## **Glass Box**

Kinetic energy

Big Back wheels

Front Triple-wheels

F

Motors

Power

Ascends curbs

Power

Batteries

Information



Heat

Sound

Kinetic energy

Hind legs

Front legs

F

Motors

Power

Storage Unit

Movement

Carries Packages

Power

Batteries

Information



Package

Processing Unit

Sensors

Heat

Sound

DELETE ABOVE THIS

1. Brainstorming
   1. Ground Robot

A ground robot with a built-in storage cart uses four wheels to move between buildings within the university campus. The robot needs to be able move safely using obstacle avoidance techniques to avoid objects around it. It uses battery, to supply enough power for a complete back and forth trip. To be able to move between buildings, the ground robot needs a navigation algorithm to guide the robot through the whole trip.

Pros :

* Free movement? Flexible path? No pre-defined stop points(NO NO)?
* No need for special roads (it uses our normal daily roads) // No infrastructure needed
* Battery powered (works even when electric power off? No need?)

Cons:

* Needs to be carefully trained to avoid obstacles
* Higher probability of getting stuck
* Easily tampered with
* Training phase is required

Movement

Batteries

Controller

Motors

rear wheels

F

Kinetic energy

commands

Power

Heat

Sound

Figure 6 - Glass box



* 1. RoboDog

This alternative is a quadruped robot. It uses two front legs and two hind legs to move just like an animal would. Furthermore, it can traverse at acceptable speeds and carry a heavy load. This alternative can also walk on the campus and roads.

Pros:

1. Innovative
2. Can climb stairs
3. Can drag or carry the packages

Cons:

1. Complex
2. Easily tampered with (pushing, vandalizing, etc…).



* 1. Robot train tracks

To be able to use a mini train within campus, we need train tracks that connect the buildings we want to deliver to and from. By having different stops at different faculty buildings, and smart train junctions that can save time by switching to shorter routes the user can drop off the packages at 1 of the stops and then the receiver would take the package at the stop nearest to him/her.

Pros

* Eliminates the need for navigation algorithms.
* If pedestrians avoid the tracks, no need for obstacle avoidance.
* Can be fast?

Cons

* Requires train tracks to function.
* Sub-optimal routes
* Limited to set of stops

Heat

Batteries

Controller

Train Tracks

Motors

Train

Power

Kinetic energy

Information

Power

Deliver packages

Sound



Figure 6 – Train’s Glass box

* 1. **Morphological chart**

Table 10 - Morphological chart

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Function** | **Means** | | | | |
| **1** | **2** | **3** | **4** | **5** |
| 1. Traversal of the campus | Wheels | Propellers | Continuous wheel track | Quadruped/Biped | Conveyer belt |
| 2. Carrying the package | Wagon | Carried Box | Pneumatic tubes |  |  |
| 3. Navigation | GPS | Predefined path | Pilotage [i] |  |  |
| 4. Maintain the safety of the package | Digital lock | Combination Lock | 2-step verification |  |  |
| **Feature** | **Means** | | | | |
| **1** | **2** | **3** | **4** | **5** |
| 1. Fast | Motors power | Mechanic | Lightweight |  |  |
| 2. Long battery life | Energy consumption | Capacity | Recharge time |  |  |

[i] navigating by reference to visible landmarks

* Alterative A: Quadruped robot with a wagon attached to it, navigates using pilotage, the packages are secured using a 2-step verification system (2FA)
* Alternative B: Conveyer belt where the packages are put in a plastic box and placed on it, the conveyer belt spans the campus on a predefined path, the packages are secured using a combination lock.
* Alternative C: Ground robot that uses wheels to traverse the campus, the package is loaded on the robot (carried box), it navigates using GPS, the packages are secured using a Digital lock

|  |
| --- |
| KTDA |
| Musts/Alternative | A: Quadruped Robot | B: Conveyer Belt | C: Ground Robot | D: Robot Train | E: Golf Cart | F: Drone |
| 1. The ability to move within 2 km range of the Engineering building autonomously on paved roads. 2. Ensures the safety of the packages. 3. Includes a storage unit for the shipments. 4. Tamper proof electronic components. 5. Made from durable material. 6. Operate within 5 km/h. 7. Can carry weight within (80kg). | **GO** / **NO** GO  **GO / NO** GO  **GO / NO** GO  **GO / NO** GO  **GO / NO** GO  **GO** / **NO** GO  **GO** / **NO** GO | **GO** / **NO** GO  **GO / NO** GO  **GO / NO** GO  **GO / NO** GO  **GO / NO** GO  **GO** / **NO** GO  **GO** / **NO** GO | **GO** / **NO** GO  **GO / NO** GO  **GO / NO** GO  **GO / NO** GO  **GO / NO** GO  **GO** / **NO** GO  **GO** / **NO** GO | **GO** / **NO** GO  **GO / NO** GO  **GO / NO** GO  **GO / NO** GO  **GO / NO** GO  **GO** / **NO** GO  **GO** / **NO** GO | **GO** / **NO** GO  **GO / NO** GO  **GO / NO** GO  **GO / NO** GO  **GO / NO** GO  **GO** / **NO** GO  **GO** / **NO** GO | **GO** / **NO** GO  **GO / NO** GO  **GO / NO** GO  **GO / NO** GO  **GO / NO** GO  **GO** / **NO** GO  **GO** / **NO** GO |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Wants | Weight | Rating | Score | Rating | Score | Rating | Score | Rating | Score | Rating | Score | Rating | Score |
| 1. All the parts for the project can be found in Jeddah | 7 | 10 | 70 | 10 | 70 | 10 | 70 | No go | | | | | |
| 1. The project can be done in 5 weeks | 10 | 10 | 100 | 8 | 80 | 0 | 0 |
| 1. The project combines all our fields (mechanical, electrical) | 6 | 5 | 30 | 10 | 60 | 10 | 60 |
| 1. The artifact could be water and dust resistant | 3 | 10 | 30 | 10 | 30 | 10 | 30 |
| 1. The project implements material learnt in class | 8 | 10 | 80 | 7 | 56 | 8 | 64 |
| 1. The Project could be made using eco-friendly materials | 3 | 4 | 12 | 0 | 0 | 0 | 0 |
| 1. Doesn’t require payment for transportation | 10 | 10 | 100 | 10 | 100 | 9 | 90 |
| 1. Could be made using less than 5 electric circuits | 8 | 10 | 80 | 7 | 56 | 3 | 24 |
| 1. The project can be easily fixed in case of a malfunction | 10 | 7 | 70 | 8 | 80 | 3 | 30 |
| 1. The project use pieces we can find in our homes. | 3 | 5 | 15 | 8 | 24 | 0 | 0 |
|  |  | ***Total A = 587*** | | ***Total B = 556*** | | ***Total C = 368*** | | ***Total D = NO GO*** | | ***Total E = NO GO*** | | ***Total F = NO GO*** | |

1. Intro+ musts+ wants + objectives
2. **Control System's Objective:** Discuss all components (Acutators: motors, power electric circuits, sensors, microelectric devices, controllers)
3. ~~Generate alternatives using morphological chart~~
4. ~~Compare alternatives using KTDA (Kepner Tregoe decision analysis)~~
5. Analysis of alternatives that pass the KTDA (Glass box (describe the systems), pros cons, cost analysis of components)
6. ~~Select an alternative~~
7. Further analysis of selected alternative (short paragraph)
8. Maturing chosen baseline design (buying motors, wasting time etc. -> Reusing a hoverboard and adding a cart to it)
9. Add 3D model of baseline design, specification, updated cost analysis
10. Discuss impact of components on economy, enviroment, society.

Next meeting:

Tentative date: **Fri 8:00 PM** 12/11/2021

1. Analysis of alternatives that pass the KTDA (Glass box (describe the systems), pros cons, cost analysis of components
2. Assign black tasks + deadlines