Microcontroller

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

|  |  |  |
| --- | --- | --- |
| Item ID | Vendor | Description |
| UDOO Quad | UDOO | The UDOO Quad is a quad core 1 GHz microcontroller with 1 GB of RAM. There are many different types of ports provided on the board, including digital in and out pins, USB, SATA, CSI Camera, HDMI, and analog audio and mic ports. Additionally, the board comes with a Wi-Fi Module, which is great for debugging. [] |
| B00K7EEX2U | Amazon | The BeagleBone Black Rev C is a high power microcontroller with a 1 GHz CPU clock speed with 1 GB of RAM. Additionally, the BeagleBone Black Rev C comes with 4 GB on-board flash storage, 3D graphics, and digital in and out pins. [] |
| B006H0DWZW | Amazon | “The Arduino Mega 2560 is a microcontroller board based on the ATmega2560 (datasheet). It has 54 digital input/output pins (of which 14 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button.” [] |
| B009SQQF9C | Amazon | “The Raspberry Pi is a credit-card sized computer that plugs into your TV and a keyboard. It's a capable little PC which can be used for many of the things that your desktop PC does, like spreadsheets, word-processing, and games, as well as plays high-definition video.”[] |

Decision Matrix

The microcontroller is one of the most essential part of the system, as the microcontroller is the brain of Roadie. The decision matrix used to select a microcontroller for Roadie is depicted in Table 2. The decision matrix weighs the processing power, RAM, cost, the community support for the microcontroller, the power consumption of the microcontroller, memory, size, Wi-Fi, and availability.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Factor | Processing Power | Memory | Cost | Community | Power Consumption | Ports | Wi-Fi | Availability | Total |
| Weight | 0.2 | 0.2 | 0.1 | 0.15 | 0.05 | 0.15 | 0.05 | 0.1 |  |
| UDOO Quad | 5 | 5 | 1 | 4 | 3 | 5 | 5 | 5 | 4.35 |
| B00K7EEX2U | 4 | 5 | 3 | 2 | 4 | 4 | 1 | 1 | 3.55 |
| B006H0DWZW | 2 | 1 | 5 | 5 | 2 | 2 | 1 | 1 | 2.4 |
| B009SQQF9C | 3 | 3 | 4 | 4 | 4 | 3 | 1 | 1 | 3.2 |

Justifications

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

Processing Power

The processing power of a microcontroller decides how long it will take for Roadie to decipher and react to certain events that happen during the competition. Since some of the challenges require to respond in a certain amount of time the microcontroller must have enough processing power to react in time. The values for processing power were based off of how many cores the microcontroller has, the clock speed, and how much RAM the microcontroller.

|  |  |  |  |
| --- | --- | --- | --- |
| Factor | Clock Speed | Cores | RAM |
| UDOO Quad | 1 GHz | 4 | 1 GB |
| B00K7EEX2U | 1 GHz | 1 | 1 GB |
| B006H0DWZW | 258 MHz | 1 | 128 KB |
| B009SQQF9C | 700 MHz | 1 | 512 MB |

**CAPTION**

Processing Power was given a weight of 20% because the processing power is one of the most of the important parts of a microcontroller.

Memory

Memory is the combination of random access memory (RAM), the on board memory that the microcontroller can store on board, and any additional memory store that can be used by the microcontroller.

|  |  |  |  |
| --- | --- | --- | --- |
| Factors | RAM | On board memory | Additional Memory |
| UDOO Quad | 1 GB | 1 GB | Micro SD Card |
| B00K7EEX2U | 1 GB | 1 GB | Micro SD Card |
| B006H0DWZW | 128 KB | 258 KB | N/A |
| B009SQQF9C | 512 MB | 512 MB | N/A |

**CAPTION**

Memory was given a weight of 20% as for the memory on the microcontroller could limit us if we were to run out of memory when trying to store all of the functionalities that Roadie will need to complete the task.

Cost

The values for cost for the microcontroller were based off the most expensive item being given a score of 1 and the least expensive item being given a score of 5. If the price of an item fell between $10 more or less of an item it will be given the same score as the item it fell between.

Cost was given a weight of 10% as the cost of items are a very import factor in any budget, but not the most important consideration for this item.

Community

The community score was based on the support of the community has towards example code online of different parts working with the microcontroller and insight the community members hold towards working with the microcontroller

The community was given a weight of 15% as it relates to how much help we will have when we run into problems or learn how to operate a piece of equipment with the microcontroller.

Power Consumption

The power consumption score for each item was obtained by taking the lowest recommend voltage the microcontroller should be powered as. So the higher the voltage need to run the microcontroller the lower the score it will receive.

Power consumption was given a weight of 5% as it relates to how many volts and amperage Roadie will need to run, but the power supply can be change relatively easily the power consumption was not weighted that high.

Wi-Fi

The Wi-Fi score for each item was obtained by if the microcontroller has Wi-Fi it was given a 5, and if the microcontroller did not have Wi-Fi it was given a 1.

Wi-Fi was given a weight of 5% as Wi-Fi is not required for Roadie to work, but would be nice to have for debugging purposes

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.

Ports

The Ports score for item was obtained by how many digital input and output pins the microcontroller has and how many other ports the microcontroller has, this could be HDMI, USB, Camera, SATA, or Ethernet ports.

Ports was given a weight of 15% as it directly relates to what hardware components we can use with Roadie.

Risk Analysis

|  |  |  |  |
| --- | --- | --- | --- |
| Risk | Prob. | Serv. | Mitigation of Risk |
| CPU Overheating | 3 | 5 | The CPU overheating on a microcontroller is huge problem that can occur, which can result in data lost. There are prevented methods that can be used and built into the microcontroller to help avoid the CPU overheating. Heat syncs are installed to help cool down the CPU by transferring heat to them for them to disperse heat through. Also, installed a cooling system to help disperse some of the heat coming off the CPU. |
| Short Circuits | 2 | 9 | To help prevent the microcontroller from being shorted out there are a few methods that can help. Using a non-conductive chassis will help lower the chances of short happening. Installing motor shield to prevent electrical feedback from the motors to the microcontroller. |
| Physical Damage | 4 | 6 | To help prevent the microcontroller from taking physical damage a few methods that can be implemented in to help reduce the chances of this happening. A casing can be installed around the microcontroller to help adsorb the impact of being hit or being dropped. |

<http://shop.udoo.org/usa/product/udoo-quad.html?___from_store=usa&popup=no>

<http://www.amazon.com/Arduino-MEGA-2560-R3/dp/B006H0DWZW/ref=sr_1_1?s=electronics&ie=UTF8&qid=1412524001&sr=1-1&keywords=arduino+mega+2560+r3#productDetails>

<http://www.amazon.com/Raspberry-Pi-756-8308-Motherboard-RASPBRRYPCBA512/dp/B009SQQF9C/ref=sr_1_1?s=electronics&ie=UTF8&qid=1412524057&sr=1-1&keywords=raspberry+pi+b>

<http://www.amazon.com/Beagleboard-BBONE-BLACK-4G-BeagleBone-Rev-C/dp/B00K7EEX2U/ref=sr_1_1?s=electronics&ie=UTF8&qid=1412524078&sr=1-1&keywords=beaglebone+black+rev+c>