Mechanical Overview

Year: 2024 Semester: Spring Team: 2 Project: M.O.U.S.E.

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Assignment Evaluation: See Rubric on Brightspace Assignment

* 1. Commercial Product Packaging

The two products we analyzed are autonomous robots, with similar designs to M.O.U.S.E. These two products are “SPAR – Autonomous Indoor/Outdoor Security Robot” [1] and “The Security Robot by SMP Robotics” [2].

* 1. Product #1

The first product similar to M.O.U.S.E. is SPAR – Autonomous Indoor/Outdoor Security Robot [1], which is a large customizable security robot designed for indoor and outdoor use.

A robot with wheels and camera

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Figure 1: SPAR - Autonomous Indoor/Outdoor Security Robot [1]

The packaging for the SPAR – Autonomous Indoor/Outdoor Security Robot as seen in *Figure 1* above features a waterproof chassis consisting of steel frame with aluminum panels. The dimensions including the vision mast are 41in long x 26in wide x 46in tall, and it features 13-inch all-terrain tires. Due to its packaging, the robot weighs in excess of 250 pounds. The camera mast is extended above the base to keep the frame of the robot as compact as possible and provide a 360-degree viewing angle for the vision system inside the top of the mast.

The positive aspects of this packaging design are its robustness coming from the steel and aluminum frame. Another significant advantage of this design is the offset vision mast allowing for the 360-degree view of surroundings by the vision system. One positive aspect of this robot’s packaging is the size of its wheels as the robot is designed for all-terrain use, this feature makes it easier for the robot to get over or around any obstacles it may encounter.

The negative aspects of this packaging design are its size, making it more difficult for the robot to fit in smaller places. The extreme weight of the robot’s packaging also makes it impossible for a single person to move the robot if necessary, such as if the robot were to break down while patrolling.

When it comes to packaging M.O.U.S.E., one of the main design features we will take from the SPAR – Autonomous Indoor/Outdoor Security Robot is its vision mast where we will mount our sonar sensors. Another design feature we will take from SPAR is the all-terrain tires as we plan on suing all-terrain tires on our design as well to make it more adept at getting over obstacles. Our robot will be differentiated from this device as it will be much smaller and lighter than the SPAR autonomous robot so it can be more easily moved by a single persona and fit and maneuver in much smaller spaces. M.O.U.S.E. will also have 3D printed construction with an aluminum chassis, differing from the steel and aluminum frame used by SPAR.

* 1. Product #2

The second product similar to M.O.U.S.E. is the Picard security robot by SMP Robotics [2].

A blue and white robot

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Figure 2: Picard security robot [2]

The packaging for the Picard security robot by SMP Robotics as seen in *Figure 2* above features a fiberglass construction and sits on top of an aluminum allow frame. There is also a mast for the vision system, allowing for the mounting of a 360-degree panoramic vision system. The overall dimensions for the packaging of this robot are 1420mm long x 780mm wide x 1320mm tall (56in x 31in x 52in). Picard security robot by SMP robotics weights and has 145mm (5.7in) diameter all-terrain tires and weighs approximately 185kg (408 pounds). The waterproof and dustproof level for the Picard security robot is IP65 rated.

The positive impacts of the packaging used by Picard security robot is the fiberglass and aluminum frame construction provide a strong and robust platform for the robot and allows it to be IP65 waterproof. The packaging of this device with the mast for the vision system, allowing for 360-degree view is also positive, as it ensures there are no blind-spots for the vision system. Another positive of this robot is its large wheels as it can traverse any terrain from these features.

The negative impacts of the packaging chosen for the Picard security robot include its size, as the robot is quite large and heavy. This size makes it more difficult for the security robot to navigate in tight space. The heavy weight of the robot’s packaging makes it impossible for a single person to lift or maneuver the robot if it gets stuck or has any issues while performing its security patrols.

For the packaging M.O.U.S.E., one of the design features it will take from the Picard security robot is the vision system mounted on a mast above the base of the robot. Similar to its function on Picard, this will enable the sonar vision system on M.O.U.S.E to see in all directions. Another design feature that will be similar to Picard is the tires, which will be about an inch smaller to those on the Picard security robot and will also be all-terrain. M.O.U.S.E. will be differentiated from Picard by SMP robotics as it will be much lighter and smaller than Picard so it can be maneuvered in small places and lifted and moved by a single person. Another difference is our robot’s packaging will be an aluminum frame with 3D printed construction, making it easier to construct and prototype; however, M.O.U.S.E. will not have any waterproof or dustproof properties.

2.0 Project Packaging Description

The packaging for M.O.U.S.E. will consist of an aluminum frame with a 3D printed shell mounted to the top of the aluminum frame. The frame being used is adapted from the Dagu robot chassis from Table 1 in Appendix 2. Due to the size and construction of this chassis, it will be robust and strong enough to support continual use, and support the battery and electronics required for M.O.U.S.E. As seen in Appendix 1, figures 3 and 4, the dimensions for the frame and shell together will be approximately 15 inches long x 6.38 inches wide x 11.13 inches tall. Extended beyond the top of this shell, there will be a mast for the sonar sensors that will be 4 inches tall and 2 inches wide. The dimensions for the packaging of our robot will allow it to navigate through tight spaces, and the weight of our robot will allow it to be lifted and maneuvered by a single person if necessary. Including the chassis, battery, and all electronics, M.O.U.S.E. will weigh under 20 pounds.

Along with the robust chassis, the packaging for M.O.U.S.E. will include large, all-terrain tires allowing it to navigate over obstacles. The overall design for our packaging can be seen in Figure 5 of Appendix 1. The coloring of the wheels in the figure is representative of the gold rims and black rubber of the wheels and tires being used. The gray box of this model is representative of the chassis and shell mounted on top of the chassis where the components for M.O.U.S.E. will be housed. The green extruded portion of Figure 5 in Appendix 1 represents the mast where the sonar sensors will be mounted as seen in the figure.

The packaging for the PCB used for M.O.U.S.E. can be seen in Figure 6 of Appendix 3. The PCB will include regions for power, where 12V power comes in from the battery and it is reduced to 5V for the shift registers and other ICs used, along with another reduction to 3.3V for the ESP32-s3. The ESP32-s3 and its supporting circuitry will be together on the PCB. There will be another section of the PCB for the motor controllers, which run off 12V. The final section for our PCB will be for the shift register circuit and the routing for our sonar sensors to connect to the PCB. The overall dimensions for the PCB will be approximately 5in x 5in.

3.0 Sources Cited

[1] “Spar - Autonomous Indoor/Outdoor Security Robot,” SPAR - Autonomous Indoor/Outdoor Security Robot - TP-300-001, https://www.superdroidrobots.com/store/usage/surveillance-robots/product=2858?utm\_term=&utm\_campaign=ET%2B%7C%2BPMax&utm\_source=adwords&utm\_medium=ppc&hsa\_acc=2041907023&hsa\_cam=20349989458&hsa\_grp=&hsa\_ad=&hsa\_src=x&hsa\_tgt=&hsa\_kw=&hsa\_mt=&hsa\_net=adwords&hsa\_ver=3&gclid=CjwKCAjwseSoBhBXEiw (accessed Feb. 6, 2024).

[2] “Security robots for home use,” SMP Robotics - Security Robots, https://smprobotics.com/security\_robot/security\_home\_robot/ (accessed Feb. 6, 2024).

[3] “ELEGOO PLA Plus Filament 1.75mm White 1KG, PLA+ Tougher and Stronger 3D Printer Filament Pro Dimensional Accuracy +/- 0.02mm, 1kg Spool(2.2lbs) Fits for Most FDM 3D Printers,” Amazon.com, https://www.amazon.com/ELEGOO-Filament-Dimensional-Accuracy-Compatible/dp/B0BM7WZPXJ (accessed Feb. 7, 2024).

[4] “Dagu Wild Thumper 6WD all terrain chassis (black, 75:1),” RobotShop, https://www.robotshop.com/products/dagu-wild-thumper-6wd-all-terrain-chassis (accessed Feb. 7, 2024).

Appendix 1: CAD Model Illustrations

A drawing of a square object with wheels

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Figure 3: M.O.U.S.E. Side View Sketch with Dimensions (in Inches)

A drawing of a machine

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Figure 4: M.O.U.S.E. Front View Sketch with Dimensions (in Inches)

A black box with wheels

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Figure 5: M.O.U.S.E. CAD Orthogonal View

Appendix 2: Project Packaging Specifications

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| --- | --- | --- | --- | --- |
| Material | Quantity | Tooling Requirements | Estimated Weight | Estimated Unit Cost |
| Dagu Robot Chassis [4] | 1 chassis | Adjustable Wrench, Allen Keys, Screwdrivers | 2 kilograms (4.4 pounds) | $311.63 |
| White PLA Filament [3] | 88in3 | 3D printer | 500 grams (1.1 pounds) | $8.00 |

Table 1: Material Specifications for Project Packaging

Appendix 3: PCB Footprint LayoutA diagram of a power supply system

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Figure 6: PCB Layout