dimension technologies

Simon Fraser University,
8888 University Dr.
Burnaby, BC Canada
Email: rmt3@sfu.ca

September 17, 2012

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

Re: ENSC 440 Project Proposal for a QuickScan Mapping Device

Dear Dr. Rawicz,

Enclosed is our *Proposal for a QuickScan Mapping Device*, which describes our project for ENSC 440. Our goal is to design a portable scanning device that will quickly measure the area of a given room in 3D space. This device will eliminate the need of manually measuring the dimensions using measuring tape or similar tools.

This proposal document gives a description of our product and its proposed features. As well, it will compare our project to some existing devices and show our device's distinctiveness. It will further state our tentative schedule, budget, sources of funding, and a description of our company's structure and members.

Dimension Technologies consists of five senior engineering students, Chris Kwong, Oliver Huang, William Chiang, Rahul Thomas, and Jack Zhang. We have a wide range of abilities with systems, electrical, and computing background. If there are any questions or concerns regarding our proposal or device, please contact me by phone at 604-807-0486 or by e-mail at rmt3@sfu.ca.

Sincerely,

Rahul Thomas
CEO
Dimension Technologies

Enclosure: *Proposal for a QuickScan Mapping Device*

PROPOSAL FOR A QUICKSCAN MAPPING DEVICE

dimension technologies

Rahul Thomas	Chris Kwong	Yumin Oliver Huang	Jack Zhang	William Chiang
CEO	CTO	CFO	COO	Managing Director

Contact Person: Rahul Thomas
rmt3@sfu.ca

Submitted To : Dr. Andrew Rawicz-ENSC 440
Steve Whitmore-ENSC 305

School of Engineering Science
Simon Fraser University

Issued Date: September 17, 2012

Executive Summary

The world we live in is constantly changing. Things are getting bigger and people in today's society are trying to increase their own borders. More specifically, companies are expanding and looking for new venues in which to conduct their business operations. Small families are trying to upgrade their current dwelling in order to live a comfortable life and fulfill personal desires. One key topic is common in each of these scenarios: commercial and residential real-estate markets are increasing. More people are looking to buy new homes, land, offices, etc.

One immediate question that is asked during inquires for a certain property is, "how large is it?" This is common factor when buying real estate in today's society. Typically, these sizes and dimensions are quantified during the construction process by drafters and builders. Many methods exist to aid such professionals to accomplish their tasks. Firstly, the most traditional and conventional methods consist of manually dimensioning room sizes using measuring tape. More advanced technologies have developed including hand held measuring devices that provide digital readings of distances based on where the device is facing. However, in all these methods, there is a time factor that is involved.

This document will outline Dimension Technologies' proposed solution to the problem identified above using our product known as QuickScan. In essence this product is a stand-alone device that will create a 3D (or if desired 2D) render of a given room. Dimensions such as height and length will also be produced which will be very suitable in drafting and floor planning applications. Additionally, color information will also be present in the extracted 3D render. This will greatly shorten the amount of effort and time that is currently needed by drafters to create a floor plan of a room. Additionally, the device can be used to create a quick 3D snapshot of a given area.

Dimension Technologies is composed of talented engineers with a grip on cutting-edge technology. We have extensive experience in digital & analog electronics, electromechanical systems, signal processing, and computer programming. These skills are key factors that will make our product operational and reliable.

Currently, we are budgeting our development costs to be $640.00 CAD. This amount covers equipment & parts costs, development costs, and a contingency fund. We propose to complete the development (including integration and testing) and have the product ready for demonstration by early December. A detailed cost, schedule & development breakdown is provided in the following sections.

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Glossary

IR – Infrared

1. Introduction

One of the many hassles that builders and interior designers have to deal with are the measurements of a room. The traditional method is to use measure taping to find out the length and width of a room or furniture in the room. The numbers then had to be recorded down and then calculations had to be made for the design. As a result of this complication, various measuring devices have been invented to solve this problem. One example is the Zircon products. Zircon is a company that designs wall scanners, stud finders, metal detectors, etc. One of their product is called Sonic Measure DM 250L [1] a measuring device for interior room with size up to 50 feet (15 m) utilizing a laser. The user only has to point the laser to a wall and the distance will appear on the LCD screen in an unit of choice. As well, it can calculate areas and volumes automatically.

Our solution to the problem is to build a device that will automatically scan the room and outputs all the measurement and calculations. This way it will speed up the process such that all the tedious works in measuring the room can be done with a few seconds of time. As well, it will avoid problems such as recording down the wrong values so that one will not have to measure again.

What is unique to our product in contrast to Zircon (the example given above) is that everything will be automatic. Companies such as Zircon and Prexiso only lessens the work by a little bit, in that they are using laser to measure the length of a room. In the end the user still has to physically take the device and measure the length and width of a room. Another advantage that our product has over the other existing products is that it can measure rooms of different shapes. If a room is in an oval shape, it would be difficult for a product like the Sonic Measure DM 250L to work with. Those products are made with the assumption that the room is in a rectangular shape. With our device, we can measure a circular room or a room with one wall on a slant and so on.

Another marketable area that our product captures is real estates. Often time when a home buyer wants to see their desired home, they can only see pictures online. With our device, real estate agent can capture the room and then the potential home buyer can actually see a room in 3D. Also, it can be used for hotels, where the guests can see their room in 3D so they can make a more accurate decision in choosing a room.

The following proposal will describe the design overview of the project, more features of the product, implementation, estimated budget, sources of funding, a tentative schedule, and an introduction to our company.

2. System Overview

QuickScan will allow the user to quickly scan a room and extrapolate a 3D model where the dimensions and other physical features of the room can be stored and easily measured. The QuickScan device is comprised of two main parts: First of which is a rotary sensory unit which is allowed to freely rotate about 360 degrees. This table like component holds the Kinect Sensor, Arduino microcontroller and control circuitry. Secondly, the body is used to house the wires and batteries. A stepper motor is secured on the top of the body allowing the rotary sensory unit to rotate at an elevate position. The body also provides an ergonomic handle for the user and conveniently stores batteries for portable use. Figure 2.1 shows a conceptual image of the overall device.

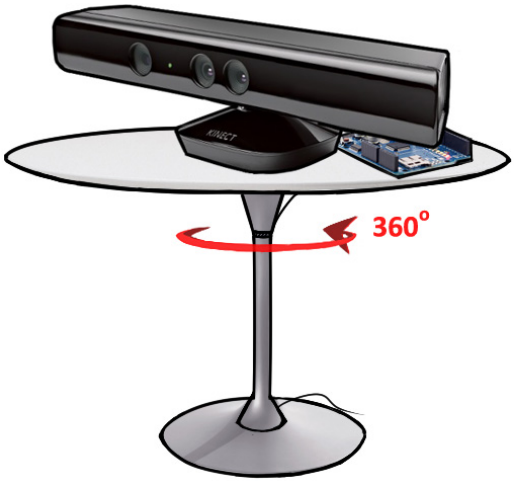


Figure 2-1 Conceptual Model of the QuickScan Device

The QuickScan device should be positioned approximately in the middle of the room. The user can control the QuickScan device remotely to initiate the scanning process. The rotatory scanning unit will complete a full rotation while capturing 3D data. The software on the mobile computer will analyse the data in real time and export an accurate 3D Model into a 3D modeling software. The following figure depicts the overall process.

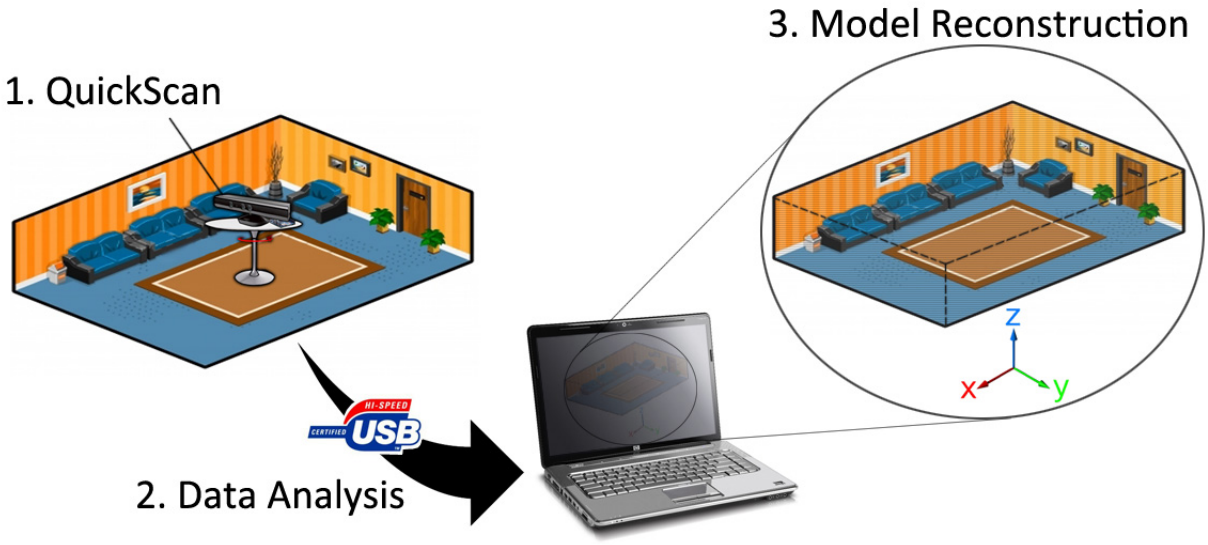


Figure 2-2 A Simple Overview of the QuickScan Process

A more in depth analysis of the QuickScan process can be summarized by the flow diagram below.

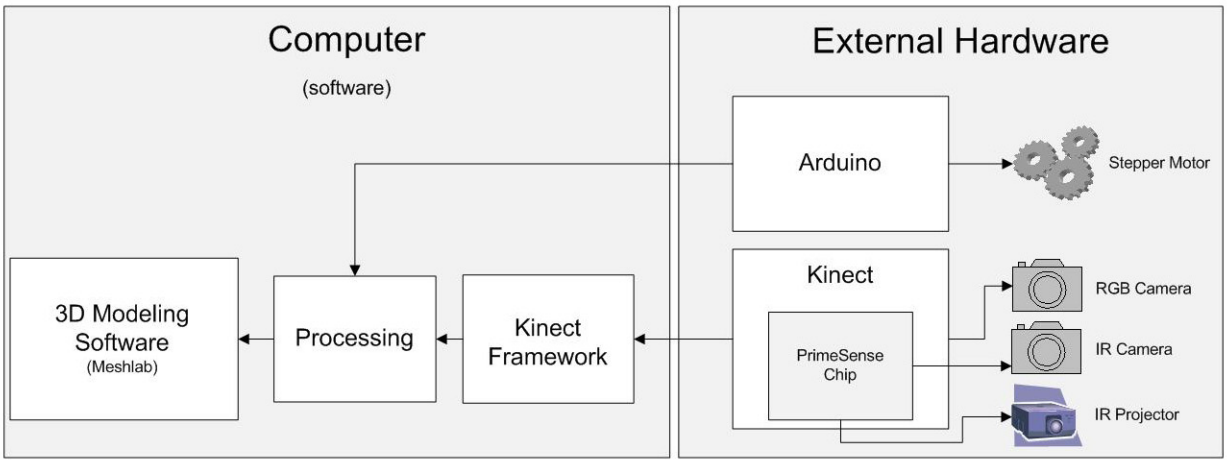


Figure 2-3 System Flow Diagram

A depth field of the environment is acquired by the IR camera and IR sensor where the data is interpreted by the PrimeSense internal chip. This information is then sent to a mobile computer which stores the 3D points into its memory.

The Kinect Sensor is secured on a turning platform which will be able to rotate to a desired angle with a stepper motor controlled by the Arduino microcontroller. The Arduino is also connected to the computer and will be able to accurately turn the Kinect Sensor into a desired angle to record the depth field incrementally. By combining the 3D data collected for each incremental rotation, an accurate 3D model can be constructed of the surrounding area.

Data analysis includes data filtering, mesh wiring, surface reconstruction. RGB colour image overlay, future development on the product will include 3D point stitching.
Finally, the 3D model of the room will be exported into a 3D Modeling program such as Meshlab. The video capture from the Kinect's RGB camera will provide a colour overlay over the 3D structure generated by 3D point cloud from the depth camera.

This preliminary prototype will feature a wired connection to a mobile computer to communicate data between the QuickScan device and the software. In future iterations, QuickScan will be able to wireless transmit data a mobile computer for added portability. The preliminary prototype of QuickScan will only work for small to medium sized rooms with few obstructions due to the limited range on the Kinect depth sensors. However, future features will include more sophisticated 3D processing algorithms to seamlessly stitch together multiple 3D capture point locations allowing for a scan of larger and more complex environments.

3. Budget

Dimension Technologies is estimating the following budget for development costs:

Table 3-1: Development Budget

Component	Price
Development Board – Arduino Mega 2560	$55.00
XBOX Kinect	$125.00
Scanner Chassis Kit	$80.00
Servo Motor	$20.00
Arduino Bluetooth Module	$30.00
Batteries/Charging Kit	$100.00
Custom PCB Board Design	$150.00
HMC5883L Compass	$30.00
Miscellaneous – Wires, cables, etc...	$50.00
Total	$640.00 CAD

We have carefully selected the required components factoring cost, performance and reliability considerations. Each of these components are essential in the development process to create a final working device. Please note that the above budget incorporates a $50.00 contingency fund (Miscellaneous costs) for various parts and components that may be needed during the development stage. Each of these costs are fairly conservative; prices have been selected using typically low cost sources and distributers.

We plan to pursue funding opportunities the following sources:

- Engineering Student Society Endowment Fund (ESSEF)
- Wighton Fund

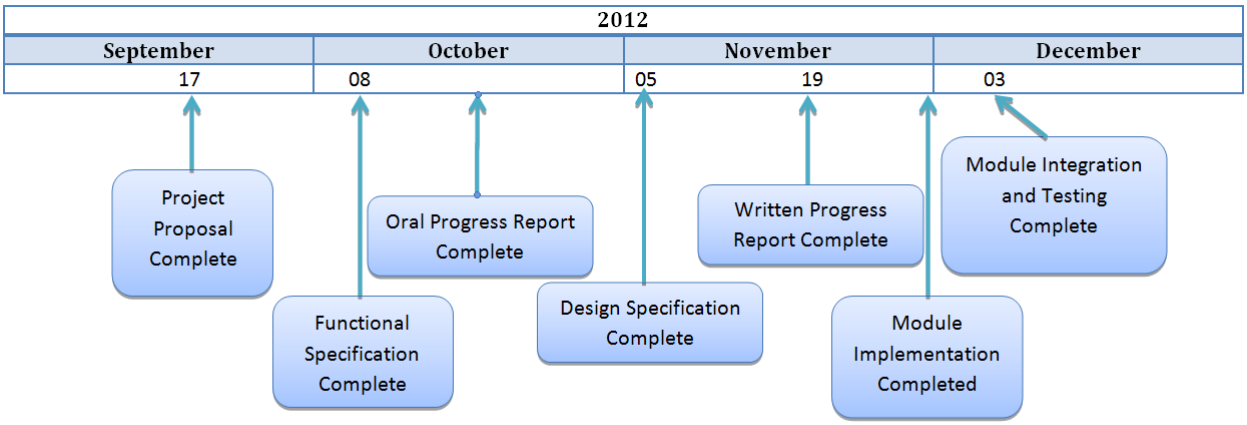
4. Time Schedule

Our estimated development time-frame is just under a 4-month period. Tables 4.1 and 4.2 display our tentative schedule and key project milestones. The final product demonstration is expected to take place in mid-December.

Table 4-1: Gantt Chart

	Task	Start	End	2012 Sep	Oct	Nov	Dec
	Project	4/9/12	3/12/12				
1	Research	4/9/12	20/10/12				
2	Project Proposal	4/9/12	17/9/12				
3	Function Sepecification	18/9/12	5/10/12				
4	Design Specification	9/10/12	5/11/12				
5	Extract and Manipulate data From Kinect	10/9/12	8/10/12				
6	Data Synthesis and Analysis	25/9/12	24/10/12				
7	Data Extraction to 3D Modeling Software	20/10/12	10/11/12				
8	Module Implementation	10/10/12	5/11/12				
9	Module Integration	6/11/12	25/11/12				
10	Unit & Integration Testing/Debugging	10/10/12	3/12/12				
11	Documentation	17/9/12	3/12/12				

Table 4-2: Key Project Milestones



5. Company Profile

Rahul Thomas – Chief Executive Officer (CEO)

Currently, I am an engineering science student in my final academic semester; specializing in Electronics Engineering. I have extensive knowledge and experience in the microelectronics fields ranging from digital & analog electronics to high-frequency design. Typically, my interests are in CMOS design related projects (from transistor level design to RTL level design flows using HDLs). I have had many schools projects and even an industry work term that have reinforced this interest. Additionally, I have strong scripting and programming skills the aid my interests. One of the most memorable projects that I have completed was during my internship in the summer of 2012. During this work term, I was able to create an RTL synthesis flow using 28nm technology for the specific design group that I was placed in.

Chris Kwong – Chief Technology Officer (CTO)

I am a fifth year SFU student studying systems engineering. Throughout my career as an engineering student, I have completed many group projects including designing a circuit for decoding NTSC signals, simulation and control system for a 4 DOF robotic arm. During my co-op at General Dynamics, I helped develop a new application program interface for controlling military weapon on a vehicle. I have also done various testing and other tasks on firmware, hardware and software projects within the company. In addition, I conducted several personal projects focusing in hardware design and prototyping, most notably a video controlled ambient light system on the Arduino microcontroller. With skills in both programming and hardware, I can produce systems requirements and integrations between hardware and software components for this project.

Yumin Oliver Huang – Chief Financial Officer (CFO)

I am currently enrolled as a fourth year computer engineering student at Simon Fraser University. I have experience programming with Objective-C, C, C++, Java, and assembly language. Additionally, I have experience designing/developing an educational iPhone app in a team of five for elementary and middle schools' field trips. The project involved GPS location functionality, PHP requests through the iPhone to our server, and the creation of a User Interface. Another project that I worked on with a group of four is designing a snake

game on the Xilinx FPGA which involved complex algorithms related to modeling and AI. In addition, I have some other projects in the areas of VLSI and FPGA design through other courses.

Jack Zhang – Chief Operating Officer (COO)

I am a fifth year computer engineering student here at SFU. I have completed so far one co-op term at PMC Sierra and worked as a system validation engineer. I have a lot of experience in software/firmware development through many projects at school and therefore worked with many programming languages (C++, C, Java, and Objective-C). One of my projects was to develop an iPhone app in a team of five for the purpose of education of elementary school children. Another project that I worked on with a partner involved Xilinx Virtex II FPGA. We built a system where we filter any image loaded onto the memory and it will output only the edge of the image (known as edge detection). Furthermore, I have some experience with VLSI and FPGA design from other courses.

William Chiang – Managing Director

I am a fifth year Electrical Engineer. I have extensive course knowledge in circuit analysis and design in DC, low frequencies as well as high frequencies. I also have experience designing digital circuits using VHDL, and have used this experience hands on with a course project; In the project I have designed a simple calculator using VHDL and an FPGA board. On the programming side I have experience in working with several scripting languages. One school project I've undertaken is using Matlab to create an image encoder for a series of video-like images. From my co-op term I have used Ruby, PERL, Python and TCL as required of my work. My co-ops has also given me exposure a variety of topics, such as interfacing and testing Android based devices, working with servers and networking, and working with virtual machines.

6. Conclusion

Our company's goal is to design a device that will improve the productivity of interior designers and builders. We will design a product that will quickly and accurate capture the measurement of an area and output what is mapped onto a 3D map. The users will no longer have to go through all the tedious process to measure the length, width, and height. They will no longer be worried measuring parts of the room that are curved or have other strange shapes. Furthermore, our product offers an excellent feature for those in real estates and hotels. Instead of showing their clients 2D pictures online, they can give their client a much better sensation by having the room in 3D so the clients can make a more calculated decision.

The project has a great potential upon complete but the journey to that completion will not be easy. Our team members are excited to embark on this journey. We trust that with the hard work of our team and our variety of skills we can reach goal in the desired manner

7. References

[1] E. Melgar, C Diez, (2012), Arduino and Kinect Projects
[2] http://stockfresh.com/image/402224/lobby-room [Online]
[3] http://s6.postimage.org/e6n1u8mqp/kinect_jpg_627x325_crop_upscale_q85.jpg [Online]
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[5] http://www.coolpctips.com/wp-content/uploads/2012/03/hp-laptop-computers-repairs.jpg [Online]
[6] http://www.adobe.com/support/freehand/basics/3d_animations/images/xyz.gif [Online]

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