Project Report*

*As a fulfilment to the course: "Project course name", D7039E & E7032E. Lecturer: Jan van Deventer.

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***Abstract*—**

I. Introduction

Background and motivation

Self explanatory.

Contributions

How does this report contribute. Are there any novel solutions?

Structure

The overall structure of the report

II. Arrowhead

Arrowhead

What is it?

Extras

More in depth about the strucutre of the Arrowhead implementation. Flow diagrams etc.

III. Concept Design

Mechanical structure

The final design of the robot. Include CAD renderings etc.

Electrical components

Electrical components such as motors, MCUs etc. Why were they chosen

Requirements

IV. Modeling

Robotic arm

Forward kinematics

Inverse kinematics

Base

Camera vision and calibration

In this section it is outlined the theory behind the camera vision system. How points in a 3D-space are projected on a 2D-plane, calibration and distortion correction.

Camera model

Distortion

V. Machine Vision

Line following

QR-codes reading

Deep learning?

VI. Motion

Robot arm

Base

VII. Experiment

Prototype components

Overview of what is being used in the evaluation

Movable base evauation

Arm evaluation

Gripping evaluation

Sensor evaluation

Arrowhead evaluation

VIII. Conclusions

Conclusions of the robot and the course (?) Is our design good? Is Arrowhead good?

Conceptual design

APPENDIX

MARTIN BLASZCZYK

Martin is a 5th year Y-student with interest in Control och Mechatronics. In this course he'll take the role of the Project Leader where the main objectives are to keep focus on the goal, hold meetings and an overall oversight of the project. As for the technical part the main interest will be in machine vision together with Edward K. to use cameras or other sensors to localize external objects for the robot to grip, avoid or approach.

EDWARD CEDGÅRD

Master in electronic systems and control engineering. Edward's main task is to design the robotic arm and gripper mechanism together with Niklas. Tasks as deriving the kinematic equations, and implementation using forward and inverse kinematics. Choise of motors, armdesign, communication with motors using serial communication.

NIKLAS DAHLQUIST

Niklas is studying his fifth year at the Engineering physics and electrical engineering student program.

His main focus will be to work with Edward Cedgård to evaluate the gripping mechanism and if necessary design new components and model the corresponding control system to be able to lift up and hold the target object.

EDWARD KÄLLSTEDT

Currently studying his fourth year in the Master Programme in Computer Science and Engineering. A fan of making things secure, fast, scalable, and well-documented. Primarily interested in low level software development. Will initially work on the machine vision implementation together with Martin. In addition to machine vision specifically this work will also consist of robot localization and collision avoidance. As the project progresses he will take on more general software problems that might arise. The first week will be spent researching different computer vision technologies.

ALBIN MARTINSSON

Albin is a 5th year computer science student specializing in industrial computersystem. In this project he will be focusing on the arrowhead integration and bein charge of the Github repository. This will entail connecting all the services toeach other and making sure they are authenticated and secure. Being in chargeof the git repository will entail merging pull requests and sorting out conflicts, making sure that the version control part of this project runs smoothly.

MÅNS NORELL

Studying for a master in electronic systems and control engineering. Måns main task is to design the base and line-following controller for moving the robot along a line. Tasks include designing the base, printing the specialized parts, simulating and testing the base. Communication between controller, motor and camera will be worked on in collaboration with those in charge of these tasks.

PROJECT STRUCTURE

To keep the project going and have an organized structure the project is divided in different parts, or subprojects. Each group member is either alone or in group responsible for each part of the project which coincides with their interests.

- Arrowhead
- Machine vision and localization of external objects
- Gripping tool
- Movable base

MEETINGS

Every week the group met on Mondays and Thursdays to catch up and support each other. This structure gave the students a great deal of responsibility to do work for each meeting while still maintaining a good structure of the project and encouraged discussions. The Monday meetings had the following agenda where the goal was to catch up with the whole project group and discuss the project and the weekly seminar

- Status of work done the previous week by each member
- Preparation for the seminar
  - Discussion of the previous seminar meeting
  - How the weeks work has been coinciding with the seminar feedback
  - Questions to ask the teachers
  - Questions to ask the other group
  - Who does what during the seminar
- Other

The Thursday meeting was to collect and reflect over the feedback from the teachers and the other group from the seminar. Also a status on the work planned to be done the following week will be discussed so that each member had an overview of what the other members are doing. The meetings had have the following agenda

- What feedback did the teachers give
- What feedback did he other group give
- Feedback to each other withing the group
- Work to be done the following week
- Other

A. Project planning

The projects course started in August 2020 and continued until mid January 2020 with the project deadline in the middle of December. To have a good structure and of the things to be done and synchronizing all the parts a plan was made to have a good overview of the project, shown in Table I. This plan enabled the group to be flexible while still have a good long-term structure of the project. Every month a more detailed time plan was prepared to facilitate the small changes, delays etc.

For the group members to what task were to be done, the built in function of Issues on the souce control platform Github® enabled all the project group members to see what had to be done every week. A Milestone was created for each week and populated with issues. When an issue was finished

TABLE I
OVERALL TIME PLAN

Sep	Oct	Nov	Dec
Concept generation	Evaluation	Evaluation	
Theory	Prototyping	Evaluation	Finishing up
Simulation	Evaluation	Evaluation	
Prototyping	Final Design	Evaluation	

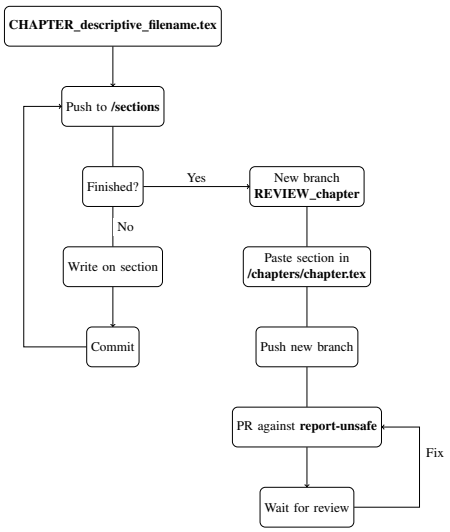

Fig. 1. Report writing flowchart

it could simply be closed. If the issue was delayed it showed clearly in the Issue overview which tasks had to be prioritized.

B. Source control

To keep track of the different software implementation the projects source control implements Git in one common repository [1]. The repository is where all source code and relevand 3D-files are located. This report is written in LaTeX with Git as source control. To make sure it's easy for all members to write their designated sections a workflow was designed to to minimiza merge conflicts while writing drafts as show in Fig. 1. Without this flow the group members would experience merge conflicts after every push which would make it more complex and time consuming.

REFERENCES

[1] Students, "D7039e," https://github.com/kottz/D7039E, 2020.