Navigation and localization sensory backpack for GPS-denied environments

ENGINEERING X
Group 09

INSTRUCTOR
Joseph T. Foley

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The problem

GPS doesn't work well underground or indoors

Your chances are slim to get a fix on enough GPS satellites to calculate your position while underground or indoors. [8, 9]

Search and rescue missions

Safety conditions in caves can be seasonal, having an accurate map can save lives.

[1]

The motivation

Too expensive:

The lowest price of similar products that we found on the market is 3,500,000 ISK.

Too heavy and uncomfortable:

Available products are either too heavy CITe or not built for long missions.

One example of a similar product. [2]

Stakeholders

Þorsteinn Hanning Kristinsson

B.Sc. Mechatronics Engineering, Reykjavík University
Intern at NASA

RIOT lab

Reykjavík University

[3]

Stakeholder View

Customer needs:

CN0:

A backpack that can collect and store data from its surroundings that will allow it to map in 3D said surroundings.

CN1:

It needs to have a 5m-6m radius for capturing data.

CN2:

It needs to be able to store 0.5TB-1TB.

CN3:

It needs to be comfortable for the wearer while mobile.

CN4:

It needs to be able to seize data from its surroundings.

CN5:

It needs to be able to capture data in 1080p quality.

CN6:

It needs to be able to process the data that is captured.

CN7:

It needs to be affordable when compared to competitors.

Stakeholder View

Functional requirements:

FR0:

The backpack needs to be able to collect and store data from its environment that will allow it to localize and 3D map said environment.

FR1:

The sensors and cameras need to be able to scan a 5m-6m radius of its environment.

FR2:

The data storage device needs to be able to store 0.5TB-1TB of data.

FR3:

The backpack should be comfortable while wearing and not cause any harm or discomfort for at least 1-3 hours.

FR4:

The backpack should be able to capture accurate data that can be utilized for 3D mapping Yes/No.

FR5:

The cameras should be capable of taking 1080p quality pictures.

FR6:

The backpack needs to be able to process data that is captured Yes/No.

FR7:

The backpack should be affordable when compared to the average price of he competitors similar product 3,500,000 ISK.

Constraints

~25 KG

Maximum weight

According to rules made by Vinnueftirlitið. [4]

300,000 ISK

Budget allocation

The budget provided by RU will be a constraint on the project regardless of generosity

2.1m x 1m

Maximum size

Needs to fit through door at RU.

Data management

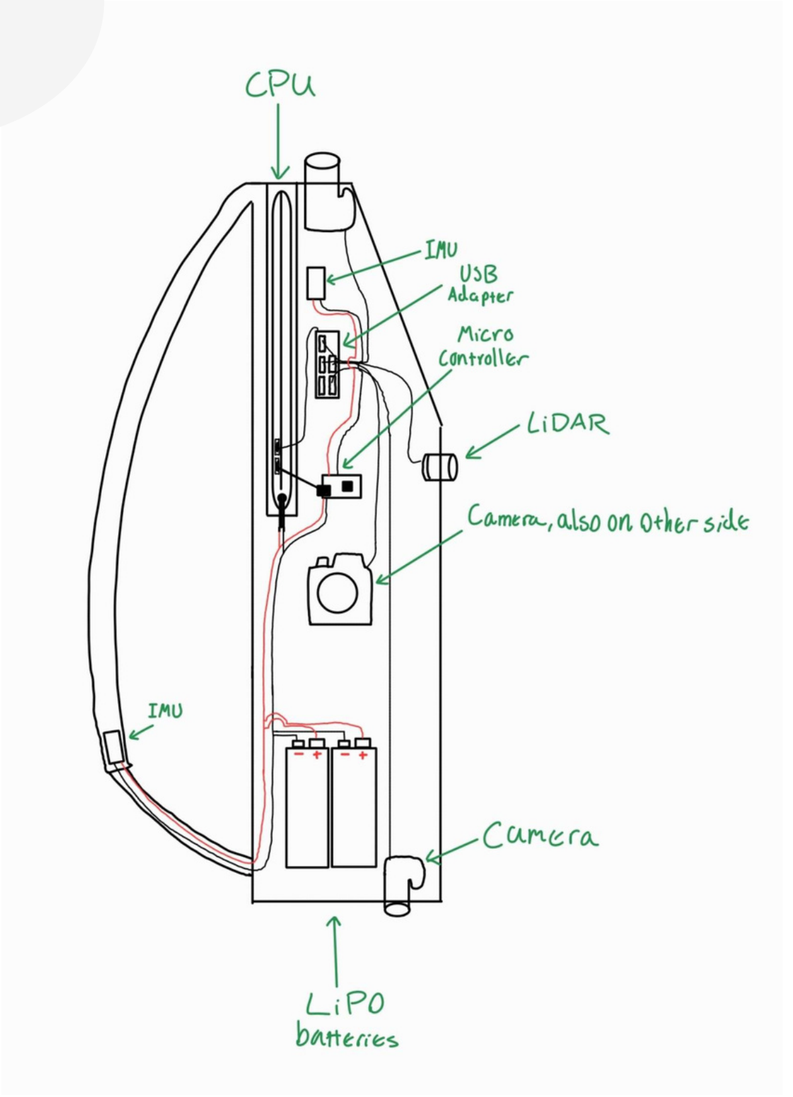
- There have been no encounters with personal data so far in the process and no imminent need for it in the foreseeable future.
    - But if the need for handling of private or medical data were to arise, it will be done in compliance with GDPR.

- The report is written in overleaf and can be found in the group's github repository where all future instances of coding and possible CAD files will be found as well.

Proposed Concept

3D mapping backpack using LiDAR technology

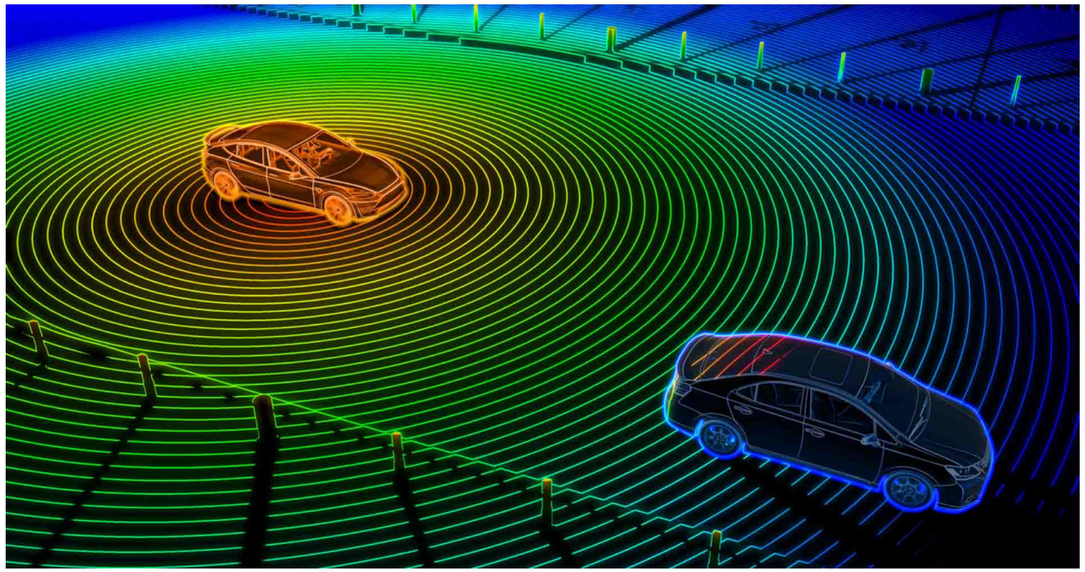
- 1x Lidar sensor
- 2x Inertial Measurement Unit
- 4x Digital cameras
- 1x Central Processing Unit
- 1x Hard Drive
- 2x LiPO batteries



Sketch by Axel Pálsson

LiDAR technology

- Uses light in the form of lasers
- Measures distance
- Point cloud system
- Useful for 3D mapping



LiDAR technology [5]

Central Processing Unit

- Brain of the system
- Takes data from the LiDAR, the cameras and the IMU
- Uses a custom made program to convert the data
- The converted data then moved to the hard disc

Personal computer [7]

Open questions

To keep all components stable we will need a structure within the backpack, the material of said structure is undecided.

Preferrably light and sturdy

Every system needs to be fail-safe and able to let the user know that the system is not working

What is the best way to establish the fail-safe?

Do you suggest any ways to attach the equipment to the backpack?

How would you keep the data-capturing equipment going at the same rate?

Any closing questions?

Reference Page

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