Mechanical Overview

Year: 2025   **Semester:**Spring   **Team:** 10   **Project:** Smart Card Shuffler
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Assignment Evaluation: See Rubric on Brightspace Assignment

1.1 Commercial Product Packaging

In this analysis, I will look into 3 commercial products that are similar to our smart card shuffler. The XMSJ Casino Machine Card Shuffler, Rareidel Automatic Card Shuffler, and Bingox Automatic Card Shuffler. All of these 3 products come at vastly different price points which offers us with a variety of options to compare to. A key difference to note is that all 3 of these products are normal card shufflers that only provide a random shuffle. None of these card shufflers are able to manipulate the card orders.

1.2 Product #1

XMSJ Casino Machine Card Shuffler

Weight: 10 kg

Size: 70*50*30cm

Materials: Metal, Plastic

Power: Wall powered AC

Price: $5028.36

Decks: 1

This commercial product is a professional casino card shuffler. The shuffler is made out of metal and hard plastic parts. It has a professional full black design. The design is wall-powered making it less portable. It also has a heavy weight which makes it not suitable for all environments. Additionally,

The XMSJ Casino Machine Card Shuffler is a professional card shuffler designed to be used in professional settings such as casinos. The machine is made from both metal and hard plastic which ensure the machine is durable and that no parts easily wear and tear. This is essential for a professional product like this as it will be used extensively on a daily basis. However, this also leads to an increased weight and price as these packaging materials cost much more and are much heavier than other packaging materials. Another factor which contributes to the products lack of portability, other than its heavy weight, is that the project is wall-powered. This does ensure continuous operation and removes the burden of changing batteries. However, this reliance on an AC power source limits its portability, making it less suitable for casual or home use. Moreover, the shuffler can only take one deck at a time, which is not ideal for games requiring multiple decks.

The XMSJ is also extremely expensive, priced at $5028.36, making it inaccessible for most consumers outside of professional casino settings. Given the high cost and complex mechanical components, its packaging is much higher quality than other commercial designs. The weight of the device is 10 kg which is extremely heavy, however this does add to its rigidness and stability. The size is 70*50*30 cm which is rather large and would take a good chunk of available table space.

While this product is great in terms of durability and reliability, its lack of portability, single-deck capacity, and high cost make it less practical for most consumers. For our prototype, we will incorporate the wheel design to shuffle the cards as we think it is the most efficient option. Additionally, we will also have an option to take out the covers to allow users to see inside the machine and how it works. We also hope to imitate this product's packaging and finishing to make it look professional and high quality. We hope to do that by paining the product and adding vinyl stickers. Lastly, we will also have an AC power supply as many of our components need high voltages and cannot run from normal batteries.

On the other hand, there are several things we hope to differentiate from this shuffler. Our designs hopes to have a much smaller size, approximately 0.75 times the size. Additionally, we hope out product will not weigh over 5 kg as we will be using wood and PLA plastic for most of the design which is much more lightweight than metal and hard plastic. Our product aims to be a casual and home-use shuffler that can be used to pull practical jokes on your friends. It must be decently portable and compact. Our product will also output the deck of cards in a tray, unlike this design which requires the user to manually remove each card.

1.3 Product #2

Rareidel Automatic Card Shuffler

Weight: 0.43 Kilograms

Size: 8.46 x 4.45 x 4.29 inches

Materials: Plastic

Power: Battery Powered

Price: $15.88

Decks: 2

The Rareidel Automatic Card Shuffler is a budget-friendly, lightweight, compact and portable solution for casual card players. There are several variations of this design available on the internet and they are generally the cheapest options. The product is constructed entirely out of weak plastic making it cheap to produce however it also makes it not as durable as other designs. The device runs on batteries, making it highly portable and convenient for casual at-home users. The device can also shuffler up to two decks. The card shuffler does not provide any option for users to see the internal mechanisms at work. It also has a removable tray to make it easier for

players to pick up cards after they are shuffled. On the other hand, the device offers a low-quality design and looks very unprofessional. The product is also very small at only 8.46 x 4.45 x 4.29 inches.

One of the biggest advantages of the shuffler is its affordability. This makes it attractive for hobbyists and casual players looking for a simple and inexpensive shuffling machine. However, the plastic material may not withstand prolonged use, and the shuffling mechanism may not be as robust as those found in higher-end models.

For our product we hope to imitate the products light weight and its small size. We also hope to have a tray for the cards to get outputted to, similar to the one in the product. We will also add vinyl stickers on the design similar to this one.Lastly, we aim to have our product be able to shuffle 2 cards too.

On the other hand, we hope our product will be much more sturdy and professional looking than this design. Additionally, our product will look more high quality. Our product will also have an option for users to look inside. It will also have a different shape rather than this box design and it will have one place to put cards in and not 2.

1.4 Product #3

Bingox Automatic Card Shuffler

Weight: 1.85 lbs

Size: 10.00 x 10.00 x 10.00 Inches

Materials: ABS Plastic

Power: Battery Powered

Price: $149.99

Decks: 5

The Bingox Automatic Card Shuffler is a mid-range product. It balances affordability, functionality, and durability. The product is made from ABS plastic making it slightly more durable than the Rareidel shuffler while also being able to remain decently lightweight. Its strongest feature is its ability to shuffle up to five decks, which makes it the most efficient option for games that need multiple decks compared to the 3 models we are analyzing. The device is also battery-powered making it even more portable. The design looks modern with good finishing, curved edges, and screen making it look more advanced than other budget-friendly options.

This product is more expensive than the Rareidel shuffler but much more affordable than the XMSJ Casino Machine. Its price suggests that it uses better technology and materials while still being accessible to a wider audience. The increased deck capacity is a major advantage, catering to a broader range of card games. It also can automatically dispense the cards to users, unlike the other models we analyzed.

The Bingox shuffler is likely sturdy enough for household used and it has some cushioning to protect the inner mechanical component. The dimensions are 10 x 10 x 10 inches and weighs 1.85 lbs.

Our designs hopes to imitate the size of this device and its weight. We also hope to imitate the modern look by adding finishing to make it look shiny, and curve all edges. Moreover, we hope to use strong plastics like ABS and to add cushioning to make sure we protect all internal components. Lastly, we also hope to add some form of user interface such as a screen to allow users to interact with it.

On the other hand, our design will have a different shape as seen in appendix A. Our design will also not shoot out cards and thus it will not need a rotating platform. Our design will also only take in cards from one place and not 2. It will also dispense cards into a tray and not shoot them out.

2.0 Project Packaging Description

The packaging of our project will involve a custom plywood enclosure that will be coated with some dark wood paint to give it a more professional look as seen in Appendix A, figure 1. The enclosure will have a removable side panel made from clear acrylic to show the user the inside mechanism as seen in Appendix A figure 2.

Most other parts will be made with PLA. There will be 2 PLA trays appearing from the outside as seen in Appendix A figure 3. The input tray will be fixed in place, while the output tray will be detachable to allow easy extraction of the cards.

On the side of the device there will be a place for the user to plug in the device. The port is seen in Appendix A figure 4.

As seen in Appendix A, table 1 the design will have a medium size compared to the 3 products we analyzed. Our devices will also be around 4 kg which is not too heavy to carry but also not too light to be unsturdy. Appendix A, table 1 contains all the relevant dimensions and table 2 contains the dimensions of all the internal mechanisms. All packaging will be manufactured in the Bechtel Innovation and Design Center using Bambu Lab P1S printers for most plastic products, and a Trotec Speedy 500 Laser Cutter A for the wooden parts. Appendix B, table 1 contains all the exact machining and tooling requirements. The overall cost of the packaging is expected to be under 30 dollars. Appendix B table 2 contains the estimated costs. The overall weight of the model is expected to be 4 kg, Appendix B table 3 contains an exact breakdown.

In terms of internal packaging for components and parts, 3D printed PLA structures will be used to house the custom PCB, raspberry Pi, and all other electronic and mechanical components. Electronic components will be put in the electronic box on a PCB according to the figure 1 in Appendix C. The Power Supply Unit already has a custom metal packaging to protect it. The internal and outer packaging will include several holes for airflow and fans for heat loss. Check Appendix C, figure 1 for a detailed layout of the PCB and Appendix A figure 5 for a labelled layout of the entire design.

3.0 Sources Cited

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https://www.amazon.com/Automatic-Card-Shuffler-Rotating-Blackjack/dp/B0DM5VDM3W

Appendix 1: CAD Model Illustrations
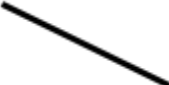

Figure 1: Full Design
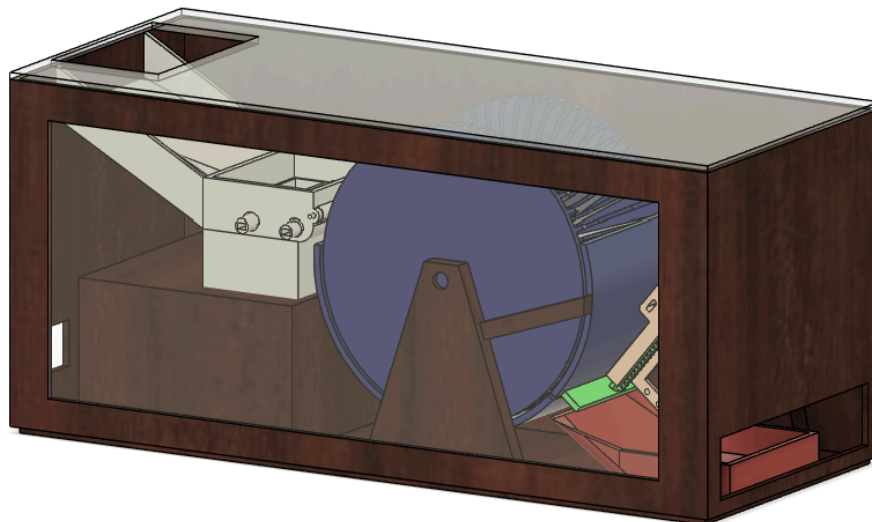
Figure 2: Full design with clear window
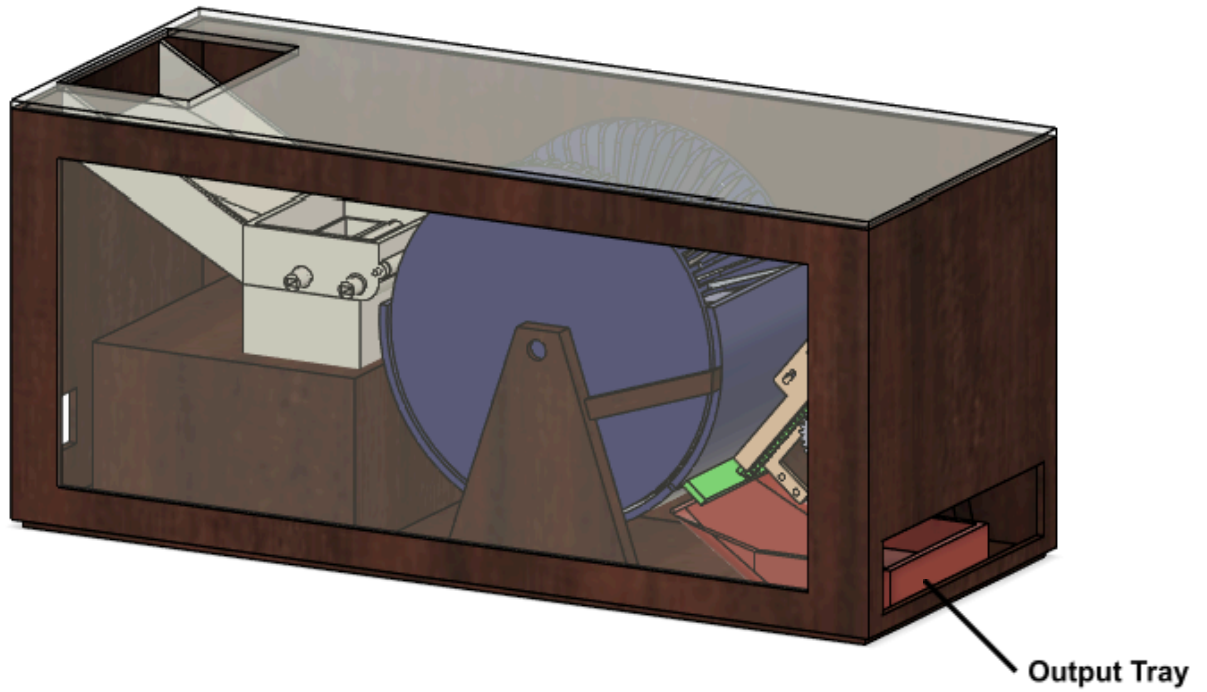
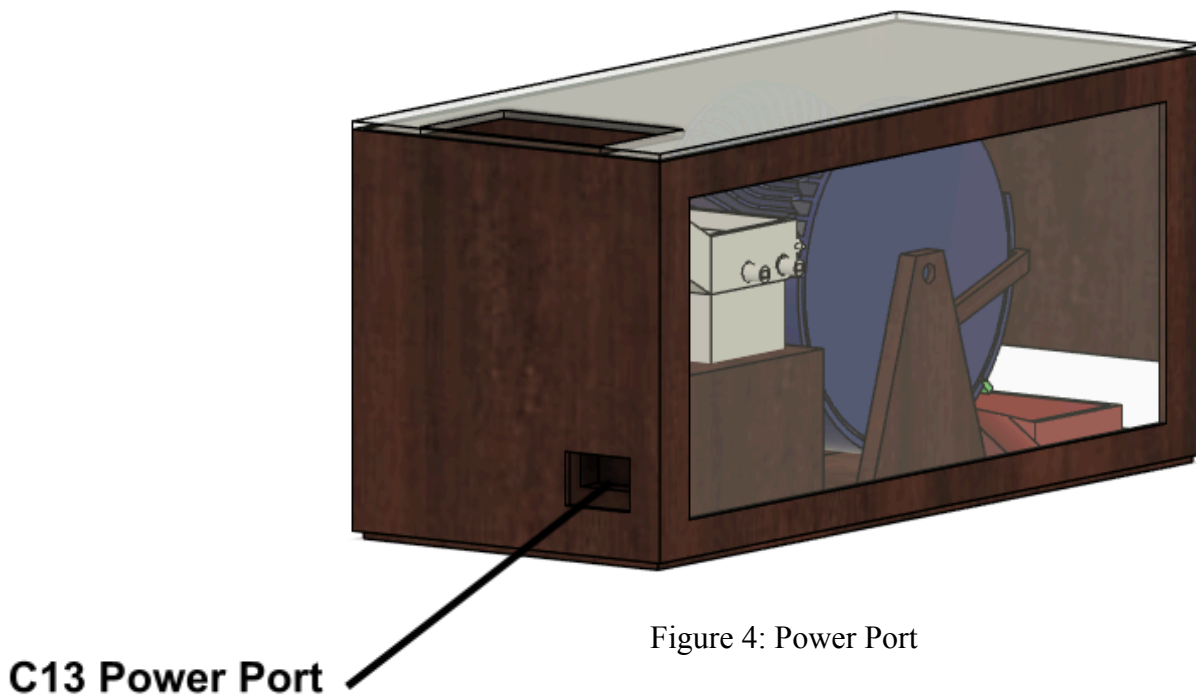**Input Tray**

Figure 3: Input and Output Trays

Figure 4: Power Port
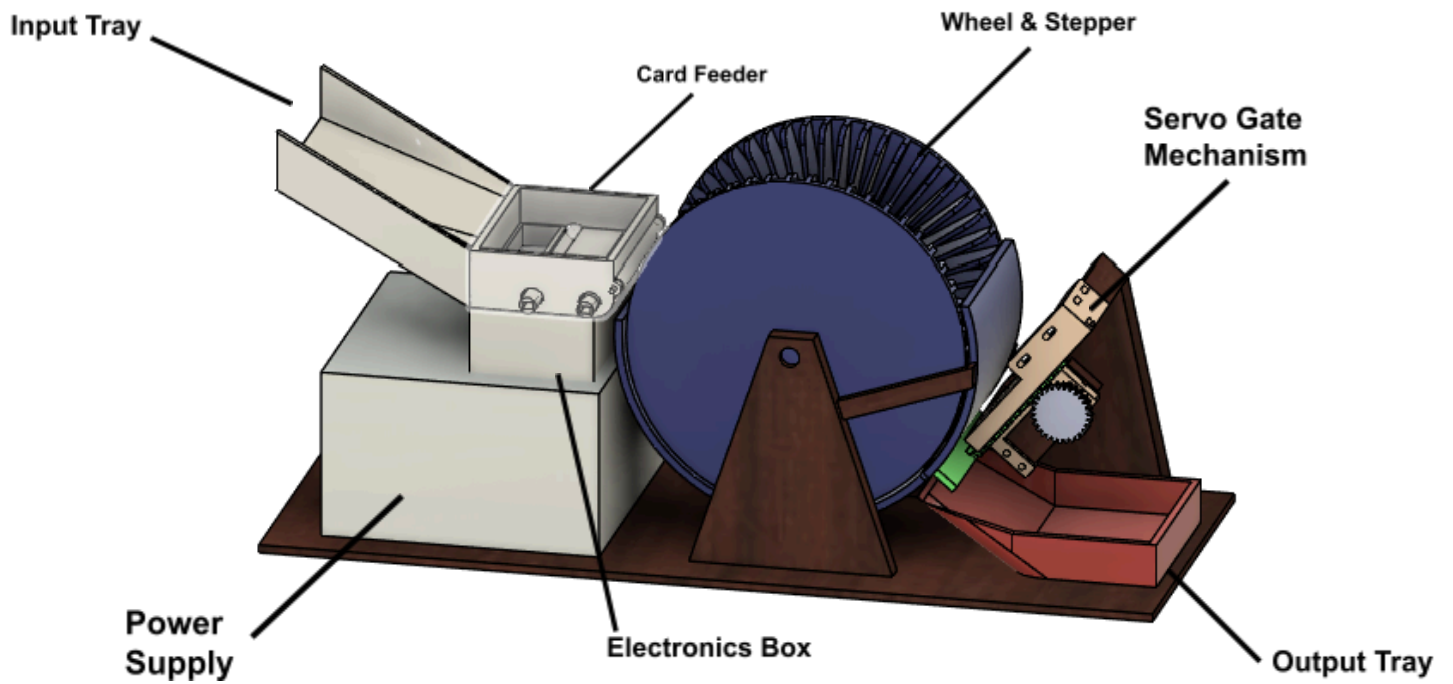
Figure 5: Labelled Design

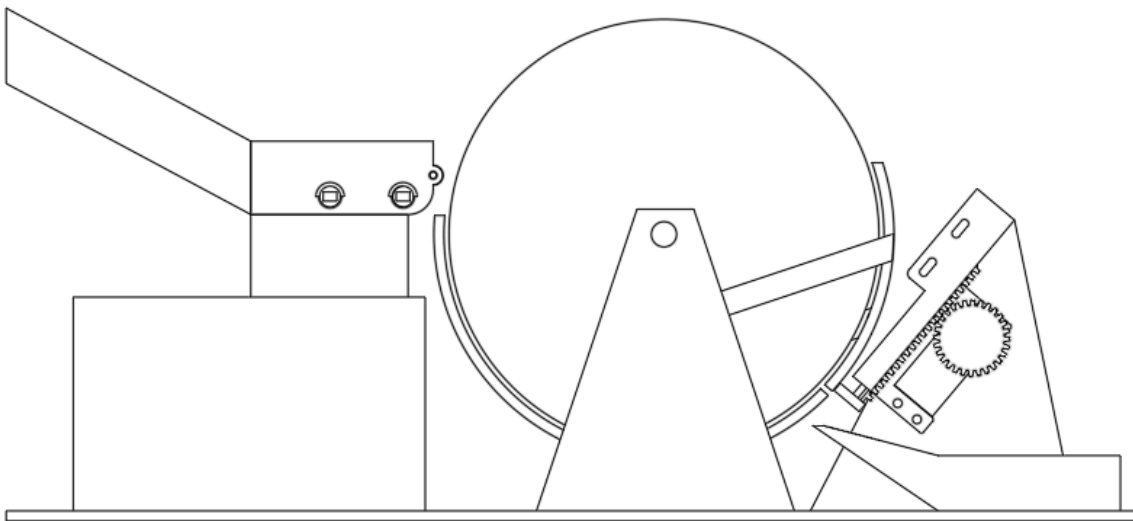Figure 6: Front Drawing

General Dimensions	
Dimensions	Measurements(mm)
Length	458
Width	188
Height	208

Table 1: General Design Measurements

Inner Part Dimensions			
Part Name	Length(mm)	Width(mm)	Height(mm)
Power Supply	150	140	85
Card Feeder	97.5	72.5	29.125
Card Holder	97.5	120	22
Wheel	171	171	171
Servo Motor	40	20	36
Stepper Motor	42	42	48
Gate Mechanism	98	40	89
Electronics Box	97.5	62.5	35

Table 2: Inner Part Measurements

Appendix 2: Project Packaging Specifications

| Machining Method			
Part Name	**Method**	**Material**	**Machine**
Power Supply	Ready	Aluminum	N/A
Card Feeder	3D Printing	PLA	Bambu Lab P1S
Card Holder	3D Printing	PLA	Bambu Lab P1S
Wheel	3D Printing	PLA	Bambu Lab P1S
Servo Motor	Ready	N/A	N/A
DC Motor	Ready	N/A	N/A
Stepper Motor	Ready	N/A	N/A
Gate Mechanism	3D Printing	PLA	Bambu Lab P1S
Electronics Box	3D Printing	PLA	Bambu Lab P1S
General Box	Laser Cutting	Plywood	Trotec Laser Speedy 500

Table 1: Part Machining and Manufacturing

Part Costs	
Part Name	**Estimated Cost($)**
Power Supply	40
Card Feeder	1
Card Holder	1
Wheel	2
Servo Motor	6
DC Motor	16
Stepper Motor	11
Gate Mechanism	1
Electronics Box	1
General Box	20
Total	99

Table 2: Cost Breakdown

Part Weight	
Part Name	**Weight(grams)**
Power Supply	1000
Card Feeder	58.45
Card Holder	45.68
Wheel	598.6
Servo Motor	270
DC Motor	368
Stepper Motor	396
Gate Mechanism	35.13
Electronics Box	50
General Box	1000
Total	**3821.86**

Table 3: Weight Breakdown

Appendix 3: PCB Footprint Layout
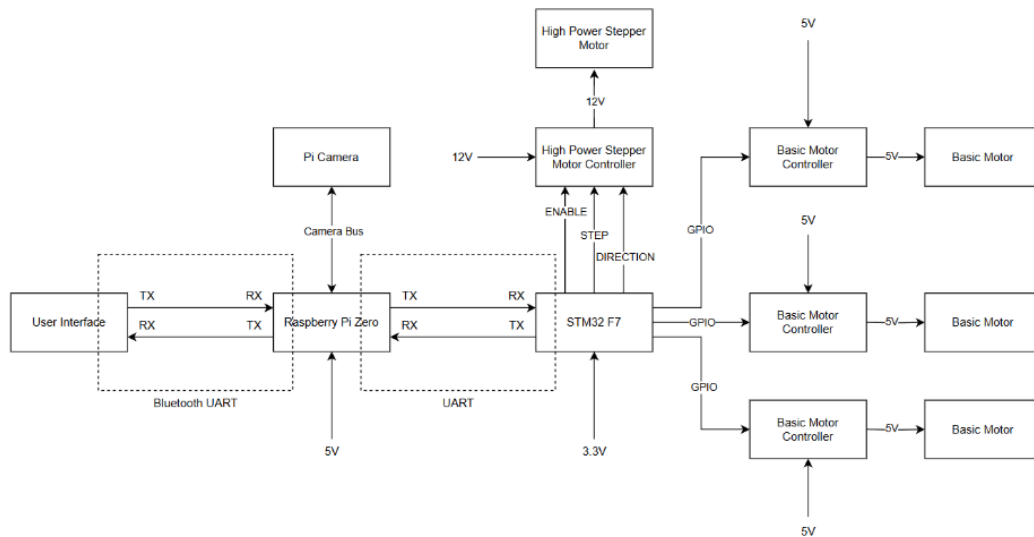
Figure 1: PCB Layout

PCB Dimensions: 90*50 mm
PCB Area: 400 mm^2

Control Section (Left Side): Dimensions: 50mm x 20mm

- Key Components:
  - STM32 F7 MCU (LQFP100 package, 20mm x 20mm with supporting components)
  - Raspberry Pi Zero W (30mm x 65mm mounting area)
  - Associated decoupling capacitors and crystals

Motor Control Section (Right Side):

- Dimensions: 40mm x 20mm
- Components:
  - High-power stepper motor driver (25mm x 20mm)
  - Three basic motor controllers (15mm x 15mm each)
  - Associated heat dissipation areas

- Component Footprint Selections:
  - STM32 F7: LQFP100 package (14x14mm chip + supporting components)
  - Motor Controllers: SOIC or TSSOP packages for compact layout
  - Power Components: Mix of SMD and through-hole for thermal management
  - Connectors:

- JST-XH for motors
- Pin headers for GPIO and debugging
- Camera connector as per Pi specifications