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neoSpectra
Technologies Incorporated

February 22, 2007

Mr. Lakshman One
School of Engineering Science
Simon Fraser University
Burnaby, British Columbia
V5A 1S6

RE: ENSC 440 ChromaTap Functional Specification

Dear Mr. One:

The attached document, *The ChromaTap Functional Specification*, outlines the required specifications for our ENSC 440 Project, the ChromaTap.

This functional specification will provide a detailed look at the requirements which the ChromaTap prototypes and final versions will need to satisfy. As you know, the ChromaTap is a solution for hot water safety which will light the flow of water different intensities of red for hot, and blue for cold, giving the user a visual indicator of water temperature. The ChromaTap will be available in both faucet add-on and showerhead replacement versions, and this functional specification covers the requirements for both versions.

NeoSpectra Technologies is made up of four savvy students. Scott Chen, Jacky Cheng, Derek Pang, and Jim Wang will be doing the product development as part of ENSC 440. William Ng, although not currently enrolled in ENSC 440, has been a cofounder of NeoSpectra, and he is valuable source for market and technical consultation.

If you have any questions or concerns, please feel free to contact me personally at 604-306-9511, or the group by e-mail at ensc440-neospectra-tech@sfu.ca.

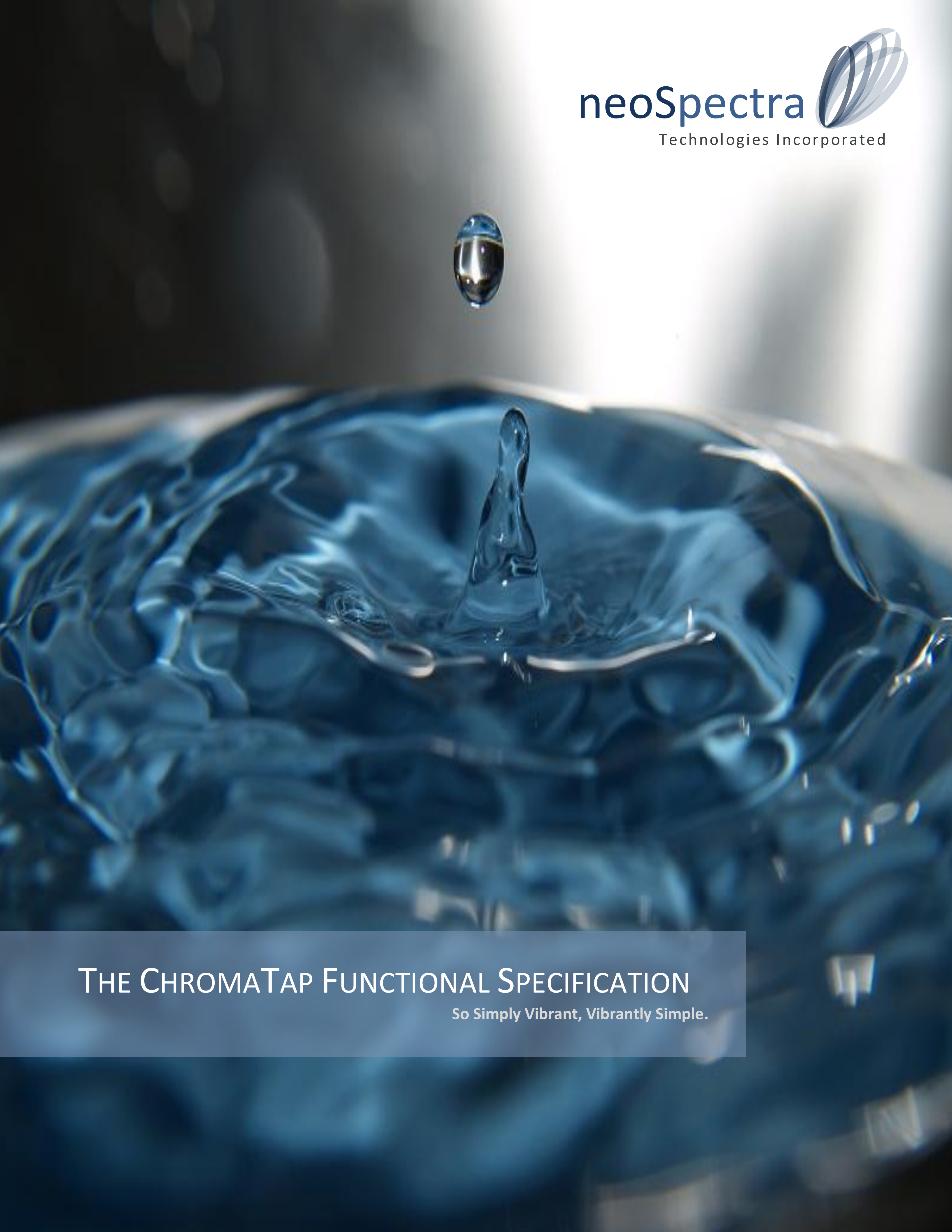
Sincerely,

Derek Pang

Derek Pang
Project Lead
NeoSpectra Technologies Inc.

Enclosure: The ChromaTap Functional Specification

neoSpectra
Technologies Incorporated



THE CHROMATAP FUNCTIONAL SPECIFICATION

So Simply Vibrant, Vibrantly Simple.

[The ChromaTap Functional Specification]

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Issue Date
February 22, 2007

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GLOSSARY

CE: Conformité Européenne. A mark which is placed on a product indicating that it conforms with the relevant essential health and safety requirements set out in the European Directives by the EU (European Union).

CSA: Canadian Standards Association. A leader in safety standards testing in Canada with their own mark, indicating a product has met or exceeded the CSA's safety standards.

FCC: Federal Communications Commission. United States government agency which regulates radio spectra and telecommunications.

FWHM: Full Width at Half Maximum. The difference between the independent variable values for the points at which the dependent variable is equal to half the maximum value.

ICC: Compliance Center Inc: Company founded in 1987 to help companies with compliance with hazardous materials handling and shipping. They have since developed their own set of regulations.

IEC: The International Electrotechnical Commission. A standards organization covering electrical and electronic technologies, sometimes working with ISO.

ISO: International Organization for Standardization, which is an international recognized industrial and commercial standard-setting entity composed of representatives from the national standards bodies

MTTF: Mean Time To Failure. Also known as MTBF (Mean Time Between Failures). Measures the average time between failures of a system.

MSL: Moisture Sensitivity Level: The packaging and handling precautions for some semiconductor products. The standard refers to the time period which a moisture sensitive device can be exposed to ambient room conditions.

NACE International: An organization for the corrosion control industry established in 1943.

NEC: National Electrical Code. A standard for the safe installation of electrical wiring and equipment.

UL: Underwriters Laboratories. A lab which develops standards and test procedures for materials, components, assemblies, tools, equipment and procedures, with product safety and performance in mind.

Executive Summary

Household safety is a growing concern for parents with young children in their care. Thousands of children are injured in the home each year, and the most common injuries among children are burns and scalds. In particular, hot water is a common hazard because it is easily accessible by children, who can suffer serious scalds from as little as one second of contact.

The ChromaTap is an easy to use and affordable solution to the problem of hot water burns in the home. It will address this problem both at the sink and in the shower, by lighting the water stream different intensities of red for hot and blue for cold. This provides a reasonable visual indication of water temperature for the user without compromising the availability of hot water, or requiring costly installation like the other current solutions available.

The objective of our project is to evaluate different design solutions for the ChromaTap (both faucet and shower versions) for engineering merit and commercial potential, focusing on the categories of size, power, reliability, safety, cost, and ease of use. To do this, we will explore three alternate methods of powering the ChromaTap: battery, solar, and water power.

The project is divided into two major phases. In the primary phase, three different prototypes of the NeoSpectra ChromaTap- powered by battery, solar panel, and water turbine – will be constructed and tested, and are scheduled to be completed as a “proof of concept” at the end of April 2007. The secondary phase involves mechanical and miscellaneous feature improvements on the prototype, and revisions to the mechanical and electrical design with the ultimate goal of commercializing of the ChromaTap.

This functional specification document details the requirements that must be met by the prototype development of ChromaTap, as well as the final production model, which has additional requirements imposed on it to ensure a seamless end-user experience.

1. Introduction

The NeoSpectra ChromaTap is an innovative faucet add-on which gives users a visual indicator of water temperature, thus reducing the incidence and probability of hot water related injuries, as well as providing novelty value. It achieves this goal by implementing an internal water temperature sensor and providing an instant visual feedback to the user by lighting the water up with continuous red-blue bi-color spectra, where red represents temperature higher than room temperature, and blue represents below room temperature. In addition, the intensity of the light is designed to reflect the magnitude of water temperature deviation from the room temperature. A shower version, which is a showerhead replacement providing similar temperature visual indication to the faucet version, is also planned.

While being a stylish household decoration, the ChromaTap is also an educational device for underage users, and a safe-guard device for seniors. It is a compact, and simple attachment, which works with all water taps, and is intended to be safe, affordable, and easy to use and install.

The project is divided into three increments, with increments 1 and 2 slated for completion as part of ENSC 440. Increment 1 will produce three different prototypes for the ChromaTap, powered by solar, water, and battery power. Increment 2 will improve upon the prototype deemed the best power solution for the ChromaTap. Increment 3 will add further improvements, resulting in the final production prototype.

1.1 Background

Traditionally, although having control over the water temperature, users often cannot tell the water temperature simply from the knob position, or by looking at the water stream. Moreover, the actual water temperature usually lags behind the user’s chosen setting depending on what was last going through the pipes. The user is lacking a safer method of acquiring feedback about temperature information. However, the ChromaTap is going to solve all of these problems.

1.2 Scope

This document contains an exhaustive list of the functional requirements the ChromaTap prototypes and commercial model are required to meet. The functional specification covers everything from the mechanical design constraints to the electrical and power supply standards, and is subject to increment and improvement upon further prototype tests and market studies.

1.3 Intended Audience

The primary intended audience for this document is the project managers, the development engineers, and the quality assurance personnel at NeoSpectra Technologies Inc. The functional specifications enumerated in this document act as general guidelines to which all the prototype modules must comply. The managers and engineers are obligated to use this document as the fundamental framework for setting the project direction and controlling progress. In the long term, this document also acts as a reference document for the marketing staff.

1.3 Objectives

The following convention is used throughout this document to denote functional requirements:

R[#]-IV Functional specifications requirement

#: Requirement Number
I: Increment Number
V: Variant

I can be represented by one of the following values:

1 – Denotes required features for only Increment 1 deliverables. Increment 1 is the conceptual design phase, and the goal is the production of proof of concept prototypes encompassing the three different types of power generation.

2 – Denotes additional features for Increment 2 deliverables. Increment 2 is the embodiment design phase, where the best design solution from Increment 1 is chosen and further developed.

3 – Denotes additional features for Increment 3 deliverables Increment 3 is the detail design phase and is no part of ENSC 440. Its ultimate goal is the final production prototype.

V can be represented by one of the following values:

S - Showerhead variant
F - Faucet variant
G - General, or both showerhead and faucet variant

2. System Overview

The ChromaTap, the proposed solution to the hot water tap problem, is an easy-to-install faucet attachment that provides an instant visual indication of the water temperature by turning the water stream to blue or red at various intensities. The natural association between red and hot or between blue and cold offers a much quicker feedback that most people can easily comprehend, especially children. A showerhead replacement with temperature-sensitive lighting is also proposed to help protect children and elders in their showers.

ChromaTap shines over the current design solutions. It has the advantage of being affordable and easy to install, while providing a colorful and a continuous visual cue for water temperature. It also allows safe access to hot water when needed. ChromaTap aims to be safe, affordable, and easy to use. To achieve these goals, we will be choosing ChromaTap designs based on a balance of size, power, reliability, safety, cost, and ease of use.

Figure 2.1 : Conceptual Overview of the ChromaTap System

Figures 2.1 depict a simple demonstration of the ChromaTap's operation. The ChromaTap is extremely easy to use: no direct user interface is required for normal operation. The user can easily install the ChromaTap faucet attachment (or a showerhead replacement) in less than a minute. After a successful installation, the device automatically turns on when the user switches on the water tap. Then, the visual indictor of the ChromaTap outputs an appropriate lighting effect: red for hot and blue for cold. The intensities of the lighting is continuously updated according to the temperature level of the water. The operating temperature of the ChromaTap ranges from 0°C to 80°C. When the user switches off the tap, the device automatically turns off.

Figure 2.2 outlines the general system architecture of the ChromaTap for both lavatory faucet and showerhead variants.

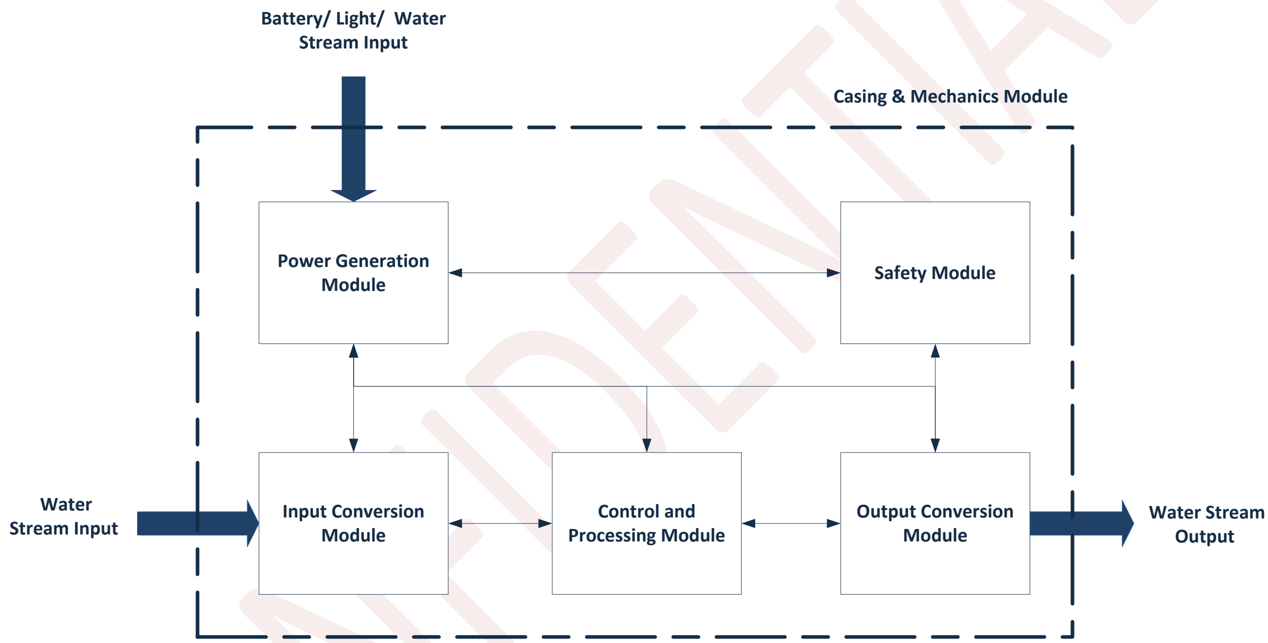

Figure 2.2 : ChromaTap System Architecture Overview

2.1 Power Generation Module

The power generation module is responsible for generating and managing a stable power source for the entire system. We currently has propose three design alternatives for the power generation module: a battery-powered module, solar-power module, and hydroelectric module. However, alternative power generation solutions will be also evaluated. A final power generation method will be chosen appropriately by weighting its associated benefits, costs and design limitations.

2.2 Input Conversion Module

The input conversion module activates the entire ChromaTap system when the user turns on the faucet or the showerhead. The module then gathers the temperature information from the water stream and converts this information into an appropriate format for the Control and Processing Module to evaluate. Modification of the input conversion module may be necessary when connecting to different types of power generation modules.

2.3 Control and Processing Module

The control and processing module assesses the input temperature information and generates an appropriate output to the output conversion module. We may also implement a power management control system to conserve power.

2.4 Output Conversion Module

The output conversion module receives the output information from the control and processing module and converts this information into an appropriate visual indication for the user. The faucet and showerhead variants may have different output configurations and methods.

2.5 Safety Module

The safety module ensures the safety and reliability of the device both mechanically and electrically. The module may be closely integrated with other system components. We will design a robust and safe device that will satisfy various international safety standards and codes. We will also perform reliability testing to counter system failures such as water leaks, power shorts and surges, and corrosion.

2.6 Casing and Mechanics Module

We will design two types of casing modules: one for the faucet add-on, and another for the showerhead. Different power modules will also require different casing designs. We will also perform detailed mechanical simulation and testing to ensure the usability and reliability of the device.

3. Overall System Requirements

This section outlines the general requirements that the ChromaTap product, including the faucet add-on and the shower replacement variants, should satisfy in order to deliver a safe, affordable, easy-to-use and easy –to-install home safety protection device for children and other users. Specific requirements relating to specific system modules are described in other sections of the document.

3.1 Functional Requirements

This section describes all the required top-level functionalities of the ChromaTap.

R[1] - 1G The system must provide a natural and progressive visual indication of the output's water temperature to the user.

R[2] - 1G The system must output and maintain a stable water outflow, at a minimum of 80% of the normal water throughput rate before the installation of the system.

R[3] - 1G The system shall employ the use of a light source to visually indicate the output temperature of the water.

R[4] - 1G The visual output indicator of the system shall be activated in less than 20ms after a user has turned on a faucet or a shower.

R[5] - 2S The shower variant unit shall be a complete and fixed shower head **r**eplacement, and must offer standard shower functionality.

R[6] - 2F The faucet variant unit shall be a faucet add-on unit which does not require replacement of the original faucet.

R[7] - 2G The users must be able to see the colour of the visual temperature indication clearly at all light conditions.

R[8] - 1G The output of the blue light indicator shall be a pure and primary colour source with a wavelength of 460±20nm.

R[9] - 1G The system shall project a blue colour onto the output water stream when the water temperature is below 24ºC(75.2ºF).

R[10] - 1G The output intensity of the blue light indicator shall be linearly proportional to the decrease in temperature with a ±5% tolerance when the output water temperature is below 24ºC (75.2ºF).

R[11] - 1G The output intensity of the blue light indication shall saturate when the temperature is at 0ºC (32ºF) or below.

R[12] - 1G The output of the red light indicator shall be a pure and primary colour source with a wavelength of 635±20nm.

R[13] - 1G The system shall project a red colour onto the output water stream when the water temperature is above 26ºC(78.8ºF).

R[14] - 1G The output intensity of the red light indicator shall be linearly proportional to the increase in temperature with a ±5% tolerance when the output water temperature is above 26ºC (78.8ºF).

R[15] - 1G The output intensity of the red light indication shall saturate when the temperature is at 50ºC (122ºF) or above

R[16] - 1G No visual indication shall be outputted when the water temperature is at 25±1ºC (77±1.8ºF).

R[17] - 2F The projection angle of the output light source shall be at least 30 degrees.

R[18] - 2S The projection angle of the output light source shall be at least 45 degrees.

R[19] - 2F The illumination diameter FWHM at a working distance of 10cm shall be at least 1.5cm.

R[20] - 2S The illumination diameter FWHM at a working distance of 50cm shall be at least 10cm.

R[21] - 2F The maximum brightness of the visual light indication shall have a luminance of 50mcd/m^2 or greater, and illuminance of 4250 lm/m^2 at a working distance of 10cm.

R[22] - 2S The maximum brightness of the visual light indication shall have a luminance of 50mcd/m^2 or greater, and illuminance of 4250 lm/m^2 at a working distance of 50cm.

R[23] - 1G The output visual indicator must not be activated if no water is present at the output.

R[24] - 1G The changes in illuminance level of the visual temperature indication shall be 850±50 lm/m^2 for every 5 ºC (41 ºF) interval of temperature change.

R[25] - 3G Users shall be able to install the device in less than 2 minutes on average.

R[26] - 3G The device shall be fully operational after a successful installation without additional setting or waiting time.

3.2 Physical Requirements

R[27] - 2F The physical dimension of the faucet variant unit shall not exceed 6.00cm (2.36") tall by 6.00cm (2.36") in diameter.

R[28] - 2S The physical dimension of the showerhead variant unit shall not exceed 12.7cm (5.00") depth by 20.32cm (8.00") tall by 15.88cm (6.25") wide.

R[29] - 2F The faucet variant unit shall not weight more than 100g (0.22 lbs).

R[30] - 2S The showerhead variant unit shall not weight more than 550g (1.21 lbs).

3.3 Safety, Regulations and Standards Requirements

R[31] - 3G The module must fully comply with the requirements for the FCC Class B specification for usage in residential areas.

R[32] - 3G The module must conform to all the applicable standards set by NEC, UL and CE for domestic / residential use.

R[33] - 3G The device must conform to the applicable standards set by CSA, including the Canadian Electrical Code Part II Consumer and Commercial Products & General Requirements.

R[34] - 3G The system must conform to the applicable IEC 60335 standards for safety of electrical household appliances

R[35] - 3G The system must conform to the IEC 60529-0-4 Ingress protection rating for protecting equipment inside the enclosure against water intrusion.

R[36] - 3G The system must conform to the applicable IEC 61508 specifications for functional safety of electrical/electronic/programmable electronics safety-related systems.

R[37] - 3G The system shall not contaminate or affect the health quality of the water.

3.4 Power Requirements

R[38] - 2G The peak power consumption of the device shall not exceed 50mW when the visual output is active.

R[39] - 2G The peak power consumption should not exceed 0.1mW when the visual output is deactivated.

R[40] - 2G The maximum current drawn by the system shall not exceed 16mA.

3.5 Environmental Requirements

R[41] - 1G The operating temperature range of the system shall be 0ºC (32ºF) to 80ºC(176ºF) or better.

R[42] - 3G The device shall operate over a humidity level ranging from 5% to 100%.

R[43] - 3G All electrical components and metal contacts must be MSL-1 compliant.

R[44] - 3G The device shall comply with NACE international standards on corrosion control.

R[45] - 3G The device shall be Restriction of Hazardous Substances (RoHS) compliant.

R[46] - 3G The device shall be capable of withstanding shock that will most likely occur during shipment and must therefore meet the requirements of appropriate ICC specifications.

R[47] - 3G The device shall withstand vibrations with a frequency from 0.3Hz to 200Hz with amplitudes as high as 0.5g.

R[48] - 3G The device shall be capable of operation in an environment with radiated electrical fields: 1V per meter from 150kHz through 25MHz, and 10V per meter from 25MHz to 1 GHz.

R[49] - 3G The system shall be capable of operation in an environment with an induced magnetic field : 20A at 60 Hz into the enclosure of the system.

R[50] - 3G The maximum noise level of the device during operation shall not exceed 45dB.

3.6 Compatibility Requirements

R[51] - 3F The faucet variant unit shall easily attach to all faucets of standard sizes, including faucets with 15/16" or 3/4"-sized aerators.

R[52] - 1F The add-on faucet module shall not interfere with the normal operation of the faucet.

R[53] - 2S The shower variant unit shall be compatible with any shower head attachment.

3.7 Performance Requirements

R[54] - 1G The operating range of system shall be 0ºC (32ºF) to 80ºC(176ºF) or better.

R[55] - 1G The accuracy of the temperature indication shall be equal to or lower than ±5% of the specified operating range in R[54], or equal to or lower than ±4ºC, at all water temperature range.

R[56] - 1G The visual temperature indication must be stable with no output fluctuation or flickers at a given temperature.

R[57] - 1G The temperature visual indication response rate shall be 20ms or better.

3.8 Reliability Requirements

R[58] - 3G The device shall have a Mean Time to Failure (MTTF) of 10 years.

R[59] - 3G The unit shall sustain at least 1,000,000 duty cycles of output activations and deactivations.

3.9 Cost Requirements

R[60] - 1G The project development cost of increment 1 shall not exceed CDN$420.

R[61] - 3F The unit production cost of the faucet variant unit shall not exceed CDN$3.50 at a production volume of 25,000 units .

R[62] - 3S The unit production cost of the shower variant unit shall not exceed CDN$8.00 at a production volume of 25,000 units

4. Input Conversion Module Requirements

This section outlines the specific functional requirements of the input conversion module, which convert the temperature information of the water into an appropriate electrical signal for evaluation.

R[63] - 1G The module shall retrieve the temperature information of the input water flow with a delay time of no more than 10ms.

R[64] - 1G The input temperature information shall be updated at a frequency of 60Hz or more.

R[65] - 1G The accuracy of the temperature measurement shall meet the requirement specified by R[55].

R[66] - 1G The module shall detect the presence of water for activating and deactivating the system and its visual output.

R[67] - 1G The module must be able to operate on a 3.00V DC power source with voltage amplitude fluctuation of ±10%.

R[68] - 3G The input conversion module must fit in a 15mm x 15mm x 15mm physical enclosure.

R[69] - 3G No electrical components, excluding the component that retrieve the temperature information, should not be exposed to the water, and should be properly sealed from water.

R[70] - 3G Users must not have any means to access the input conversion module.

R[71] - 1G Within the operating temperature range specified in **R[54],** the input conversion module must convert temperature information at different levels into voltage signal of different amplitudes using a linear relationship with a tolerance of 5%.

R[72] - 1G The peak power consumption of the input processing module shall not exceed 10mV.

R[73] - 1G The system's internal heating will not affect the accuracy of the temperature measurement unit.

5. Output Conversion Module Requirements

This section describes all the specific requirements that the output conversion module should satisfy. The output conversion module converts the electrical signals from the control module into an appropriate visual temperature indication output.

R[74] - 1G The output conversion module should convert the output electrical signal from the control and processing module into an appropriate visual temperature indication as specified by R[7] to R[24], with a delay of less than 100µs.

R[75] - 1G The output visual temperature indication shall be refreshed at a frequency of 60Hz or higher.

R[76] - 3G The output conversion module must fit in a physical enclosure of 10mm x 10mm x 10mm.

R[77] - 2G All electrical components shall not be directly exposed to water.

R[78] - 3G Users must not have any means to access the output conversion module.

R[79] - 1G The module must be able to operate on a 3.00V DC power source with voltage amplitude fluctuation of ±10%.

R[80] - 1G The peak power consumption of the output conversion module shall not exceed 20mW.

6. Power Generation Module Requirements

This section consists of requirements specified for the power generation module of the ChromaTap system. The power generation module provides and controls all the regulated energy required by the device.. The power sources of the system can be varied and may include batteries, rechargeable power, solar power, and hydroelectricity. However, all power generation solutions must fully comply with all requirements listed in this section.

R[81] - 1G The power generation module must provide a constant 3.00V DC, with voltage amplitude fluctuation of ±10% or lower.

R[82] - 1G The power generation module must supply energy when the system is activated with a delay of 100µs or less.

R[83] - 1G The peak power consumption of all power control and regulation units shall not exceed 1mW.

R[84] - 1G The module must provide a maximum current drain of 16mA or higher.

R[85] - 1G The average lifetime of the power source (i.e. batteries) shall be 3 years or greater before the users must replace the power source.

R[86] - 1G If the module requires a power source replacement, the power source compartment must be easily accessible, and users must be able to change the power source in less than 30 seconds on average.

R[87] - 2G When renewable energy sources, such as solar light and sufficient water flow, are not present, the module must sustain at least 40 minutes of continuous operation.

R[88] - 2G The power generation module shall protect other modules from power surge or other power irregularities.

R[89] - 3G All electrical connections and components should be properly sealed from water.

7. Control & Processing Module Requirements

The control and processing module evaluates the temperature information from the input conversion module, and outputs an appropriate voltage output to the output conversion module. This section lists all requirements applicable to the control and processing module.

R[90] - 1G The control and processing module must process the temperature readings from the input conversion module and control the output conversion module to output the specified temperature visual indication as specified in R[74].

R[91] - 1G The processing time of the module shall not exceed 1ms.

R[92] - 3G The control and processing module must fit in a 10mm x 12mm x 10mm physical enclosure.

R[93] - 1G The module must be able to operate on a 3.00V DC power source with voltage amplitude fluctuation of ±10%.

R[94] - 2G All electrical components shall not be directly exposed to water.

R[95] - 3G Users must not have any means to access the output conversion module.

R[96] - 1G The peak power consumption of the module shall not exceed 5mW.

8. Casing & Mechanical Module Requirements

The casing and mechanical module holds the system together and keeps system safe from outside disturbances. This module also enables and enhances the usability and reliability of the system. This section lists all the specific requirements that the module shall fulfill.

R[97] - 3G The casing module shall enable the device to be easily assembled and installed by the user. Assembly and installation should not take more than 2 minutes on average.

R[98] - 3G The casing shall hold all system components together as a single standalone device.

R[99] - 3G All casing and mechanical components shall withstand the operating temperate specified on R[54].

R[100] - 3G The casing shall isolate all electrical components completely from water.

R[101] - 3G The casing shall have smooth and symmetric edges and corners.

R[102] - 3G The casing design shall target children between the ages of 4 to 8 as its typical users, and be designed in a way which appeals to them.

R[103] - 3G The casing module must be able to tolerate strains and pressures of at least $7N/m^2$ at all angles.

R[104] - 3G The casing module shall not sustain any damage when it is dropped 2m or higher above the ground at any orientation.

R[105] - 3G The casing module shall withstand abrupt changes in temperature at a rate up to 10ºC/s.

R[106] - 3G The moisture level inside the water-sealed compartments shall be at 60±10%.

R[107] - 3G Mineral and other deposits from water shall not affect day-to-day operation of the device

R[108] - 3G Water shall not leak from the casing module anywhere other than the intended output of the device.

9. Documentation & User Training Requirements

9.1 Documentation Requirements

This section describes all the required features to be provided in the ChromaTap installation and operation manual.

R[109] - 3G The installation and operation manual will be provided in English, French, Traditional and Simplified Chinese, German, Japanese, Spanish.

R[110] - 3G The installation and operation manual must provide clear step-by-step installation instructions and explanations on device features.

R[111] - 3G The installation and operation manual must provide unambiguous device specifications, precautions, and troubleshooting instructions and FAQ's.

R[112] - 3G The manual must provide contact information for the company and cover details of the product warranty. Alternatively, warranty information can be provided in a separate warranty card.

R[113] - 3G The manual must mention all relevant safety certifications met or exceeded by the ChromaTap product.

R[114] - 3G The manual will detail safe and environmentally friendly disposal of any depleted batteries.

R[115] - 3G The manual will explain how the solar charging system works and the expected performance metrics users can expect from the device; such as light exposure requirements.

9.2 User Training Requirements

This section describes all the requirements to simplify user training.

R[116] - 3G The mechanical design of the device must be simple and intuitive in order to minimize the required training time

R[117] - 3G The installation manual must provide a detailed user-training section (although it does not necessarily need to be denoted specifically as a user training section) covering device operation and safety instructions.

R[118] - 3G NeoSpectra Technologies Inc. must dedicate a team of engineers for technical support in order to provide user-training instructions in English, French, Chinese, and Japanese.

R[119] - 3G Users must be trained on replacement on the battery when the need arises.

R[120] - 3G Users should be informed that the solar panels should be kept clean for optimal device operation.

10. Quality Assurance Requirements

Not only does a successful product come with benefits and functionalities that a user might want, but it also requires high quality and strict standards. NeoSpectra is committed to devote an immense amount of resources on the quality control of the ChromaTap product, ensuring every ChromaTap produced has all met the requirements listed in this document. Furthermore, we will also assure our ChromaTap products carry social benefit to most people and the environment.

R[121] - 3G NeoSpectra Technologies Inc. shall fully comply with the ISO9000 standard for quality management system during the development and production of ChromaTap.

R[122] - 3G NeoSpectra Technologies Inc. must satisfied all standards set by ISO14000 for being a responsible corporate environmental citizen.

11. Device Limitation

The intention of ChromaTap is provide users with a quick visual temperature indication of the water running from a faucet or a shower. This section lists some of the major design limitations that the ChromaTap may impose.

1. The ChromaTap is not able to predict future changes in water temperature.

2. The battery-powered ChromaTap variant will not operate indefinitely without user maintenance (replacement of the battery).

3. The solar-powered ChromaTap variant requires occasional exposure to light to operate. If the power reserve is drained, it will require continuous exposure to light in order to recharge the power reserve.

4. If the power reserve for the water-powered ChromaTap variant is drained, there is a minimum level of water flow required before the device will operate and the power reserve will begin to recharge. Users running their water at relatively high flow rates should not be affected.

5. The ChromaTap does not provide any indication of water temperature for colorblind individuals.

6. Prototypes will not have any explicit shock protection.

7. Increment 1 prototypes will not fit in sinks of non-standard size.

8. The ChromaTap is not designed to withstand severe shock or inappropriate use. Any abusive usage, such as exposure to excessive heat or pressure, or high damage impacts, will result in device failure. The ChromaTap is designed to perform normally only assuming the shock encountered is of a small magnitude as part of normal day-to-day operation

9. The ChromaTap is unable to prevent the user from intentionally burning themselves on excessively hot water, or suffering hypothermia from prolonged exposure to excessively cold water.

10. The ChromaTap will not provide any benefits other than giving most users a visual warning of water temperature.

11. The ChromaTap is not self-installing; it requires the user to securely attach the product to the faucet

12. For installation, the user must first remove any existing shower or faucet attachments before installing the ChromaTap.

12. Conclusion

This document has clearly defined the functional requirements for the prototype and final versions of the ChromaTap. Meeting these functional requirements will ensure a product which delivers on the promise of a safe, affordable, and easy to use and install faucet add-on or showerhead replacement. The ChromaTap will provide this by lighting the color of the water different intensities of red for hot, or blue for cold.

The development of prototypes which meet the requirements detailed in this document is scheduled for completion by April 2007.

13. References

Reference

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The ChromaTap Functional Specification

So Simply Vibrant, Vibrantly Simple.