# **Budget Decision Matrices and Justifications**

This section contains the justification for the selection of the major components of Roadie. The driving force for the selection process are decision matrices. Decision matrices aid in the decision process by assigning a 1 through a 5, with 1 being least desirable, to characteristics applicable to each item. Each characteristic is given a weight, with higher weights being more important to each item. The total of the weight/score pair is calculated for each item. The item with the highest total score relative to its opponents is deemed the preferable option in its category.

## **Camera**

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

### **Items Under Consideration**

The following items have been considered for use as a camera 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 |
| B00IUYUA80 | Pixy (CMUcam5) | Amazon | Pixy is an image sensor paired with a dedicated processor. Pixy is able to process images from the image sensor and send condensed image and location data to the microcontroller at a frame rate of 50Hz. [1] |
| B008GWPC1Q | Fosmon USB 6 LED Webcam | Amazon | 1.3 Megapixel webcam with six LEDs to illuminate objects. |
| B00K11RI6W | TeckNet C015 Webcam | Amazon | 5.0 Megapixel webcam with built in microphone. |

Table 1: Cameras under consideration for Roadie

## **Decision Matrix**

The decision matrix used to select a camera for Roadie is depicted in Table 2. The decision matrix weighs the resolution of the camera, if lights are installed on the camera, perceived ease of use, availability of the camera as well as the cost of the camera. The highlighted row is the camera selected for use on Roadie.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Factor | Resolution | Lighting | Ease of Use | Availability | Cost | Total |
| Weight | 0.3 | 0.2 | 0.3 | 0.1 | 0.2 |  |
| B00IUYUA80 | 2 | 1 | 5 | 1 | 1 | 2.6 |
| B008GWPC1Q | 2 | 5 | 2 | 1 | 5 | 3.3 |
| B00K11RI6W | 4 | 1 | 2 | 1 | 4 | 2.9 |

Table 2Decision matrix for camera

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 | Resolution | Lighting | Ease of Use | Availability | Cost |
| B00IUYUA80 | 0.6 | 0.2 | 1.5 | 0.1 | 0.2 |
| B008GWPC1Q | 0.6 | 1.0 | 0.6 | 0.1 | 1.0 |
| B00K11RI6W | 1.2 | 0.2 | 0.6 | 0.1 | 0.8 |

Table 3Weighted 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 | Resolution | Lighting | Ease of Use | Availability | Cost |
| B00IUYUA80 | 1.0 Megapixel | No | Plug and play | In stock | $69.00 |
| B008GWPC1Q | 1.3 Megapixel | No | In-depth configuration required | In stock | $8 |
| B00K11RI6W | 5.0 Megapixel | Yes | In-depth configuration required | In stock | $10 |

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

### **Justifications**

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

#### **Resolution**

The resolution for a camera is directly related to how clear and image will be. Since the camera will be the primary way in which Roadie will be able to identify challenges, having the best resolution possible is very important. Therefore, items with a resolution low relative to the average resolution in the group (2.3 Megapixels) were ranked low and items with a resolution high relative to the average resolution in the group were ranked high.

Resolution was given a weight of 20% because if the resolution of the camera is low, it will result in a fuzzy or grainy image which may compromise Roadie’s ability to correctly identify the challenge.

#### **Lighting**

In order for the object to be reliably identified, lighting conditions must remain relatively constant. One way to assure lighting remaining constant is to purchase a web cam with lights on it. It is for this reason that a camera without lights was scored at one, where as a camera with lights on it was scored at five.

Lighting was given a weight of 20% because the ambient light in the room is something to be considered when identifying objects. If the lighting changes, the ability of Roadie to identify the challenges might as well.

#### **Ease of Use**

Ease of use is how AWTY perceived the difficulty in implementing each camera. A device that is plug and play with little to no set up was ranked a five, whereas a camera that has a learning curve with a great degree of difficulty would be ranked as a one. From our selections, two of the cameras, B008GWPC1Q and B00K11RI6W received a score of two as they will be difficult to implement, but their implementation will be guided by examples found on the internet. B00IUYUA80 was ranked a five because it includes software to natively recognize up to seven objects as well as software to recognize rotation angle and distance of an object.

The weighting for ease of use is set to 30% because Roadie will be completely dependent upon some form of camera to be able to correctly identify any challenge it arrives at. If the camera is not behaving as expected due to a difficult or poorly understood implementation, the whole system will fail.

#### **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 values for cost for the cameras were obtained by giving the most expensive camera a score of one, and the least expensive camera a score of five. As there was only one other camera to consider, and its price was $2 more than the cheapest camera, a score of 4 was awarded since the price was so close.

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.

## **Camera**

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 B008GWPC1Q will fulfill said requirement.

|  |  |  |
| --- | --- | --- |
| ID | Requirement Text | Fulfillment |
| 3.1.7 | The system shall wait for red [RGB value TBD] LED in starting area to turn off before exiting the starting area. | With the selection of B008GWPC1Q, Roadie will be able to reliably identify the red LED in all lighting conditions. Additionally, B008GWPC1Q provides a fine enough resolution to correctly identify the red LED. |
| 3.2.3 | The system shall identify the challenge zone and stop movement upon arrival. | With the selection of B008GWPC1Q, Roadie will be able to reliably identify all challenge zones in all lighting conditions. Additionally, B008GWPC1Q provides a fine enough resolution to correctly identify all challenge zones. |
| 3.3.1 | The system shall correctly identify the challenge upon arrival. | With the selection of B008GWPC1Q, Roadie will be able to reliably identify the challenge it has arrived at in lighting conditions. Additionally, B008GWPC1Q provides a fine enough resolution to correctly identify the challenge zone it has arrived at. |
| 3.3.1.1 | The system shall correctly identify the Simon Carabiner depicted in **Fig. 8**. | With the selection of B008GWPC1Q, Roadie will be able to reliably identify the Simon Carabiner in all lighting conditions. Additionally, B008GWPC1Q provides a fine enough resolution to correctly identify the Simon Carabiner. |
| 3.3.1.2 | The system shall correctly identify the Rubik’s Cube depicted in **Fig. 9** | With the selection of B008GWPC1Q, Roadie will be able to reliably identify the Rubik’s cube in all lighting conditions. Additionally, B008GWPC1Q provides a fine enough resolution to correctly identify the Rubik’s cube. |
| 3.3.1.3 | The system shall correctly identify the pocket Etch-A-Sketch depicted in **Fig. 10**. | With the selection of B008GWPC1Q, Roadie will be able to reliably identify the pocket Etch-A-Sketch in all lighting conditions. Additionally, B008GWPC1Q provides a fine enough resolution to correctly identify the pocket Etch-A-Sketch. |
| 3.3.1.4 | The system shall correctly identify the playing cards depicted in **Fig.** [TBD]. | With the selection of B008GWPC1Q, Roadie will be able to reliably identify the playing cards in all lighting conditions. Additionally, B008GWPC1Q provides a fine enough resolution to correctly identify the playing cards. |
| 3.3.3.3 | The system shall correctly sense color blue [exact RGB values TBD] when illuminated on the Simon Carabiner. | With the selection of B008GWPC1Q, Roadie will be able to reliably identify the blue LED on Simon in all lighting conditions. Additionally, B008GWPC1Q provides a fine enough resolution to correctly identify the blue LED on Simon. |
| 3.3.3.4 | The system shall correctly sense color red [exact RGB values TBD] when illuminated on the Simon Carabiner. | With the selection of B008GWPC1Q, Roadie will be able to reliably identify the red LED on Simon in all lighting conditions. Additionally, B008GWPC1Q provides a fine enough resolution to correctly identify the red LED on Simon. |
| 3.3.3.5 | The system shall correctly sense color yellow [exact RGB values TBD] when illuminated on the Simon Carabiner. | With the selection of B008GWPC1Q, Roadie will be able to reliably identify the yellow LED on Simon in all lighting conditions. Additionally, B008GWPC1Q provides a fine enough resolution to correctly identify the yellow LED on Simon. |
| 3.3.3.6 | The system shall correctly sense color green [exact RGB values TBD] when illuminated on the Simon Carabiner. | With the selection of B008GWPC1Q, Roadie will be able to reliably identify the green LED on Simon in all lighting conditions. Additionally, B008GWPC1Q provides a fine enough resolution to correctly identify the green LED on Simon. |

Table 1: Requirements traceability for camera.

Risk Analysis

|  |  |  |  |
| --- | --- | --- | --- |
| Risk | Prob. | Sev. | Mitigation of Risk |
| Complete loss of camera system | 2 | 9 | In the even that Roadie loses the camera system, its ability to complete the remaining challenges will be compromised. Since Roadie is completely dependent upon its camera to be able to identify the challenges, a loss of the camera would cause Roadie to fail that round of competition. In order to mitigate the occurrence of such an event, extensive stress testing and **BLRH** will be done to ensure that the camera performs flawlessly. |
| Misidentifcation |  |  |  |

# References

[30]

*http://www.cmucam.org/projects/cmucam5/wiki/Introduction\_and\_Background*. (n.d.).

<http://www.amazon.com/TeckNet%C2%AE-Webcam-Camera-MegaPixel-Microphone/dp/B00K11RI6W/ref=sr_1_1?ie=UTF8&qid=1412384184&sr=8-1&keywords=B00K11RI6W>

[31] "Robot Check." Amazon.com. Accessed October 2, 2014. http://www.amazon.com/TeckNet®-Webcam-Camera-MegaPixel-Microphone/dp/B00K11RI6W/ref=sr\_1\_1?ie=UTF8&qid=1412384184&sr=8-1&keywords=B00K11RI6W.

<http://www.amazon.com/Fosmon-Webcam-Camera-Meeting-compatible/dp/B008GWPC1Q/ref=sr_1_1?ie=UTF8&qid=1412384157&sr=8-1&keywords=B008GWPC1Q>

[32] "Fosmon Webcam." Amazon.com. Accessed October 2, 2014. http://www.amazon.com/Fosmon-Webcam-Camera-Meeting-compatible/dp/B008GWPC1Q/ref=sr\_1\_1?ie=UTF8&qid=1412384157&sr=8-1&keywords=B008GWPC1Q.