ColourSense Inc. Reveals True Colours

February 22nd, 2005

Lucky One
School of Engineering Science
Simon Fraser University
Burnaby, British Columbia
V5A 1S6

RE: ENSC 440 Functional Specification for a Colour Identifying Device

Dear Mr. One:

The enclosed document, *Functional Specifications for a Colour Identifying Device—ColourIt*, outlines the operational requirements for our proposed product.

We are in the process of developing a handheld device that can determine the colour of a point. Capable of distinguishing 147 colours, it is ideal for designers, painters, hobbyists, as well as the colour vision deficient.

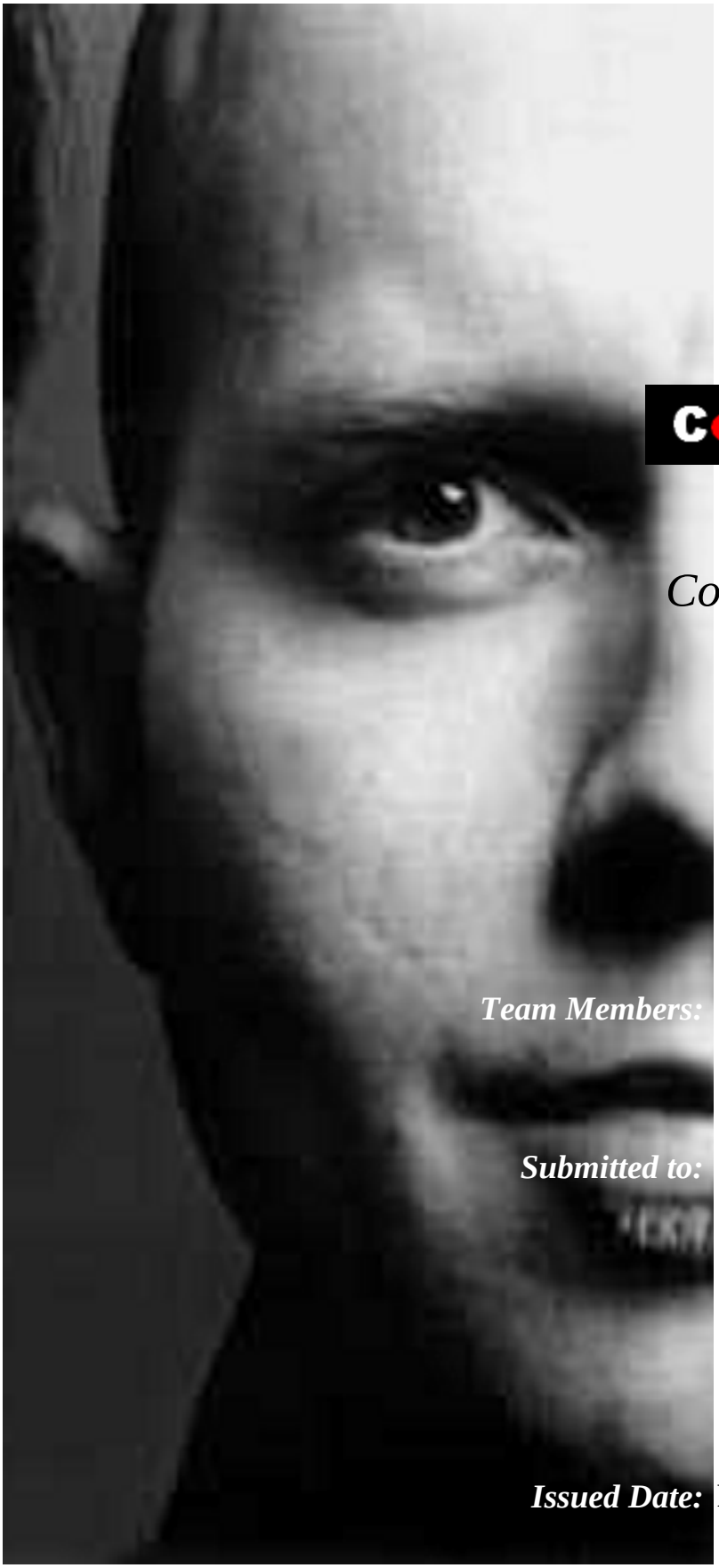
The purpose of this functional specification is to ensure our project will meet the specific needs of the user. We will use this set of clearly defined requirements of the system as a guideline for our final product.

ColourSense Inc. is comprised of three innovative, diligent and ambitious fourth year engineering students – Julie Chao, Linda Ni and Bill Yang. I am more than willing to answer any questions or concerns in regards to our functional specification. Please feel free to contact me by phone at 604-764-2608 or by email at coloursense-ensc440@sfu.ca.

Sincerely,

Julie Chao
Chief Executive Officer
ColourSense Inc.

Enclosure: *Functional Specification for a Colour Identifying Device—ColourIt*



ColourSense Inc.

Proposal for a
Colour Identifying Device

ColourIt

Team Members:	Julie Chao	ctchao@sfu.ca
	Linda Ni	lni@sfu.ca
	Bill Yang	billy@sfu.ca
Submitted to:	Lucky One	lucky@sfu.ca
	Amir Niroumand	amniroum@sfu.ca
	Mike Sjoerdsma	msjoerds@sfu.ca
	Tony Ottaviani	tottavia@sfu.ca
	Scott Logie	slogie@sfu.ca
	Steve Whitmore	whitmore@cs.sfu.ca

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Executive Summary

In John Locke's famous essay of 1690, he pondered whether the "*violet produced in one man's mind by his eyes were the same that a marigold produced in another man's, and vice versa*[1]." The colours perceived by an individual would not be the same as the colours perceived by another at a different time or different place. While philosophers and scientists have debated over this issue for centuries, the engineers of ColourSense Inc. have proposed to develop a portable colour-identifying device - ColourIt.

Designers and manufacturers are known to be critical in their selection of colours. The slightest variation in tint could result in the reproduction of substantial amounts of raw materials. ColourIt, capable of displaying the exact name of a colour on LCD, will make the use of bulky colour cards archaic.

The increasing popularity of reality television featuring shows like home makeovers and custom automobile upgrades has stimulated hobbyists. People are becoming more and more eager to set themselves apart from others through their personal taste in style. Choice of colour is a key factor in any form of distinction. ColourIt will ensure they never confuse white smoke with ghost white.

Unfortunately for the colour vision deficient, colour distinction does not come easy. ColourIt will end any ambiguity about the colour one might have difficulty distinguishing.

The development of ColourIt will occur in three stages. The first stage to be completed by the end of February, 2005, will have the following features:

1. Isolate external light and illuminate the desired point for colour detection by placing the device directly over surface.
2. Detect amounts of red, blue, green and intensity of the desired point and relay the information to the user.

After the first stage, the device will have the following features by mid-April, 2005:

1. Display the name of the colour detected on an LCD.
2. Be fully portable and compact for the user.

The third stage will include the following features:

1. Have a backlit display for viewing in the dark.
2. Identify colour of a point over one metre away.

A target completion date has not been set for the third stage of development.

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1. Introduction

ColourSense Inc. is developing a handy device, ColourIt, which can tell a user the colour of the point he or she is looking at. Shaped like a standard laser pointer, the user aims the device at desired point. Immediately, ColourIt displays the colour of the spot it is pointing at on a LCD screen. The device is capable of recognizing 147 colours defined by the World Wide Web Consortium [2]. When not in use, ColourIt slips easily into a pocket or a purse.

ColourIt is intended for both amateur and professional designers. ColourIt is also will also help those with colour vision deficiency.

1.1. Scope

This functional specification is the blueprint for the development of a colour identifying device. The overall system requirements outline environmental, power and packaging specifications. The central system of ColourIt include data sampling, data processing and data output. The testing, minimum and ideal requirements of each subsystem will be examined accordingly.

1.2. Intended Audience

The functional specification for ColourIt is primarily intended for the design engineers and the project manager. Designer engineers will develop the device in accordance to this carefully defined set of functional requirements. The project manager will use this document to ensure project development and performance objectives are met.

1.3. Acronyms

LCD	Liquid Crystal Display
LED	Light Emitting Diode
MTBF	Mean Time Between Failure
RGB	Red, Green, Blue

1.4. Notation

Throughout this document, the following convention is used to differentiate between the test, minimum and ideal requirements of the functional specification of ColourIt.

[T – #]	The specification is the test requirement.
[M – #]	The specification is a minimum requirement.
[I – #]	The specification is an ideal requirement.

Most of the specifications are minimum requirements. Test requirements are intermediate steps that facilitate to minimum requirements. Ideal requirements are desired requirements that would make the device more attractive and appeal to more users.

2. System Overview

The development of ColourIt can be split up into three stages. The first stage is an intermediate, testing stage and will require an external power supply for the system. The device will be able to isolate external light and illuminate the area of interest. A colour sensor will pick up the light intensity based on the colour of the area and process this information using a microcontroller. The levels of red, blue green and intensity of the detected area will be displayed on a light emitting diode (LED) array. When the requirements of the testing stage are met, it will pave the way for the next stage.

The second stage will see that the minimum requirements of a working prototype are met. The physical outcome requires the device to be packaged in a portable and compact manner; therefore, the system will be powered by batteries. The device will be able to output the name of the colour on a liquid crystal display (LCD); there are 147 possible colours. The device will have two buttons for the user: sample and toggle. The sample button is also the power button; when selected, it detects the colour of the area and outputs the name of the colour on the LCD. The LCD can also output another piece of information for the user; the user can see the pixel numbers that the colour detected is composed of. The toggle button allows the user to switch back and forth between displaying the name of the colour and its pixel numbers. Refer to Figure 1 for the integrated system of the second stage.

The third stage involves ideal requirements that can expand the functionality of the device for a bigger market. The device will have a backlit function for viewing the LCD in the dark. A third button will be implemented to turn the backlight on or off. The device will also be able to identify the colour of a point over one metre away.

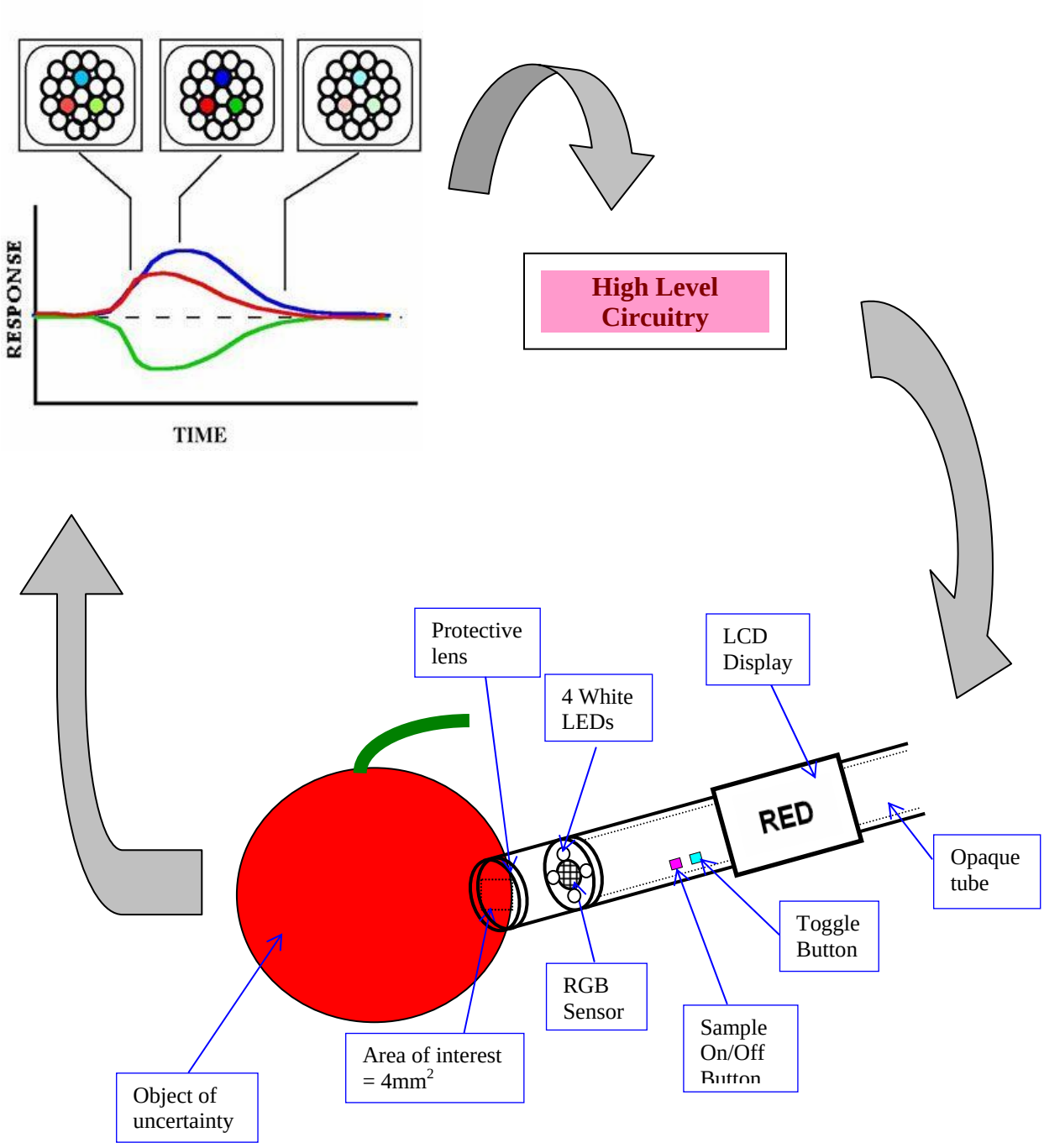

Figure 1: Integrated System for Second Stage

3. Overall System Requirements

3.1. System Power Specifications

The sensor circuit, light source and microcontroller require the following power specifications to ensure a safe and reliable operation of ColourIt.

[T – 01] The power supply must be less than 5V DC, with the current limited under 200mA.

[M – 01] The device must be powered by standard AA batteries.

[M – 02] The batteries must be able to sustain consistent power under normal operation.

3.2. Package Specifications

The final package, which will contain all the electronic components, must meet the following requirements:

[M – 03] The package must protect and insulate the internal circuitry from static and shock.

[M – 04] The package will be no greater than 4.40×2.00×12.00 cm to fit in most pockets and purses.

[M – 05] The device should weigh no greater than 100g.

3.3. Environmental Specifications

Since ColourIt is expected to operate in a wide range of environmental conditions to suit various user needs, it must meet the following requirements:

[M – 06] The operating temperature range for the device is -20°C to 70°C.

[M – 07] The device will be able to operate under normal humidity (10-80%), normal altitude (1,000 to 12,000m) and normal atmospheric pressure.

[M – 08] The device should not be subjected to direct sunlight or direct exposure to ultraviolet rays.

4. Central System Requirements

4.1. Data Sampling Unit

The data sampling unit is comprised of requirements for the user when sampling the data as well as the requirements of the sensor when collecting the sample:

4.1.1 User Interface

[M – 09] The area of interest must be less than $4mm^2$.

[M – 10] The front tip of the device must cover the contact surface entirely to block out external light.

[M – 11] The sample button should be clicked and not held for periods longer than 0.4s.

[M – 12] The user should not move the device when sampling the area of interest.

[M – 13] Only one button can be clicked at a time.

[I – 01] The user can determine the colour of a point over one metre away.

4.1.2 System

[M – 14] Only the four white LEDs should be used to illuminate the area of interest.

[M – 15] The RGB sensor must be able to collect information on the red, blue, green and intensity levels of the area of interest.

[M – 16] The RGB sensor must be able to convert light intensity based on the colour to a signal that can be sent to the microcontroller to process.

4.2. Data Processing Unit

The information collected by the user through the colour sensor will be processed through a microcontroller under the following requirements:

[T – 02] The microcontroller must have pins that can receive an output from the sensor module.

[T – 03] The microcontroller must have pins that can control the input signals to the sensor.

[T – 04] The microcontroller must be able to supply 5V and ground for the sensor.

[M – 17] The oscillatory clock must be fast enough to receive input from the sensor.

[M – 18] The microcontroller must be able to check the status of two buttons continuously.

[M – 19] The microcontroller must be mounted on a socket to reduce static interference.

[I – 02] The setup should be mounted on a PCB.

4.3. Data Output Unit

To relay the information to the user, the data output unit must have the following specifications:

4.3.1 User Interface

[T – 05] The user can determine the 5 levels of intensity for each colour based on the LED array.

[M – 20] The name of the colour or the different pixel numbers it is composed of is displayed on the LCD.

[M – 21] The toggle button switches between an output of pixel number and name of colour on the LCD.

[I – 03] The LCD will have a backlit display for viewing in the dark.

[I – 04] Instead of a point, the user can scan a line of interest and get instantaneous changes in name of colour.

4.3.2 System

[T – 06] 16 red LEDs (in an array) are connected to the 16 I/O ports on a microcontroller. The LEDs light up when signaled to show the levels of colour intensity.

[M – 22] The LCD must be able to output at least 2 lines with 8 characters each line.

[M – 23] The display lines must be able to scroll if information is over 8 characters each line.

5. Standards Compliance

5.1. Serviceability Requirements

The following specifies the serviceability requirements of the device:

[M – 24] The device should have mean time between failures (MTBF) greater than 1000 hours.

[M – 25] The buttons should have a duty cycle greater than 1,000,000 cycles.

5.2. Reliability Requirements

To ensure ColourIt's long lasting serviceability, the following requirements must be met:

[M – 26] The device should not be subjected to severe and intentional shock.

[M – 27] The device should be kept in dry conditions.

6. Conclusion

The functional specifications outlined in this document have described functions that apply to the entire system in many levels. This was based on careful decisions based on feasibility, practicality and usability. The testing, minimum and ideal requirements of the device must be met to ensure an operation that is safe and reliable. This imparts responsibility in both the designer and the user.

The engineers of ColourIt will follow this set of functional specifications for the successful development of ColourIt.

7. Sources and References

[1] J. Locke, *An Essay Concerning Human Understanding*, London: Routledge, 2000, 2.32.15

[2] World Wide Web Consortium, "Recognized Colours and Keyword Names," http://www.w3.org/TR/SVG/types.html, January 2003