## 2.6 ProDuct Design Specifications (PDS)

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| **Functions** | * Traversal of the campus * Carrying the package * Navigation * Maintain the safety of the package | |
| **Specifications** | * Carry packages up to 80 Kg * The Battery life lasts for a complete trip * Operate within 2 Km range * Operate within 5 km/h. | |
| **Constraints** | * The cost of the project must not exceed 5000 SAR. * Project must be completed before the end of Term-2. * Causes no harm to the surroundings. * Battery life lasts for at least one complete trip (2 km). * Guarantees the privacy of the packages. * The artifact should withstand normal heat (36° C) for the duration of the trip (2 km) | |
| **Musts** | * The ability to move within 2 km range of the Engineering building autonomously on paved roads. * Ensures the safety of the packages. * Includes a storage unit for the shipments. * Tamper proof electronic components. * Made from durable material. * Operate within 5 km/h. * Can carry weight within (80kg). | |
| **Wants** | * The ability to move around the whole campus autonomously on paved roads. * Neat design. * Can carry weight within (120kg). * Can charge using charging stations. * Costs less than 2500 SAR. | |
| **Assumptions** | * The university network covers the whole campus or at least a 4G connection is available. * No lock-down or any action that can limit our visits to the targeted campus. * No temporary or constructional change on the campus map. * It is allowed to operate prototypes within the campus roads & facilities. | |
| **Scope** | For this project, the following must be clear for all parties:   * The design is targeted to be specific for the KAU Campus. * The information gathering will be done with the guidance of the advisor and includes all the team members. * Team members will provide all the required resources needed to implement the solution. * Team members are responsible of any financial obligations that could be a result of purchasing a required component or subscribing to a license. * The solution will be designed for only outdoor use. * The solution is limited to paved roads with no stairs. | |
| **Risks and Remedies** | | |
| **Risk** | | **Remedy** |
| Weak wide fidelity (Wi-Fi) signal. | | Use 4G network. |
| A part breaks down. | | Replace with higher quality part. |
| Shipping delay/dead on arrival. | | Order them early/Find local alternative. |
| A team member quits. | | Find another, otherwise just keep going with two. |
| Term concludes sooner than scheduled | | work for extra hours, fulfill the musts in worst case scenario. |

### 3.2.2 Circuit component specifications

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| **Component** | **Specifications** |
| **Jetson Nano** | **Manufacturer:** Nvidia  **GPU:** 128-core NVIDIA Maxwell  **CPU:** Quad-core ARM® A57  **Memory:** 2 GB 64-bit  **Module Size:** 70mm x 45mm |
| **NodeMCU ESP8266** | **Microcontroller:** ESP-8266 32-bit  **Module Size:** 49mm x 26mm  **Clock speed:** 80 MHz  **Operating Voltage:** 3.3V  **Input voltage:** 4.5V-10V  **SRAM:** 4 MB / 64 KB  **Digital Pins:** 11  **Analog Pins:** 1  **Built-in Wi-Fi:** 802.11 b/g/n  **Temperature range:** -40C - 125C |
| **IMX219-83 8MP 3D Stereo Camera Module** | **Megapixels:** 8 Megapixels  **Resolution:** 3280 × 2464 (per camera)  **Dimensions:** 24mm × 85mm  **Gyroscope Operating Current:** 1.23mA  **Angle of View:** 83/73/50 degree (diagonal/horizontal/vertical) |
| **dc-to-dc convertor 12v to 5v** | **Manufacturer:** Chuanguifa  **Type:** step down dc-to-dc convertor  **Input voltage:** 12V  **Output Voltage:** 5V  **Output current:**3A  **Output power:**15W  **Efficiency:** ＞96%  **Operating temperature:** (-40°, 80°)  **Size:** 45x26x12 (mm) |
| **Rechargeable battery** | **Voltage:** 36 V  **Discharge Current:** 75A  **Dimensions:** 101mm x 90mm x 70mm  **Weight:** 1.62 Kg  **Internal Resistance at 1KHz:** 34 mΩ |
| **Motors** | **Manufacturer:** huhu  **Speed:** 100 RPM  **Operating voltage:** 36 volts  **Torque:** 10 Kg.cm  **Weight:** 158.75 g |

### 3.2.6 Input/output specifications

An AC input power source of 220Vac with 60Hz frequency, single phase is needed to supply the battery with charging power. Max input current is 2A current with max power consumption of 440W.

### 3.2.3 Flowcharts for software blocks

## Navigation Flow Chart

Diagram

Description automatically generated

## Obstacle avoidance flow chart

A screenshot of a map

Description automatically generated with medium confidence

## 4.3 Environmental impact

It is known for years that our vehicles produce harm gases to our environment. However, we cannot refrain from using them. The only thing we can do, is to reduce our usage and to eliminate unnecessary trips. One service our product provides is to reduce the need of using a car in delivering shipments within the campus.

Although our product does not produce green gases, it still has some impacts on the environment. For instance, the baseline design uses a lead acid rechargeable battery which could cause potential threat to people and to the environment if not properly discarded. However, we encourage having a facility that recycles dead batteries to reduce their potential impact on the environment by extract the lead.

In the baseline design, although we could have included other power options that may produce harm gases to our environment we preferred not to, for the sake of our environment. Another way of visualizing the big picture is to consider that the product reduces the need of having duplicated versions of certain things (e.g., textbooks, papers, plastic tools) by allowing these gadgets to be easily transferred from building to another. Which expected to play good for our environment.