**EGR 302 – Engineering Design and Documentation**

**Deliverable 3: Requirements Specification**

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Version: \_\_\_\_\_\_\_\_\_Version 2\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**3.1 Constraints**

Constraints involve the limits of variables that create the product. These values are only what is needed to accomplish what is specified by the client.

**Functionality:**

- The light wand length should be between 30-50cm so someone can clearly see from up to 50 feet away.

- Should have a timer that the user can set

- A wide or heavy base to prevent major wobble due to rotation

- Should have a moderate strength magnets on the bottom of base to prevent sliding on a slightly slanted surface

- Light wand must have at least 30 LEDs to create a clear enough image

- Max amount of rotational wiggle room < 1cm

- There needs to be two microcontrollers, one on the base that wirelessly sends data to another one on the rotating armature

**Economic:**

- Total budget: $250

**Energy:**

- battery life:

- 1 full hour run time

- 4 months while not in use

**Usability:**

- Easy to assemble with light wand attaching to the base

- Needs to be able to fit in the average car trunk

- Should be less than 30 pounds

- Easy to carry for a short distance

**Health and Safety:**

- Light wand should not rotate at 960 - 1500 rpms to reduce chance of seizures

- Motor should quickly stop when something obstructs the rotation like a hand or ground after being tipped over

**Operational:**

- Must be able to run in temperatures ranging from 30-120 fahrenheit

**Time:**

- Must be built in 1 month

**3.2 Standards**

Standards are ways of doing things that apply to specific aspects of products. They are used to make sure that products work together (example: computers work with printers, internet, mousepads, and other attachable objects). There are many forms of standard procedures including: safety, communications, programming languages, and connector standards.

**Safety**

* + ISO 13849-1
    - Control Systems
      * <http://www05.abb.com/global/scot/scot209.nsf/veritydisplay/f282e8fb773fa733c1257996004307a6/$file/en_iso_13849-1_2tlc172003b02002.pdf>
  + UL 817
    - Cord Sets and Power-Supply Cords
      * This is a possible standard. Things could develop during this project where this standard would then become obsolete.
  + UL 94
    - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
      * Possible standard if this project uses plastic materials
  + UL 746C
    - Polymeric Materials - Use in Electrical Equipment Evaluations
      * Possible standard if this project uses plastic materials

**Communications**

* + IEEE 802.11-2012
    - Standard for Wireless Radio
  + IEEE 802.15.1 (no longer maintained)
    - Standard for Bluetooth Technology
      * Used for Bluetooth Transmitter/Receiver
  + IEEE 802.11g
    - Amendment to Wireless Radio Standard
      * Used for Arduino Shield
  + IEEE 802.14.4
    - Standard for low-rate wireless personal area networks (LR-WPANs)
      * Used for IR Blaster
  + USB 3.0
    - Standard for USB connection (backwards compatible with 2.0)
* Programming Languages
  + ISO/IEC 9899:2011
    - Standard for C Language
* Connector Standards
  + SPI (Serial Peripheral Interface)

**3.3 Requirements Specification**

Specifications are precise, unambiguous, measurable statements about what the product will do. They contain a metric and a value, and they specify behaviors, functions or attributes. They are the targets that the product must satisfy.

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| --- | --- | --- |
| Marketing Requirements | Engineering Requirements | Justification |
| 1 | 1. The light wand length should be 30 – 50 cm. | Based on eye tests, a person with 100/20 vision can read something 363mm from 50m |
| 3 | 1. The whole product together should weigh less than 30 pounds. | The product needs to be relatively light. Something over 30 pounds is hard to lift over the head. |
| 1 | 1. There should be at least 30 LEDs on the wand | The image should be clearly read and understood, more detailed |
| 2 | 1. The product should have 1 hr run time and 4 months down time charge storage | A requirement given by the client |
| 4 | 1. The product should be able to run in temp. 30 -120 F. | The product should be operational within normal weather constraints. |
| 1 | 1. Max amount of rotational wiggle room < 1cm | The product should not be blurry or unstable because of wobbling |
| 1 | 1. The diameter of rotating arm should be from 40 - 45cm | The ratio of width to height should be 16:9 |
| 1-5 | 1. Production cost should not exceed $250 | Required by the client. |
| 3 | 1. The size of the disassembled product should not take up more than 30cm by 30 cm by 20cm. | The product should easily fit in a trunk of a car. Cars usually have at least 30cm height and 50cm by 50cm area in their trunk. |

Table 3.1 Marketing requirements

**Marketing Requirements:**

1. The device should generate an image that can be seen far away.

2. The device should provide adequate run time and charge storage capabilities.

3. The device should be moderately easy to carry and fit in a car trunk.

4. The device should be able to operate in typical outdoor temperatures.

**Discussion:**

The product’s engineering specifications are developed from the marketing requirements. They are attempts to fulfill the requirements using measurable values and justifiable, scientific reasons.

The first engineering requirement deals with creating a light wand that is big enough for the average person to see at 50 meters. There was research done into peoples’ eyesight and what defines a clear image.

The second engineering requirement has to do with the portability issue of weight. The weight value of 30 lbs is strictly an estimation of what someone is comfortable to carry a short distance or have to lift over their head.

The third engineering requirement pertains to creating an image with a high enough resolution to distinctly represent one character from another. A light wand with 30 LEDs is a good base number and can be improved fairly easily.

Engineering requirement 4 and 5 are constraints set by the client and both can be realistically achieved. The motor needed to rotate the armature does not need much torque and the rotational speed is reasonable. The temperature range requirement is reasonable for standard usage conditions.

For engineering requirement 6, the max rotational wiggle room of less than 1 cm is an educated guess. It is expected that there will be some uncertainty with each rotational motion being identical to the previous one.

Engineering requirement 7 deals with a desire to create an image with a 16:9 ratio. This would make it more pleasing to the eye and is what people are used to seeing.

For Engineering requirement 8 the budget was set by the client and all marketing requirements can be tied to staying within budget.

Engineering requirement 9 deals with the portability of the product and its ability to fit in the average car trunk in the disassembled state. These are not strict restrictions but should be understood that a small change in one dimension can make the difference between fitting in the trunk or not.