## **Chassis**

The following tables and justifications are the basis for the decision making process of selecting a suitable chassis for Roadie.

### **Items Under Consideration**

The following items have been considered for use as a chassis on Roadie. Each item has a unique product ID as well as the vendor and a short description of the product, as depicted in *Table 1*

|  |  |  |  |
| --- | --- | --- | --- |
| Item ID | Item Name | Vendor | Description |
| ROB-12866 | Magician Chassis | Sparkfun | Acrylic chassis with two gearmotors, two 65mm wheels and a rear caster. Pre-drilled mounting holes. An AA battery holder with barrel plug termination is included. |
| KIT660 | Build Your First Robot Chassis Kit | Budgetrobotics.com | Dual level chassis with wheel well cutouts for drive wheels. Includes mounts for two servos. |
| DG012 | DG012-Tank | Hobbyking | Square chassis made out of aluminum. It come with two 48:1 geared motors, an AA battery holder and pre-drilled mounting points. |
| Custom | Custom Chassis | N/A | Constructed to resemble a cargo container crane. Room for four drive motors. Attachment point for arm mounted high on chassis. |

Table 1: Chassis under consideration for Roadie

## **Decision Matrix**

The decision matrix used to select a chassis for Roadie is depicted in Table 2. The decision matrix weighs the. The highlighted row is the chassis selected for use on Roadie.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Factor | Surface Area | Adaptability | Availability | Cost | Total |
| Weight | 0.3 | 0.4 | 0.1 | 0.2 |  |
| ROB-12866 | 2 | 1 | 1 | 5 | 2.1 |
| KIT660 | 5 | 2 | 1 | 4 | 3.2 |
| DG012 | 3 | 1 | 1 | 1 | 1.6 |
| Custom | 5 | 5 | 5 | 3 | 4.6 |

Table 2: Decision matrix for chassis

The weighted matrix, or the matrix computed by multiplying the score in each category by its weight is show in Table 3. The total score for each item in the decision matrix (Table 2) is calculated by summing the values for each row in the weighted value matrix.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Factor | Surface Area | Adaptability | Availability | Cost |
| ROB-12866 | 0.6 | 0.4 | 0.1 | 1 |
| KIT660 | 1.5 | 0.8 | 0.1 | 0.8 |
| DG012 | 0.9 | 0.4 | 0.1 | 0.2 |
| Custom | 1.5 | 2 | 0.5 | 0.4 |

Table 3: Weighted value matrix. It is comprised of the score for each category multiplied by the weight for the category.

The weightings for the decision matrix were created by using the data in Table 4

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Factor | Surface Area | Adaptability | Availability | Cost |
| ROB-12866 | 110 x 174 mm | Not very | In stock | $14.95 |
| KIT660 | 177.8 x 127 mm per deck (2 decks) | Moderately | In stock | $16.95 |
| DG012 | 157 x 149mm | Not very | In stock | $44.96 |
| Custom | Variable | Very | Available | $25.00 |

Table 4 Quantitative and qualitative values of the chassis under consideration that led to the decision matrix.

### **Justifications**

The following section represents the reasoning behind each category and how their weights were determined.

#### **Surface Area**

The surface area of the chassis is how much surface will be available to mount components to Roadie. Since there will be many circuit boards, wires, and other sorts of devices, having an abundance of surface area will be to our advantage. Chassis with the highest surface area, KIT660, received a score of five. The custom chassis received a score of five because its surface area will be greater than or equal to that of KIT660. DG012 had a surface area approximately half of KIT660, therefore its score is half of KIT600’s score rounded up. ROB-12866’s surface area was close to that of DG012, earning it a two, one less point than DG012.

Surface area was given a weight of 30% because the more surface area Roadie has, the more space will be available for mounting of critical systems. Mounting systems to a chassis with little surface area will prove difficult as space would become a premium with larger items.

#### **Adaptability**

Adaptability of the chassis pertains to how well the chassis will be able to cope with our design changes. Currently, Roadie is still in the prototyping process. As such, we are not sure how well our system design will function. This means that the chassis of Roadie will need to be able to easily change as our design changes. Chassis that provide the ability to move components around without major modifications received a score of five and a chassis that would essentially require the building or purchase of another received a score of one. Both the ROB-12866 and the DG012 scored ones because they are designed to work with certain motors and wheels. Therefore, these chassis are not very adaptable. The KIT660 scored a two because while it does not come with any servos or motors, the wheel well cutouts limit the wheels that can be used. The custom chassis is very adaptable since it can be easily modified as the system design changes.

Adaptability was given a weight of 40% since the adaptability of the chassis directly correlates to the ability to rapid prototype. A chassis that is designed with particular wheels and motors in mind is not as adaptable to change as a chassis that is built independent of wheels and motors.

#### **Availability**

The availability score for each item was obtained by scoring items on hand as a five, and items that need to be purchased as a one.

Availability was given a weight of 10% as it directly relates to the ability to prototype Roadie.

#### **Cost**

The score for cost was obtained by ranking the lowest cost item, ROB-12866 as a 5 and the most expensive item, the DG012 as a one. Since the KIT660 was within $2 of the cost of ROB-12866, it received a score of 4. The custom option was budgeted at $25 as it is the average price of the other chassis in the group. This was awarded a 3 as it was about $8 more than the KIT660, and still significantly cheaper than the DG012. Since it was close to the lower priced chassis options, a score of 3 was awarded.

Cost was given a weight of 20% as the cost of items are a very important factor in any budget, but not the most important consideration for this item.

|  |  |  |
| --- | --- | --- |
| ID | Requirement Text | Fulfillment |
| 3.3.2 | The system shall align with the challenge before attempting to complete the challenge. | By implementing a custom design for the chassis, the time required to align with the challenge will decrease, thus shortening the overall time that Roadie is on the course. |
| 3.3.3.7 | The system shall not obstruct the Simon Carabiner during play. | By designing a custom chassis, it will be possible to ensure that Roadie will not obstruct the Simon Carabiner. |
| 3.3.4.1 | The system shall not obstruct the Rubik’s Cube during play. | By designing a custom chassis, it will be possible to ensure that Roadie will not obstruct the Rubik’s cube. |
| 3.3.5.2 | The system shall not obstruct the pocket Etch-A-Sketch during play. | By designing a custom chassis, it will be possible to ensure that Roadie will not obstruct the Etch-A-Sketch. |
| 4.1.1 | The system size shall be no greater than 1ft. x 1ft. x 1ft. within the starting area and the finishing area. | With a custom chassis design, it will be possible to ensure that Roadie fits into the mandated dimensions while still having enough surface area to mount all the required components. |
| 4.3.1 | The system shall have an easily accessible power switch. | With a custom design, Roadie will not be limited to where the power switch is mounted on an “off the shelf” chassis. |
| 4.3.3 | The system shall maintain contact with the competition area’s surface at all times. | Implementation of a custom chassis will ensure that Roadie will always maintain contact with the course. |

Requirements Traceability

The following requirements traceability refers to the System Requirements Specification for Roadie, revision 1.0.0, published September 18, 2014. As shown in **TABLE BLAH,** below, the requirement ID is followed by the requirement text and an explanation of how the custom chassis will fulfill said requirement.

Risk Analysis

Since the chassis is the component that supports all of the other components of the systems, it is imperative that Roadie is operated in a manner as to not cause harm or damage to the chassis. Should the chassis be completely damaged, this would represent a catastrophic failure as it would require many man hours to reassemble the chassis and resolve any issues rising from such an event. An example of an even that would be an inconvenience, yet Roadie would still be operable would be if one of the towers supporting the arms became misaligned. This would be a temporary hindrance to the system as it would last for one competition round.

|  |  |  |  |
| --- | --- | --- | --- |
| Risk | Prob. | Sev. | Mitigation of Risk |
| Loss of Chassis | 1 | 9 | In the event that Roadie was to fail in such an extreme event that the chassis is not salvageable, this could potentially result in the project not being delivered on time. An example of such an occurrence would be in the power source was improperly handled, thus causing the chassis to ignite or melt in some spectacular fashion. Another such instance would be if the vehicle ran into some obstacle at ludicrous speed, causing the chassis to be rendered useless. In order to mitigate these events, safeguards will be implemented to ensure that Roadie always maintains a safe operating speed. Additionally, all power sources will be properly handled and maintained to ensure that the chassis does not catch fire. |
| Misaligned arm tower | 2 | 4 | In the event that one of the chassis towers supporting the arm were to become misaligned, this would cause a slight hindrance to Roadie. Roadie would still be able to attempt the challenges, however, the attempts may not be optimal. In order to mitigate this, the arms will be redundantly reinforced as well as designed with the ability to support a load at least 1.5 times that of the theoretical load the arm would have to support. |

<http://www.hobbyking.com/hobbyking/store/__44607__DG012_Tank_SV_Standard_Version_Multi_Chassis_Kit_with_Two_Rubber_Tracks.html>

[29] "DG012-Tank SV (Standard Version) Multi Chassis Kit with Two Rubber Tracks." HobbyKing Store. Accessed October 1, 2014. http://www.hobbyking.com/hobbyking/store/\_\_44607\_\_DG012\_Tank\_SV\_Standard\_Version\_Multi\_Chassis\_Kit\_with\_Two\_Rubber\_Tracks.html.

<http://www.budgetrobotics.com/category/Chassis-Kits-161>

[30] "Chassis Kits Budget Robotics - Robot Kits, Robotics Kits, Robot Parts, Educational Robots, Amateur Robots." Chassis Kits Budget Robotics - Robot Kits, Robotics Kits, Robot Parts, Educational Robots, Amateur Robots. Accessed October 1, 2014. http://www.budgetrobotics.com/category/Chassis-Kits-161.

<https://www.sparkfun.com/products/12866>

[31] "Magician Chassis." Sparkfun. Accessed October 1, 2014. https://www.sparkfun.com/products/12866.