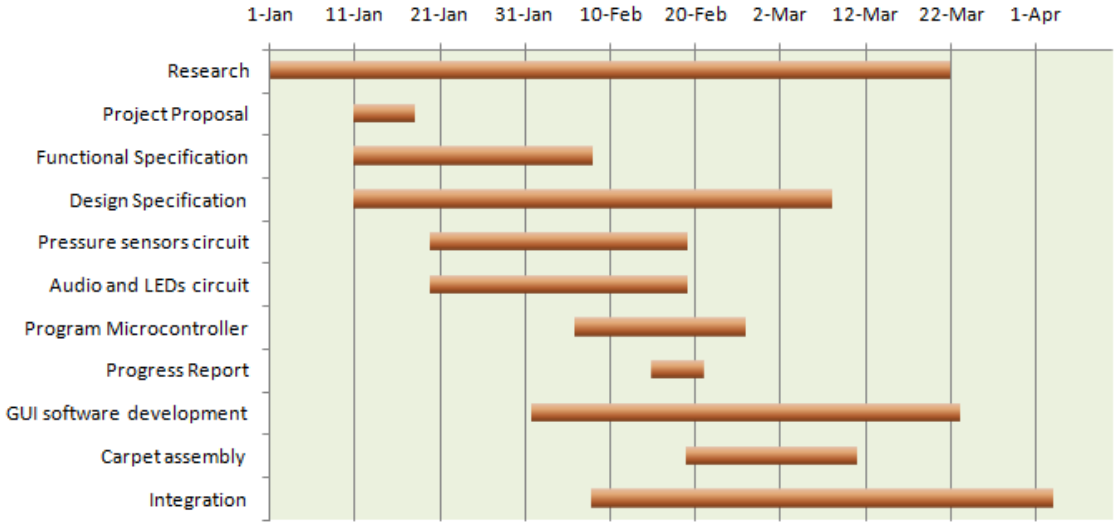
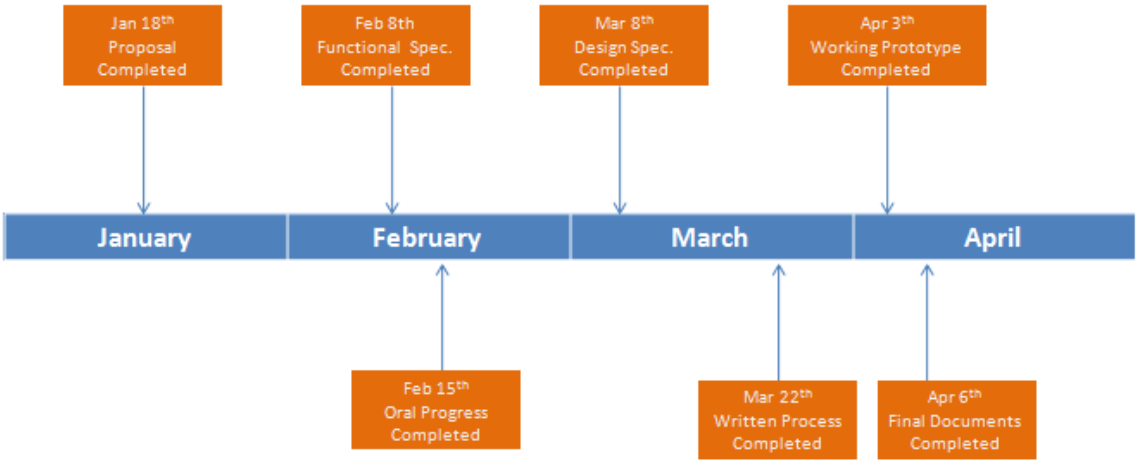


Figure 7-2 represents the milestones of our project. It shows the completion date for the specific tasks, especially documents.

Figure 7-2. Milestones of Musical Carpet Project



8. TEAM ORGANIZATION

MusEd Technologies Inc. is a young research and development company. Our team consists of four talented fifth year engineering students: Anthony Tsang, Anton Ayzikovsky, Danny Jiang and Payam Norouzi. Anthony is specialized in the computer option; Danny is specialized in the electronic option; Anton and Payam are specialized in the system option. So every team member has a unique aspect of engineering expertise and experiences.

While working towards this project, we have assigned roles for each member based on his/her strengths, weaknesses and past experiences. Anthony, Chief Executive Officer (CEO), leads the team and he is responsible for management, decision making. Danny Jiang, Chief Technical Officer (CTO), is responsible for making technical decision and solving high priority technical issues. Anton Ayzikovsky, Chief Financial Officer (CFO), is in charge of budget and funding management, cash flow tracking and price research for different components. Finally, Payam Norouzi, Chief Operating Officer (COO), is responsible for day-to-day operation such as meeting management.

Communication within the team is very important. We will regularly have meetings every week to monitor progress of the project and discuss technical issues encountered during the project. To make the meeting more efficient, each member should be prepared with updates of activity for individual's task and proposed solutions for potential issues. One member will be typing out meeting minutes. Some small issues will be discussed through email, telephone and instant messaging.

To make integration easier, everything should be well planned before we start working on it. Every team member should fairly share equal amounts of work for this project. Although the project is divided into small tasks, each team member should fully understand what other team members are doing beside his own task. Every component of the project should run sanity and unity testing to reduce the overhead when identifying and debugging problems during integration.

Overall, we believe we will overcome challenges by our strong teamwork and co-operation.

9. COMPANY PROFILE

Anthony Tsang – Chief Executive Officer

Anthony is a fifth year computer engineering student at Simon Fraser University. His co-op experience is largely software oriented after working at Research in Motion as a software engineer and at the Vancouver International Airport as a technical analyst. He has previously programmed microcontrollers with assembly and also C. He is also familiar with FPGA development and system on chip design. He communicates well with others and is a team player.

Danny Jiang – Chief Technology Officer

Danny is a fifth-year electronic engineering student at Simon Fraser University. He has rich experiences in both software and hardware development. He had one year working experience in Zeugma as a software engineer programming in C/C++ under Linux environment. He has a solid understanding in TCP/IP, IDSN, ATM, modulation theory and encoding algorithms. Beside software, he had 8-month co-op work term with VTech as a hardware engineer. He is well versed in circuit and PCB design. He also has experience in debugging Electrostatic discharge (ESD) and Electromagnetic Interference (EMI). He is familiar with all the electronic equipment such as oscilloscopes, power supplies, function generators and digital analyzer.

Anton Ayzikovsky –Chief Financial Officer

In addition to deep understanding of theory of technology and practical skills gained at BCIT and SFU electronics laboratories, Anton possesses knowledge and experience with financial procedures. From handling money at Domino's Pizza years ago to calculating projects budgets, ordering parts from vendors, compiling financial statements at several internship jobs and taking economics courses. He proved to be a fast learner and a wise spender. Quite naturally, he was selected for the role of chief financial officer.

Payam Norouzi - Chief Operating Officer

Finishing up his final year in Engineering Science, Payam Norouzi has gained much software and hardware knowledge through his studies in Systems Engineering. Payam's previous co-op work terms have provided him with extensive software testing and development experience, while through course work and projects he has also gained skills in analog and digital circuit design as well as robotic control systems. In addition to this, he

has a solid teamwork personality and is sure to keep the team at Mused Technologies focused and motivated in the toughest hours.

10. CONCLUSION

We believe this product will bring fun to the music learning process for kids. By using this product, children are able to familiarize themselves with the basics of music. On the other hand, the teachers can use it as a tool to ensure students are singing in tune.

MUSED Technology is composed of motivated individuals coming from diverse backgrounds and experiences in engineering. We are driven by excitement from working with our areas of expertise during the project development. We will do our best to follow the milestones we set for ourselves and for the group while minimizing, as much as possible, the costs we might incur. Overall, the experiences and background of each group member is adequate for our proposed project.

11. SOURCES AND REFERENCES

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