Homework 4: Packaging Specifications and Design

Team Code Name: _____ Every1DJ**_____ Group No. _**2**___**

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Evaluation:

SEC	DESCRIPTION	MAX	SCORE
1.0	Introduction	5	
2.0	Commercial Product Packaging	-	
2.1	<Product #1>	10	
2.2	<Product #2>	10	
3.0	Project Packaging Specifications	20	
4.0	PCB Footprint Layout	10	
5.0	Summary	5	
6.0	List of References	10	
App A	Project Packaging Illustrations	10	
App B	Project Packaging Specifications	10	
App C	PCB Footprint Layout	10	
	TOTAL	100	

Comments:

Introduction

The Every1 DJ is an interactive DJ system that allows users to vote for songs they wish to be played next. The song selection and voting process will take place on a web application which will interact with the onboard audio streaming device.The system will include a disco ball that sits on a box-shaped base which will rotate to the beat of the music. The base will house all of the electronic hardware as well as the motor. An LCD screen will be mounted on the exterior of the device to display current song information. In addition, pushbuttons will be accessible to the users in order to skip songs or modify playback and allow for volume control. Finally, four LED's will be mounted on posts that project up at a 45-60 degree angle from the base. One LED will be designated to each corner of the base. The LED's will face the disco ball and react to the sampled audio by periodically changing color.

2.0 Commercial Product Packaging

There are a significant amount of DJ and party systems on the market today. Below are two products currently on the market, each with different packaging designs.

2.1 Product #1

The LumiSource Novelty Lighting Disco Ball Table Lamp with 2 Mirrors, Figure 1, is a commercial product sold at WalMart [1]. The packaging includes a black plastic base, where the power button and the lighting unit are housed. The rotating disco ball sits on top of the base. The dimensions of this product measure 9.5" H x 5" W x 10" D.

One great aspect of this design is that the lights are housed outside of the discoball. Originally, the Every1 DJ design featured LED's mounted inside the discoball. After further research into other designs, it was determined that external lights would be easier to mount and there would be no issues with rotating wires. In addition, the reflective effect of near-mounted LED's is significantly more impressive than interior-mount, externally directed LED's.

Aside from its lack of song selection, voting, and playback control, this system differs from the Every1 DJ in another significant way: the lighting and rotation of the disco ball does not change based on an input frequency. Because of this design difference, the Every1 DJ will need a larger

base to store a microcontroller and Raspberry Pi. The Every1 DJ will also require an auxiliary output mounted on the base for users to attach speakers to the system.

Figure 1: LumiSource Novelty Disco Ball Table Lamp

2.2 Product #2

The Creative Motion Twin Mirror Ball is another DJ system that is currently on the market and is available at Walmart [2]. This design, Figure 2, features two disco balls and multiple LED's attached to a black plastic base. The Creative Motion base is much smaller than other designs on the market because it has a more upright design in which the disco balls are attached perpendicular to the base. This design measure is 19.4 "W x 22.4" D x 12.8" H.

Because there are two disco balls in the Creative Motion design, the base must accommodate enough room to fit twice the amount of hardware. This includes motors, lights, etc. The disco balls in the Creative Motion design are also much smaller than the Every1 DJ design. According to the customer reviews, the two disco balls are about the size of softballs. Some customers complained about the size stating that it is not big enough to light up a whole room.

Again, this product mounts the LED's externally from the disco ball, which eliminates the issue of spinning wires.

Overall the Creative Motion Twin Mirror Ball is a great design but does not completely fit the needs of the Every1 DJ. This includes the ability for the motors and lights to change according to the music being played. Another difference is that the Every1 DJ design will include an LCD mounted at the base that will display current song information to the users. This feature is something that was not found in researching other DJ and party systems.

Figure 2: Creative Motion Twin Mirror Ball

3.0 Project Packaging Specifications

The design starts off with a 10.75x6.78x4.332 inch box that will contain the motor, LCD, PCB board, and the Raspberry Pi. A hole will be drilled at the top of the box where the motor drive shaft will emerge. A hole will be cut in the side of the box for the LCD to be mounted. The PCB board and the Raspberry Pi will be mounted on the bottom of the box. There will be four 6 inch poles that will be on each corner at an angle of 45 degrees. The LEDs will be placed at the end of the pole and the wires will go up through the center of the pole. Mounting the LEDs on the outside of the rotating ball simplifies the design in that wires won't be tangled. It was determined that a sufficiently bright and entertaining lighting display could be accomplished with a small number of LED's. The rectangular shape of the base lends itself well to mounting a single LED on each corner. On the motor, there will be a small rectangular plate that sits on the shaft of the stepper motor, which will be designed using a 3D printer. The 12 inch disco ball will be sitting

on top of the plate by glue to makes sure that when the motor starts spinning, the ball will not fly off.

4.0 PCB Footprint Layout

The amount of space in the box enables the PCB board to vary in size dramatically. Because of the aggregate footprint of the current parts selection, the PCB board was determined to measure 101.6x127 mm. The microcontroller mainly controls most of the functions of the design, so it will sit in the middle of the board. In this model, we will be using 20 I/O pins to control LEDs, control the motor, audio sampling, and connection of the Raspberry Pi. To control the four LEDs on the corners of the box, we are using a LED driver that connects to 6 I/O pins on the microcontroller, so it will be placed near the microcontroller. The 3 pin connector is used to connect the Raspberry Pi to the microcontroller so that will also sit near the edge of the board, but also close to the microcontroller because it uses 3 I/O pins from the microcontroller. There will be two audio connector ports that will sit at the top of the board and they are used to bring in the audio signal from the Raspberry pi so that it can be sampled by the microcontroller using an I/O pin. The reason why there are two is because the other one is used to take the signal from the Raspberry Pi and put it on an audio port so that the users can plug in their own speakers to the device. Finally in regards to power supply, we will be using a 12V power supply. This is because 12V is needed to supply the motor. We also need 5V to power the Raspberry Pi and 3.3V to power the microcontroller and the LED driver. To drop the voltage from 12V to 5V, we are going to use a LM 7805 transistor with a 4.7 uF capacitor. To drop 5V to 3.3V, we are going to use a MAX856CSA regulator which is also in the footprint placed close to the microcontroller due to the output of the MAX856CSA will be used to power the microcontroller.

5.0 Summary

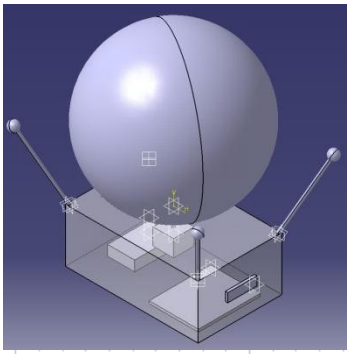
The Every1 DJ design was selected specifically due to the effects that rhythmically pulsing lights have on a disco ball. The LED's will be mounted outside of the disco ball's interior in order to avoid potential issues with rotating wire harnesses and cabling. Ultimately, the placements of all the components were strategically decided simplify construction and maximize output lighting effects. Therefore, the biggest packaging constraint is ensuring that the disco ball rotates freely with minimal structural interference and supplies an effective lighting display.

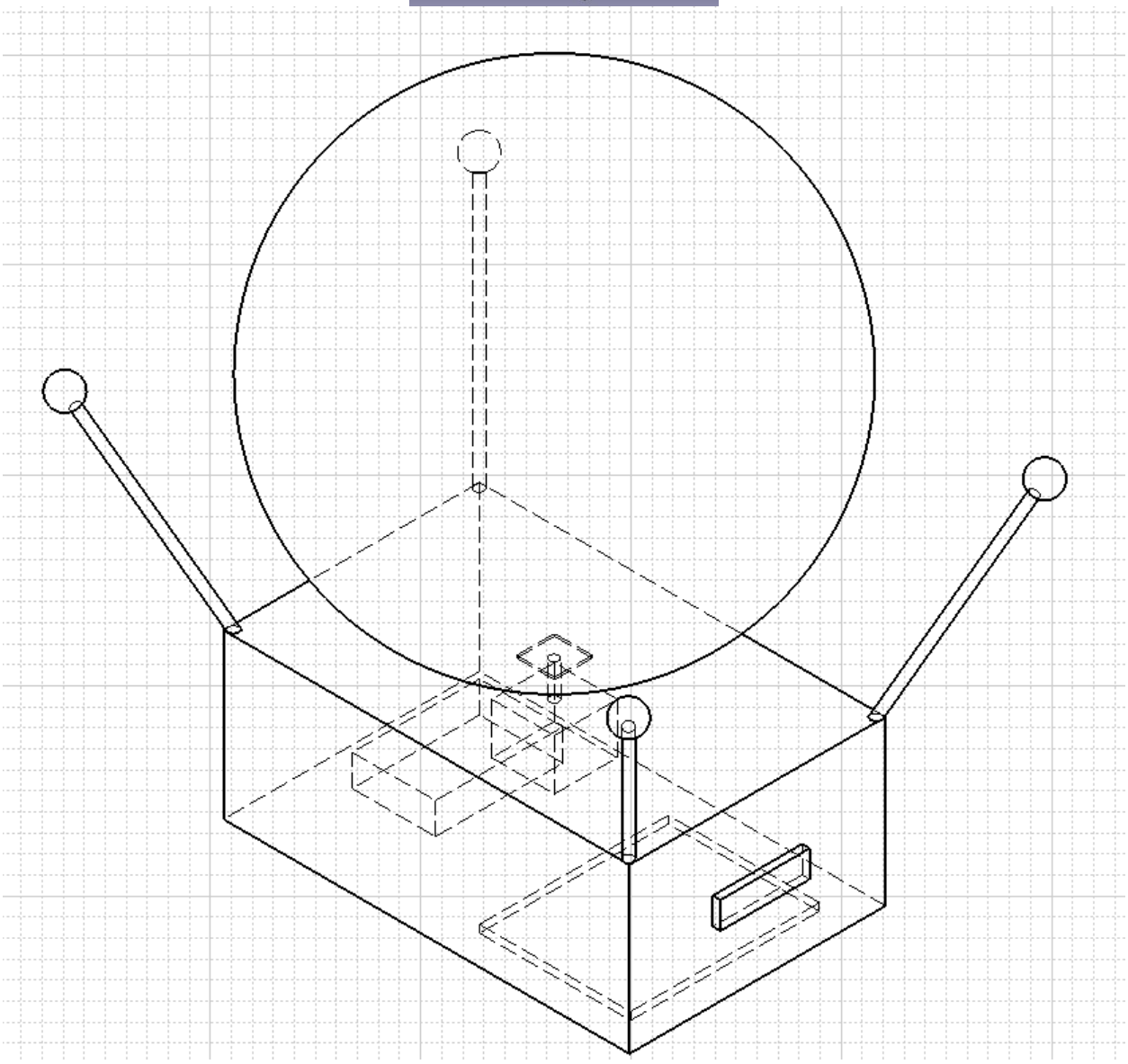
6.0 List of References

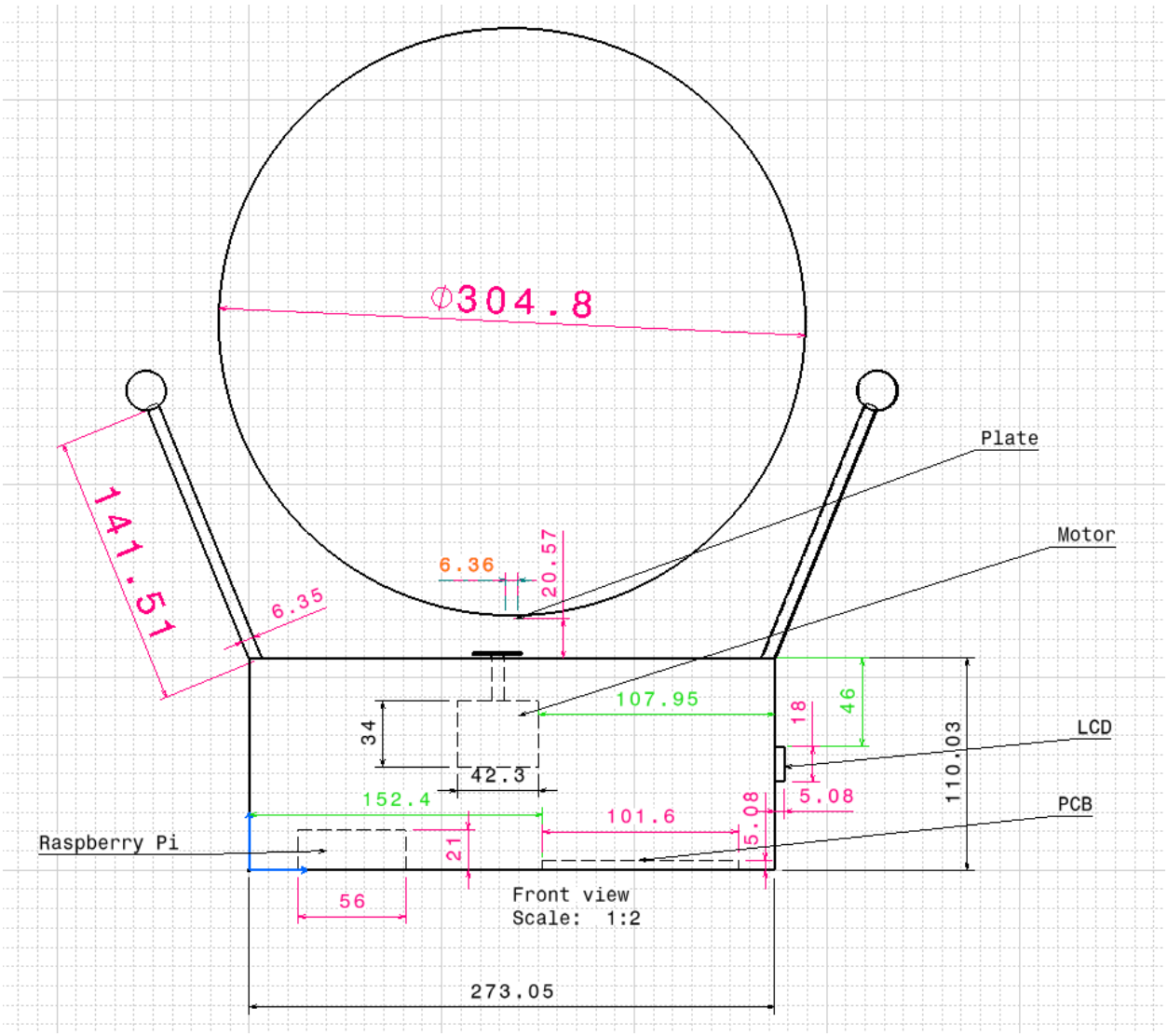
[1] "LumiSource Novelty Lighting Disco Ball Table Lamp with 2 Mirrors." Internet: http://www.walmart.com/ip/LumiSource-LumiSource-Disco-Ball-with-2-Mirrors/21432012, [Feb. 13, 2014].

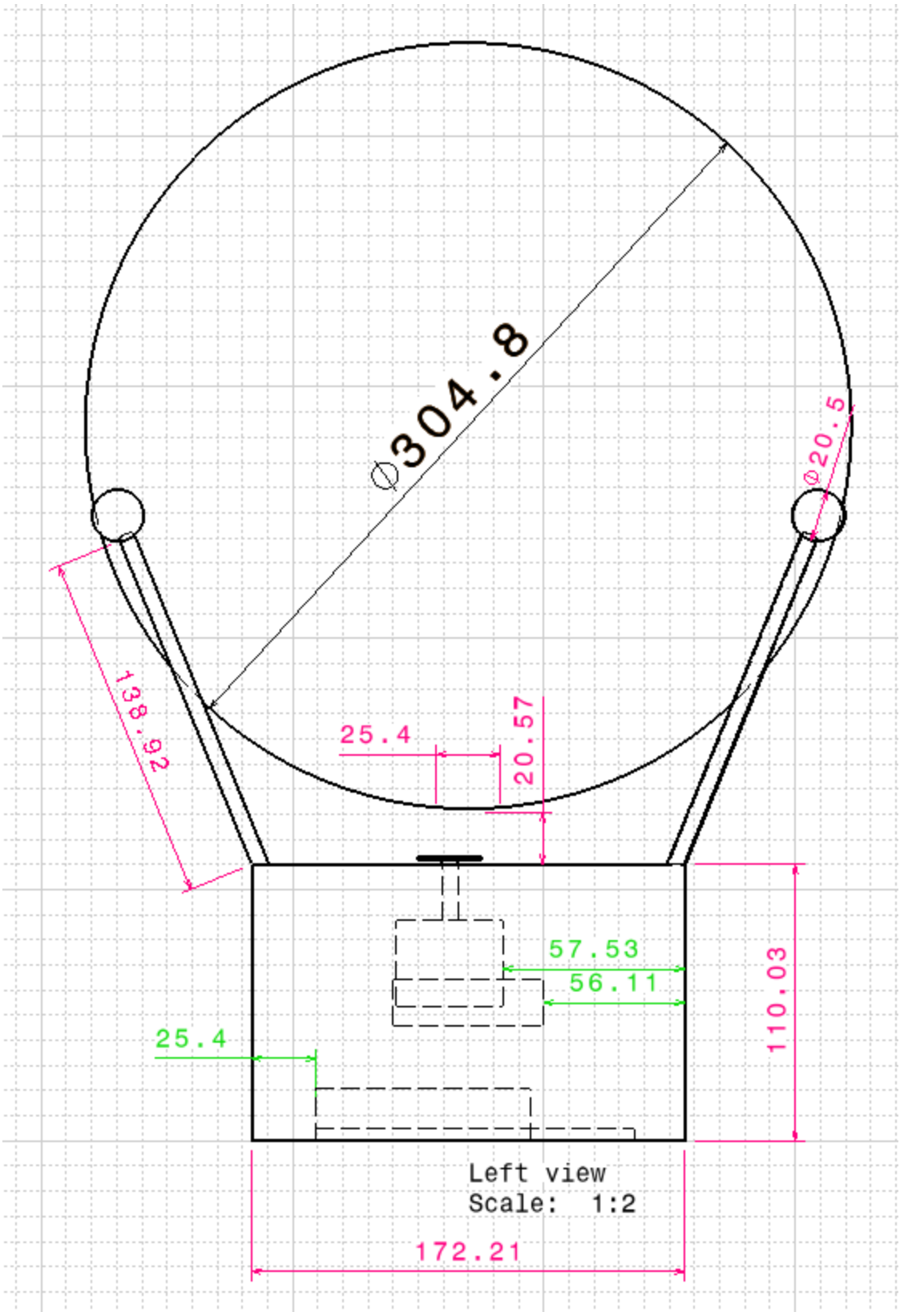
[2] "Creative Motion Twin Mirror Ball." Internet: http://www.walmart.com/ip/Creative-Motion-Twin-Mirror-Ball/13845000?action=product_interest&action_type=image&placement_id=irs_middle&strategy=PWVUB&visitor_id=66262534639&category=0%3A4044%3A133012%3A133113%3A556513&client_guid=48de2272099044e080901090bfd80a22&config_id=0&parent_item_id=21432012&guid=ee654ba55d8e43a7bb9b2601181ab5f0&bucket_id=irsbucketdefault&findingMethod=p13n#Product+Reviews, [Feb. 13, 2014].

Appendix A: Project Packaging Illustrations






Φ304.8
141.51
6.35
6.36
20.57
Plate
Motor
LCD
PCB
107.95
34
42.3
18
46
110.03
152.4
101.6
5.08
5.08
21
Raspberry Pi
56
Front view
Scale: 1:2
273.05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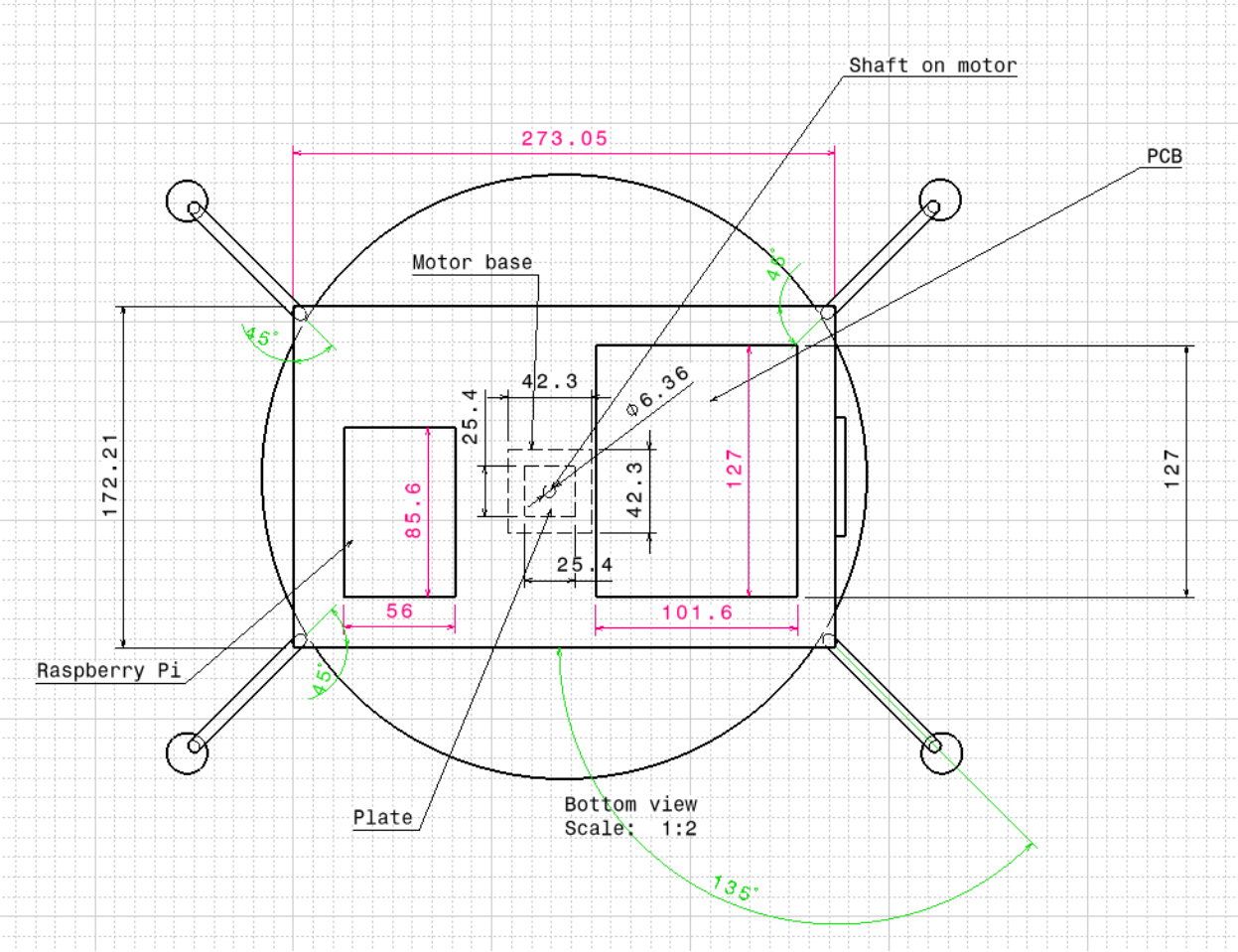
25.4
20.57
57.53
56.11
25.4
110.03
Left view
Scale: 1:2
172.21


Shaft on motor
273.05
PCB
Motor base
45°
45°
172.21
42.3
25.4
ø6.36
85.6
42.3
127
127
25.4
56
101.6
Raspberry Pi
45°
Plate
Bottom view
Scale: 1:2
135°

Appendix B: Project Packaging Specifications

Material	**Cost**	**Quantity**	**Total Cost**	**Weight**
LCD Screen	27.65	1	27.65	0.04 lb
3W RGB LED	14.95	4	59.80	0.01 lb (5 grams)
PCA9626 12C LED Driver	4.90	1	4.90	N/A
LM 7805	1.99	1	1.99	N/A
TIP120	0.80	4	3.20	N/A
12 inch disco ball	19.99	1	19.99	4 lb
Stepper Motor	14.95	1	14.95	0.469585
Switching Regulators - MAX856CSA	2.93	2	5.86	N/A
Enclosure (by itself)	33.70	1	33.70	1.7 lb
Crystal Oscillator	1.12	1	1.12	N/A
Wall Adapter (12V)	5.95	1	5.95	0.432
6 inch Poles	4.80	4	19.20	0.2
Single Audio port	1.35	2	2.70	N/A
Male to male audio cable	2.67	1	2.67	N/A
3 pin connector	4.90	1	4.9	N/A
Total Cost			208.58	

Weight

Enclosure is going to house: Raspberry Pi (.4375 lb) and memory card (0.04 lb), microcontroller (0.44 lb), motor (.469585 lb), and LCD (0.35 lb). With that being said the enclosure is going to weigh approximately: 1.737 lbs. Outside the enclosure are the LEDS (.04 lb) placed on poles (.2 lb), a power supply(.432 lb) and a disco ball (4 lb).

Approx enclosure (with everything) weight	1.737 lbs
Approx external weight	4..672 lbs
Approx Total Weight	6.409 lbs

Therefore looking at the total weight, we hit it a very reasonable weight that could be table top as well as portable.

Special Tooling Requirements:

A plate will sit on top of the motor shaft in order to provide a connection between the motor and the disco ball. The plate will be developed in CAD and fabricated on a 3D printer. Therefore, the special tooling requirement needed to build this device will be the use of a 3D printer that can be found in fabrication shop or other places around campus.

Appendix C: PCB Footprint Layout