Justification document

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## Introduction

In this document you will find the justification of each piece of work done by me. Some parts are already done, while some problems will reiterate a few times throughout the sprint, depending on their size.

## Proof of concept Map environmental structures with LIDAR

### Context

The JACKAL is aware of its surroundings. A key part of this is being able to recognize and see certain obstacles. This requires detailed sensors to provide the JACKAL with qualitative data to make these recognitions. But not only the JACKAL needs qualitative data to understand its environment, it also needs this data to be useful enough to serve to the end user so that it can understand the environment as well. The end-user could make use of this data in the form of a map or a 3d visualization.

### Problem/Opportunity

Currently the data provided by the JACKAL is inferior to the data which could be provided if the hardware would be upgraded. The current data which is provided by the robot is not good enough. The 2D map, although understandable, would benefit massively from a new LIDAR which is a direct hardware upgrade. And the 3D mapping, currently done by a camera, is almost too detailed, showing way too much data of the visuals around it; creating a very fuzzy and illogical image.

### Goal

Create a proof of concept which shows that a 3D LIDAR is a viable method to upgrade not only the 2D but also the 3D map by providing more accurate and quantitative data to construct these maps. The end-user benefits massively by having a map based on more and more accurate data to gain environmental awareness, this proof of concept aims to provide an answer to the question whether it is possible to create this data with the use of a new 3D LIDAR.

### Process

To start this proof of concept I first looked at viable algorithms to support the new LIDAR. Since the LIDAR natively has a high tunability, we were looking for an algorithm which can incorporate this. After finding one I integrated the new algorithm on my computer and connected my LIDAR.

When I made sure this was working, I went ahead and connected everything to the robot. I did this intuitively since the algorithm used is supposed to be a lightweight package. Therefore, I was curious as to how it would perform on a system which is arguably slower and has more latency.

In order to serve the same data but via the robot, some additional infrastructure had to be set up to accommodate this. After integrating the LIDAR and replacing the old algorithm with the new one; I was done.

### Validation

The validation of this proof of concept in its core are very simple, the visualization needs to be “good” enough to see what is going on. However, what is good? I determined that being able to quickly recognize a room and its contents is a must for this project. The key objects in the room should always include the walls and passageways/doorways. Pillars, poles and other, smaller, vertical objects should appear on the map as measured data.

To combat pattern recognition while testing this “room recognition”, I drove the robot to a part of the building which I had never seen before. Letting the robot scan the surroundings for a while; I then went back to see if what the robot saw was how I envisioned the room. These results seemed to overlap quite nicely.

I briefly mentioned the efficient speed of the algorithm, inherently this means that speed is desirable in this application. To test the speed correctly, I needed to recreate the scenario like it will be when the end users use this product. Which is remotely via some sort of data tunnel. In my case, SSH is the option I went with. I tested the speed of the feed by having colleagues walk and perform quick jerky motions in front of the robot. If I could distinguish in a reasonable reaction time if there was a person or what they were doing; the speed would be adequate. This happened to be the case.

## Integration of a new camera

### Context

We would like to make the JACKAL more aware of its surroundings, while simultaneously make it easier for the end user to see what the robot sees. Some data is interpretable way quicker for a computer than a human, for example highly noisy point clouds. This is currently solved by a camera at the front of the robot, in its current configuration it is responsible for 3D scanning; as well as deliver a camera feed to the end user if desired.

### Problem/opportunity

The current problem is that the camera feed generated by the camera is very slow/choppy. This feed is not reliable at all for first person driving or accurate mapping. Let alone being able to monitor or recognize anything going on when far away from the robot. Furthermore the PO gave us a requirement which requires the robot to be able to see in the dark, the current camera did not support IR camera modes and therefore does not honour the requirements.

### Process

First, I made sure the camera worked according to the factory standards. I did this by installing the manufacturers software and checking all output feeds. After this, I researched how the current camera on the jackal actually talks to the rest of the system. This would be my beginning point of integration, since the system should start to listen to a new camera.

When I was done with this, I made sure the camera also worked in the ROS configuration on the robot; by running it locally on my pc with the same settings. The feed in this preliminary testing was very good and clear, so I was quite opportunistic to integrate it.

After this, I integrated the camera in the system. First of course all the required drivers, then I made the new camera talk to the existing system. Because I had first figured out how the previous camera worked, this was a very smooth job to do. I had to alter a few lines of code in setup files to accommodate for the new drivers.

### Validation

To validate this outcome, we can simply view the infrared camera stream and see if it outputs something which is not a black screen. This happened to be the case. The requirement was fulfilled.

We also wanted to fix the latency issues. To test the speed correctly, I needed to recreate the scenario like it will be when the end users use this product. Which is remotely via some sort of data tunnel. In my case, SSH is the option I went with. I tested the speed of the feed by having colleagues walk and perform quick jerky motions in front of the robot. If I could distinguish in a reasonable reaction time if there was a person or what they were doing; the speed would be adequate. This happened to NOT be the case. Sadly, the choppy feed was not due to the internal speed of the camera.

When testing the robot for its primary application, driving from first person view. The feed sadly wasn’t any better. Though it was actually doable to drive it, with little pauses in between it was no problem to navigate through the building.

## Project Plan Personal project

### Context

For my Personal Project I need to keep track of when I am going to do what and what my steps are. This way I can better plan the project, as well as project it to others a lot better.

### Problem/Opportunity

With this projectplan I could improve the way I manage and present my project better to others.

### Goal

Have a project plan which lists the scope, steps needed, the planning and a risk analysis.

### Process

I sat down and made sure to write down everything I knew about the project on a piece of paper. Then I slowly made it into separate boxes so I could plan and phase it better. Then it was a matter of making it into a project plan.

### Validation

I think the only possible validation for this is feedback from the teacher. Furthermore a good validation can be at the very end of the project. Did the project plan fit the phasing of the project? The better this fits, the better the project plan was.