

Eindhoven University of Technology

Department of Mathematics and Computer Science

Automotive/Mechatronics Systems Design

**Extrinsic Sensor Calibration**

**Project Management Plan**

Automotive Systems Design In-house Project

Eindhoven, February 2023

Contents

[1 Project Overview 1](#_Toc1228960546)

[1.1 Purpose 1](#_Toc431762054)

[1.2 Scope 1](#_Toc243757978)

[1.3 Deliverables 1](#_Toc1784596811)

[1.4 Schedule 1](#_Toc661258160)

[1.4.1 Milestones (Tentative) 1](#_Toc1983351477)

[1.5 Stakeholders and involved parties 1](#_Toc1792685814)

[1.6 Evolution of the project 1](#_Toc48697096)

[2 References 1](#_Toc905598999)

[2.1 Project Management Framework 1](#_Toc1865205017)

[2.2 System Architecture Framework 1](#_Toc1437968636)

[3 Project context 1](#_Toc418713708)

[3.1 Process model 1](#_Toc2039803057)

[3.2 Process improvement 1](#_Toc83145669)

[3.3 Infrastructure and enabling systems 1](#_Toc1422888976)

[3.4 Methods, tools, and techniques 1](#_Toc264810656)

[3.5 Product acceptance 1](#_Toc740888062)

[4 Project Planning 1](#_Toc873302268)

[4.1 Working hours 1](#_Toc1398956634)

[4.2 Project work plans 1](#_Toc739094618)

[5 Project assessment and control 1](#_Toc187326826)

[5.1 Requirements management 1](#_Toc2130243949)

[5.2 Schedule control 1](#_Toc583395225)

[5.3 Quality assurance 1](#_Toc1036991077)

[5.4 Project closeout 1](#_Toc951341519)

[6 Project Delivery 1](#_Toc480558547)

[7 Supporting processes 1](#_Toc556874831)

[7.1 Project supervision and work environment 1](#_Toc875159032)

[7.2 Decision management 1](#_Toc45396126)

Document version

|  |  |  |
| --- | --- | --- |
| Version | Date | Description of changes and person responsible for making changes |
| 1.0 | 09/02/2023 | Initial draft (A.V. Damle) |
| 1.1 | 21/02/2023 | Refinement (A.V. Damle) |
| 1.2 | 18/03/2023 | Refinement (A.V. Damle) |

# Project Overview

This project is aimed at achieving the extrinsic calibration of two sensors to be mounted on a test vehicle, in order to capture data which can be further developed for other advanced driving aids like autonomous driving.

## Purpose

To capture the data from multiple sensors to be mounted on the test vehicle, ready for post-processing by implementing spatial calibration for the sensors.

## Scope

The scope of the project is to capture data on an Imaging RADAR and camera with the axes aligned appropriately. The available sensors will be studied for data capture. This will output combined data that can be utilised in the future for applications like object and range detection. A combination of AGILE and Project Management methodology is used to achieve project goals, with a GitHub repository for tracking tasks, deliverables and documentation.

## Deliverables

The following deliverables are considered throughout the project:

1. A Project Management Plan
2. Sensor data spatial and temporal alignment
3. Combined data capture
4. Comparing the data with the available reference data (Valeo study)
5. System architecture
6. Final presentation of project results, where the added value will be demonstrated
7. Documentation including Wiki page

## Schedule

The project start date is Thursday, February 06th 2023.

The project presentation date is Monday, March 24th 2023

The project end date is Friday, March 25th, 2023.

### Milestones (Tentative)

The following table shows the planned milestones for the project:

|  |  |  |
| --- | --- | --- |
| **Milestone** | **Start Date** | **End Date** |
| Literature survey | 06/02/23 | 10/02/23 |
| Data capture from ImRadar sensor | 13/02/23 | 17/02/23 |
| Data capture from camera | 20/02/23 | 24/02/23 |
| Sensor axes alignment | 27/02/23 | 03/03/23 |
| Sensor timing synchronization | 06/03/23 | 10/03/23 |
| Combined data capture, compare with benchmark data (Valeo) | 13/03/23 | 17/03/23 |
| Final documentation | 20/03/23 | 24/03/23 |

## Stakeholders and involved parties

Client: Pavol Jancura  
ASD Program manager: Riske Meijer  
Project Manager: Abhinav Damle  
Team Leader: Subash Mohan  
Team System Architect: Aditya Kuncolienkar

Team members: Shreyas Ravi

Luka Gradinac

Pratik Vaje

Sohrab Nasiri

## Evolution of the project

The progress of the project will be evaluated during weekly meetings with the client. The agenda for this meeting is:

1. The progress achieved during the previous week
2. The proposed goals for the coming week

After the meeting with the stakeholder, a retrospective meeting with the team will be held, in order to review the sprint and propose process improvements.

# References

## Project Management Framework

This project implements both Project Management framework with Agile methods based on the PMBOK and AGILE manifesto.

## System Architecture Framework

The selected standard for the development of the System Architecture is ISO 42010.

# Project context

## Process model

The team will be divided into sub-teams based on the technical areas to be explored, namely: Hardware team (to setup and get the hardware working, capture data etc), software team (to explore the algorithms for processing the capture data), and ROS team (to explore the feasibility and integration of hardware with ROS).

The SCRUM methodology is selected for organizing and developing the work. In SCRUM, there are rituals that are followed by the team on a regular basis. The work is divided into sprints. Sprints have a duration of one week, and at the end of each sprint, a meeting is held with the client, where the team progress is reviewed, and new goals are set for the coming week. Any obstacles faced and need for change in scope are also discussed and approved by the stakeholders.

After the meeting with the client, a retrospective meeting is held, where the team has an opportunity to review the past sprint and propose process improvements.

Additionally, there is one daily scrum meeting (daily standup), where each team member briefly describes what they did the last day, what they plan to do for that day, and if they have any roadblocks. In case there is a roadblock, the team leader provides support in removing the roadblock. The weekly tasks are divided into smaller sub-tasks to be completed for the day, and the sub-tasks will be assigned to the members based on the nature of the task.

## Process improvement

There will be a formal update meeting every week, where the team members can discuss progress, findings, learnings, and provide feedback and suggestions for improving the team’s processes. The PD coaches have meeting with the team every week to discuss the progress of the project and review the team work.

## Infrastructure and enabling systems

The project will make use of the following resources:

* TI Cascaded Imaging Radar: The primary sensor module for Radar data capture.
* Basler Camera: The secondary sensor for capturing image data
* Microsoft teams: For communication and sharing files
* GitHub repository: This is the official location where the store source code, datasets, documentation, tutorials, and all relevant technical assets will be stored as per the client’s request. This will also be used as a scrum board to divide and assign tasks to team members, and keep watch on the timelines of the each task.

## Methods, tools, and techniques

The GitHub repository will be the main location where the project management activities will be documented throughout the project. Since this is an exploratory study, the goals and tasks need to be updated every week. Every week, new tasks will be assigned to the team members, and each user story will be maintained under the ‘issues’ section in the GitHub repository.

Each user story has a name, a description, a number of tasks, an acceptance criteria, and a responsible person for its development.

Every week, the tasks are decided during the weekly meeting. These tasks are updated in the GitHub repository and are assigned to respective sub-teams. The progress of each task is also recorded.

## Product acceptance

The final product to deliver consists of the reports, documentation, source code, datasets, technical specifications and technical knowledge generated for the sensor. It should include the following information:

1. Overview and description of the sensors
2. Operating principle of the sensors
3. Technical guides, detailing how to setup, configure, and use the sensors
4. Datasets generated from sensor measurements, under different conditions and in different environments
5. Study analysis detailing different approaches to axes and temporal synchronization of sensors
6. Study comparing the captured data with the available reference data.
7. Improvements and further development.

# Project Planning

## Working hours

The duration of the project is approximately 6 weeks. The estimated time to work on the project is 101 hours (2.5 weeks FTE) per team member.

The following hours availability have been estimated based on the current scheduled activities:

|  |  |
| --- | --- |
| Week | Available hours |
| 06/02/23 - 10/02/23 | 19 |
| 13/02/23 - 17/02/23 | 15 |
| 20/02/23 - 24/02/23 | 24 |
| 27/02/23 - 03/03/23 | 11 |
| 06/03/23 - 10/03/23 | 10.5 |
| 13/03/23 - 17/03/23 | 7 |
| 20/03/23 - 24/03/23 | 15 |

## Project work plans

The following are the initial proposals for activities to perform in the project. Since the outcomes are yet unknown, the description, scope, and number of activities are subject to change.

1. SDK (software development kit) setup
2. Radar Sensor setup
3. Data acquisition from Radar
4. Repeat steps 1-3 for Camera
5. Axes alignment of sensors
6. Time synchronization of sensors
7. Benchmark on data collected

# Project assessment and control

## Requirements management

The management of the requirements will be logged in a document called the Requirements Register. This document will be located in the project’s Teams channel. It is the responsibility of the System Architect to maintain this document for the duration of the project.

## Schedule control

The schedule for the project is maintained continuously by the Project Manager using GitHub. Tasks are decided in a weekly meeting with the stakeholder. These are updated on the GitHub page, where the end date is defined, and the task is assigned to a sub-team. This is continuously updated as the tasks are completed.

## Quality assurance

The quality of the deliverables to the stakeholders will be monitored completely from the beginning to the end of the project timeline through the following steps:

1. As the first step of quality assurance, every user story is only accepted and closed after review from fellow team members, so that everything is in order and clear.
2. All the deliverables/updates are reviewed on Thursday before the stakeholder meeting on Friday.
3. Further, the stakeholder also evaluates the quality or functionality of the deliverables such as research or code during the weekly update meeting.
4. Finally, two team members are appointed for reviewing the quality of code to ensure its readability and modularity throughout the project.

## Project closeout

At the closure of the project, a final meeting with the stakeholders will take place, where the team will present all the deliverables. There will be final hand-over of the GitHub repository to the client, where he will make the repository public for other interested parties to gain knowledge from this project’s learnings. Team members will archive copies of all the information in the Teams folder for their personal use and reference, since permanent access will not be provided after the project ends.

# Project Delivery

This section describes how the deliverables, as presented in Section 1.3, will be delivered. The project documentation and relevant source code will be delivered through the GitHub repository, more specifically in the Wiki of the repository. A final presentation will be held for the client to present all the project outcomes.

# Supporting processes

## Project supervision and work environment

This section describes how day-to-day instructions, guidance and discipline are provided to the team. The main tasks are divided between the project manager and the team leader.

The project manager will log all tasks to be done in the project environment in the GitHub repository, as introduced in section 3.3. For each week (sprint), tasks with highest priority are moved to the sprint board, after consultation with the client. The GitHub project board consists of mainly four sections: Backlog, to do, In Progress, and Finished. Team members will be always assigned tasks on this board so it is clear who must do what. A main responsible person will be appointed for each task.

This board will be the main tool to monitor progress. Once tasks are finished, they move to the ‘finished’ section. This will give a good overview of the progress.

To maintain an overview of the tasks in progress, the team leader will be responsible for monitoring the individual progress. The team leader will discuss the progress with the project manager to evaluate the progress and identify possible corrective actions.

## Decision management

This section describes the strategy that is employed when taking decisions throughout the project. The table below describes for each decision type the following things:

1. Who should be involved during the decision?

2. Who needs to be informed about the choice?

3. What actions must be taken before deciding?

|  |  |  |  |
| --- | --- | --- | --- |
| Decision about | Involve | Inform | Actions |
| **Project scope** | Client  Project Manager  Team Leader  System Architect | Team | Evaluate consequences regarding planning and deliverables |
| **Project process** | Team | Team | Check team satisfaction |
| **Requirements** | Client  System Architect | Team | Check conflicts with design  Consult client about changes |
| **Software design** | System Architect  Project Manager | Project Manager | Evaluate pros and cons  Create decision matrix  Evaluate consequences for planning |