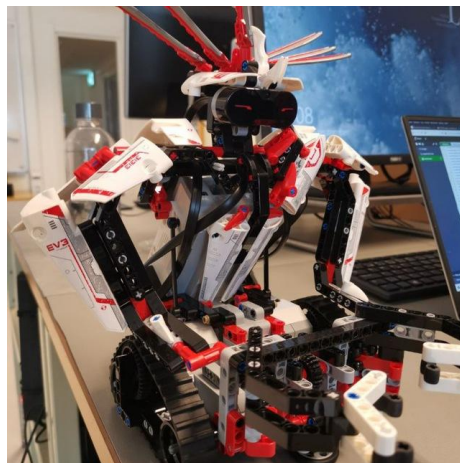# Project in Industrial Computer Systems
D7039E, Lp1-2, H20

Martin Blaszczyk `marbla-6@student.ltu.se`
Edward Cedgård `edwced-4student.ltu.se`
Niklas Dahlquist `nikdah-6@student.ltu.se`
Edward Källstedt `edwkll-7@student.ltu.se`
Albin Martinsson `albmar-6@student.ltu.se`
Måns Norell `mnsnor-5@student.ltu.se`

LULEÅ
TEKNISKA
UNIVERSITET

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Abstract

Introduction

Background and motivation

Self explanatory.

Contributions

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

Structure

The overall structure of the report

Conceptual 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

Computer Vision System

ID: 01
Titel: *Line Detection*

- Given a distinctly colored line along the floor the computer vision system should be able to track it and feed back an accurate measurement of how much the robot deviates from said line.

ID: 02
Titel: *Color Detection*

- Camera input should be filterable by RGB pixel values. Objects within certain color ranges should be detectable.

ID: 03
Titel: *QR Code Identification*

- The system should be able to recognize and read the contents of QR Codes.

ID: 04
Titel: *Real-Time Performance*

- It should be possible for the system to keep up with and process a continuous video stream in real-time.

ID: 05
Titel: *Visualization*

- An accompanying GUI should exist where the raw video stream can be seen adjacent to a video stream where color and line detection is active. Detected objects should have a border and an object coordinate should be seen on screen. When the system is following a line it should be possible to see how the robot is positioned relative to the line. A measurement of the current deviation should be seen on the screen.

Modeling

Robotic arm

Forward kinematics

Inverse kinematics

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

Motion algorithms

Robot arm

Path planning

preliminary stuff

- Since the base use tracks, it can turn on a point. Therefor the turning radius will be the length from the center of the tracks, to the object furthest away from the center.

- The acceleration need to be slow enough to not tip the robot over, since it seems quite top heavy.

- The motors will need decoders for some of the control to work, if done the way they're planed

- The motors also need to be strong enough to move the robot, both with and without load.

Since the robot is using tracks, it can be viewed as a simple two motor system. Where one can control the turning and direction of the robot by reducing or increasing the speed of the two motors. The diffirence in the speed (Δv) can then be used to calculate the turning speed ($\dot{\theta}$)

Experimental evaluation

Prototype components

Movable base evauation

Arm evaluation

Gripping evaluation

Sensor evaluation

Conclusions

Conclusions of the robot and the course (?)

Appendix A

Team members

Martin Blaszczyk

Edward Cedgård

Master in engineering electronic systems and control engineering. Edward main task is to design the grip mechanism with Niklas. Topics like the design of the claw, necessary components, model of the controlsystem and then implementation.

Niklas Dahlquist

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

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 computer system. In this project he will be focusing on the arrowhead integration and be in charge of the Github repository. This will entail connecting all the services to each other and making sure they are authenticated and secure. Being in charge of 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

As Måns is a control student, he will be working on the movement and navigation system for the robot. In the beginning this will manifest in moving the robot to user specified coordinates.

Appendix B

Working together

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 will be meeting on Mondays and Tuesdays to catch up and support each other. This scheme may change in the future if needed. The Monday meetings will have the following agenda where the goal is to catch up with the whole project group and discuss the project

- 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 Tuesday seminar

- Other

The Tuesday meeting will be after the seminar to collect and reflect over the feedback from the teachers and the other group. Also a status on the work planned to be done the coming week will be discussed so that each member has an overview of what the other members are doing. The meetings will 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

As mentioned, this meeting structure may be subject to changes if needed and of course if any member of the group wants to work from home a video call will be organized.