



Project Plan

CrazyTrain

2022-12-12

Version 1.2



Status

Reviewed	Anton Bossen	2022-09-26
Approved	Filipe Barbosa	2022-09-30



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DOCUMENT HISTORY

Version	Date	Changes made	Changes by	Reviewer
0.1	2022-09-09	First draft.	Project group	Anton Bossen
1.0	2022-09-16	First version.	Project group	Anton Bossen
1.1	2022-09-20	Modifications as requested by the Orderer.	Oskar Grönlund	Anton Bossen
1.2	2022-09-26	Modifications as requested by the Orderer.	Anton Bossen	Anton Bossen



1 AN OVERVIEW OF THE PROJECT

In this section, a short overview of the project goal and purposes is presented together with a time frame of the different deliverables.

1.1 Purpose and goal

The aim for this project is to make a visual demonstration using formation flying drones which can be presented in Visionen at LiU. To achieve this, the drones should be robust against disturbances and be able to follow predefined trajectories. Another goal is to build a simulation environment where future testing could be performed with software-in-the-loop. The project will serve as a base for further development in future projects and the software should enable for customized flight missions to be created by other users.

1.2 Customer

The customer of the project is Daniel Axehill from the department of electrical engineering at the division for automatic control.

1.3 Deliverables

An overview of the project deliveries is presented in Table 1.

Table 1: Deliverable

Delivery	Toll gate	Date
Requirement Specification	BP2	2022-09-21
Project Plan	BP2	2022-09-21
Time Plan	BP2	2022-09-21
Design Specification	BP3	2022-10-05
Test Plan	BP3	2022-10-05
Basic functionalities in the simulation environment	BP4	2022-11-09
Test protocol for requirement for the functionalities above	BP4	2022-11-09
All functionalities of priority 1 and most of the priority 2	BP5	2022-12-09
Test protocol	BP5	2022-12-09
User manual	BP5	2022-12-09
Presentation where most requirements are fulfilled	BP5	2022-12-09
Technical report	BP6	2022-12-12
After study with project follow-up of results and times used	BP6	2022-12-12
Poster presentation	BP6	2022-12-13
Website	BP6	2022-12-15
Film summarizing the project	BP6	2022-12-19



1.4 What is not included

Since the drones are provided to the project group, no hardware developing will be needed. Also, some software from the project Crazyswarm [1] will be provided to fly the drones.



2 PLAN FOR THE PROJECT PHASES

The working process of this project will follow the LIPS model which contains three phases; Before, during and after. These are presented further below.

2.1 Before-phase

The main part of the before-phase is about planing the project. The system is dissected into components and the requirements of the finished product are derived. A plan for how the goal and requirements could be achieved is also created.

2.2 During-phase

In the during-phase, the main part of the project will be performed. The plan from the before-phase is executed. A design plan for the product is created and maintained during this phase. System testing, integration and documentation are all important for the during-phase.

2.3 After-phase

In the after-phase the final product will be presented and delivered to the customer. An after-study will also be conducted which focuses on reflection of the project work.

3 ORGANISATIONAL PLAN

In this section, an overall plan for the organisation of the project is presented. This includes the internal relations of the group’s members as well as the external relations towards the supervisor and customer.

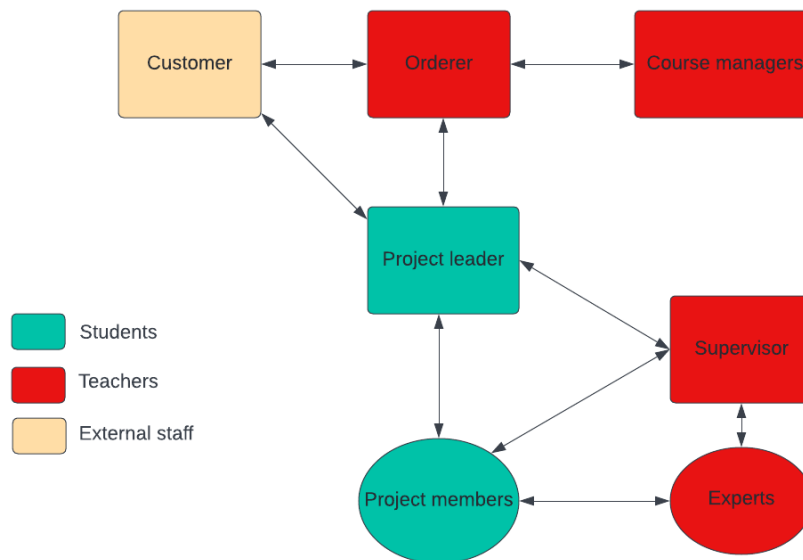


Figure 1: Organisational structure of the project.

3.1 The customers organisation

The customer is Linköping University, where Daniel Axehill is Liu’s representative. The project group’s contact person and orderer is Filipe Barbosa.

3.2 Conditions for the cooperation in the project

A group contract will be created by the project leader and signed by the project members to maintain a good group dynamic. The group contract will include the division of the group, the responsibility for each individual and guidelines for the collaboration in the group.

3.3 Definition of work contents and responsibility

There are three external roles for this project, they are the following:

- Customer: Daniel Axehill
- Orderer: Filipe Barbosa



- Supervisor: Daniel Arnström

3.3.1 *Definition of project group responsibilities*

The project group has been split into 8 different positions of responsibility. These are the following:

- **Project leader:** The project leader is responsible for organising the group and providing support to the group members. The leader is also responsible for day-to-day tasks such as booking meetings and rooms. The communication between the orderer and the project group is done through the project leader.
- **Software manager:** The software manager's main task is to be responsible for the code in the project. The code should be up to standards and the software manager is also responsible for given notice to changes in the code.
- **Hardware manager:** Since there is no developing of hardware in the project, the hardware manager's task is to be responsible for the existing hardware and make sure it is in working condition.
- **Design manager:** The design manager is responsible for documenting the design process and making sure that the overall presentation of the project looks good. The design manager also have the responsibility to create the website for the project.
- **Documentation manager:** The documentation manager is responsible for sorting the documentation of the whole process. All written files should also have the same template. During group meeting, the documentation manager has the responsibility of taking notes.
- **Simulation manager:** The simulation manager is responsible for the simulation environment.
- **Testing manager:** The testing manager is responsible for creating and executing tests for the product. The main goal is to try the system for robustness and see if the system works as intended. Testing manager is also responsible for the test protocol, where all documentations of the test are made.
- **File manager:** The main responsibility of the file manager is organising GitLab in such a way that it is easy to understand and make sure files are up-to-date.

3.3.2 *Assigned project group responsibility*

- **Project leader:** Anton Bossen
- **Software manager:** Lukas Jonsson
- **Hardware manager:** Morteza Akbari
- **Design manager:** Anton Håkansson
- **Documentation manger:** Erik Axelsson
- **Simulation manger:** Oskar Grönlund
- **Testing manger:** Patrik Lindström
- **File manager:** Emil Lydell



4 DOCUMENT PLAN

Plan of documents and files that are going to be created during the project can be read in Table 2.

Table 2: Document Plan

Document	Description	Target	Format
Requirement specification	Requirements on the system	Orderer, Customer, Project group	PDF
Project plan	Outline of the project, overview of necessary tasks	Orderer, Project group	PDF
Time plan	How project time is distributed among tasks.	Orderer, Project group	PDF
Design specification	Specification on the system design	Project Group	PDF
Test plan	Outlines of how tests are going to satisfy requirements.	Orderer, Project group	PDF
Test protocol	Results from the tests performed.	Orderer, Project group	PDF
Technical Documentation	Report on the technical details of the project.	Orderer, Customer	PDF
After study	Project follow-up of results.	Orderer	PDF
Poster	Presentation of the project in the form of a poster.	Customer	PDF
Website	Website with information about the project.	Customer	HTML
Project Film	Short film that displays the project in a fun and interesting light.	Customer	MP4
Meeting protocol	Protocol from the project meetings.	Project group	PDF
Time report	Report of hours spent on tasks by each group member in the project.	Orderer	PDF
Status report	Updates to the customer on the progression of the project.	Orderer, Customer	PDF
User manual	An manual that describes how to use the system.	Orderer, Customer	PDF



5 DEVELOPMENT PLAN

The project will be divided into different subsystems, which will be split up amongst the group and solved individually. If help is necessary, support will be given from other project group members first and secondly from the supervisor. In later stages of the project, all subsystems will be integrated to each other.

Weekly meetings will be held where all project members will be informed of the project progress and if there are any new challenges in the project.

All milestones that are close to deadline and all requirements from the requirement specification that have been assigned priority of 1 will be prioritised by the project group.

Tests will be performed in order to see how the implemented methods works in reality, in order to avoid sequential errors in the project in future.



6 TRAINING PLAN

The project members need to understand how the Qualisys system in Visionen works. Hence, a training session will be held in Visionen with the project supervisor.

The project will be heavily based on the CrazySwarm platform [1] and take inspiration from the work of previous project group CrazyCrowd [2]. It is therefore essential that the project members are well-read on how the existing platform works. To understand the code is also important so that changes can be done and modularity can be achieved. Other training include getting familiar to GIT and ROS (Robot Operating System).



7 REPORT PLAN

Every project member must report their expended time and a description of the works they did, in the group time report after the every session or at the latest at the end of each week (Sunday's at 17:00). The aim of this is to track the project progress and each member's time disposal.



8 MEETING PLAN

Weekly meeting will be held every Monday between 13:15 and 15:00 in the first period. The time will be changed in the second period due to overlapping courses for project members. The project leader will meet the orderer every week, a specified date has not been decided yet. Extra meetings will be scheduled if it is needed.

Before each meeting, the project manager will publish a meeting protocol and group members are allowed to add points to the agenda. During the meeting, a secretary will fill out the meeting protocol with the content of the meeting. The documentation manager will check and sign the document. These protocols will serve as a way of keeping track of the weekly work progress and decisions made by the group attending the meeting. Members that are not able to attend the meeting will then have all the useful knowledge available in order to keep up with the current issues of the project.



9 RESOURCE PLAN

In this section, describe resources that the project has access to. These include persons, material, workrooms and economy.

9.1 Project members:

- Morteza Akbari
- Erik Axelsson
- Anton Bossen
- Oskar Grönlund
- Anton Håkansson
- Lukas Jonsson
- Patrik Lindström
- Emil Lydell

9.2 Supervisor:

- Daniel Arnström

9.3 Material

- 1 x Crazyflie 2.0
- 4 x Crazyflie 2.1
- 1 x Crazyradio
- Qualisys camera positioning system
- 1 x laptop running Ubuntu and ROS

9.4 Work rooms

- Visionen
- Project room

9.5 Economy

Every member of the group has 240 hours of planned work. The project does not include a budget, since no new components are to be bought.



10 MILESTONES AND TOLL GATES

This section describes the milestones and toll gates in the project.

10.1 Milestones

The milestones in the project are listed in Table 3.

Table 3: The list of all milestone

No.	Description	Date
1	Qualisys communication should be integrated with Crazyswarms project.	2022-09-30
2	GUI should be completed and integrated.	2022-10-24
3	Basic requirements for the simulation environment should be achieved.	2022-11-07
4	Filter should be ready and integrated.	2022-11-07
5	Controller should be ready and integrated.	2022-11-10
7	A drone should be able follow a trajectory in Visionen.	2022-11-14
8	Multiple drones should be able to preform formation flight in Visionen.	2022-12-05
9	Multiple drones should be able to endure planned robustness tests in Visionen.	2022-12-09
10	System testing should be finished.	2022-12-11

10.2 Toll gates

The toll gates in the project are listed in Table 4.

Table 4: The list of all toll gates.

No.	Description	Date
0	Approval of the project directive, decision to start the pre-study.	2022-09-02
1	Approval of the requirement specification, decision to start the preparation phase.	2022-09-21
2	Approval of the project plan, decision to start the execution phase.	2022-09-21
3	Approval of the design specification, decision to continue the execution phase.	2022-10-05
4	Approval of the basic functionalities in the simulation environment	2022-11-11
5	Approval of the all functionalities of the system, decision to deliver	2022-12-02
6	Approval of the delivery	2022-12-09



11 ACTIVITIES

In this section we go through the activities, their dependencies on other activities and estimated hours to complete the activity in Table 5. For more detail, see Excel document **timeplan**.

Table 5: Project Activities

No.	Activity	Dependencies	Hours
1	Project plan	-	40
2	Requirement specification	-	50
3	Time plan	-	20
4	Design specification	-	90
5	Competence development	-	110
6	Create a GUI with an overview of the design	-	20
7	Add functions to the GUI	6	40
8	Connect GUI to planner	6	20
9	Connect GUI to Visionen	6	10
10	Trajectory building	-	140
11	Further development	10	60
12	Get a position estimate from Qualisys	-	40
13	Get IMU data	-	20
14	Fuse IMU together with Qualisys data to estimate position	12, 13	80
15	Create an overview of the design for the simulation	-	20
16	Visualization of the planned path	15	20
17	Provide a visualization of the estimated position	15	20
18	Be able to simulate multiple drones	16, 17	45
19	Further development	15-18	40
20	Controller development	-	155
21	Parameter setup script	-	40

Continued on next page



Table 5: Project Activities (Continued)

No.	Activity	Dependencies	Hours
22	Test protocol	-	80
23	Test GUI	6-9	5
24	Test Planner	10	20
25	Test Simulation	15-18	30
26	Test Sensor system	12-15	20
27	Test Controller	20	60
28	Technical documentation	-	92
29	After study	-	16
30	User manual	-	32
31	Film making	-	20
32	Presentation	-	32
33	Website	-	20
34	Poster	-	20
35	Project leader post	-	38
36	Meeting	-	152
37	Team building	-	112
38	Time reporting	-	26



12 SYSTEM TESTING

Testing will be performed throughout the whole project. Every requirement will be tested according to our test plan and documented in test protocols.



13 TIME PLAN

Every project member will put 240 hours on the project which will sum up to 1920 hours in total. Check Excel file for details [3].



14 PLAN FOR CHANGES

If there are any new guidelines regarding COVID-19 pandemic, the project shall return to distance mode. Any delay of project toll gates should be informed to the orderer in order for the issue to be resolved.



15 RISK ANALYSIS

In every project there are some risks. Risks, consequences and how to avoid can be read in Table 6. Every member of the project shall follow the safety directive document for Visionen given by ISY.

Table 6: Risks

Risk	Consequence	How to avoid
Person-related accidents with the Crazyflies	Blindness, bruises, burn injuries from handling batteries or other possible overheating equipment	No uncertified humans inside Visionen while drones are flying. People who are inside shall have full focus on drones in case of emergency.
Unable to fulfil the requirements or unable to produce an adequate report	Project not satisfying demands and unhappy stakeholders	Continuously updating and reflecting upon set goals with the orderer. The group should also be responsive to if new updated goals should be set or negotiated.
Internal conflicts within the group.	Obviously bad tension between group members. Could also affect the overall quality of the project.	The group consist of adults and internal conflict should not be a problem to handle within the group. If absolutely necessary the group supervisor could interfere. The group will work a lot with team building activities to make the team spirit remain.
Another pandemic	Group entering distance mode.	Can not really be avoided, but since all the group members can work in almost full distance mode, this would not really be a problem.
One group member will be long-term sick or can't produce the work required out of sudden need of absentee due to other accepted reason.	More group work for others or missing hours put in the work.	If needed the responsibilities will be divided fairly within the group. If this is not possible the group could re-negotiate the set demands.
Hardware malfunctioning	Unable to perform tests and general time loss	Carefully handling the equipment and if needed ordering parts quickly if parts needs to be replaced. If possible test that can be simulated before testing in a real life environment, will be simulated first.



16 PRIORITIES

The goal is to first be finished with all requirements with the priority level 1 before starting with priority level 2. Most of the priority level 2 should also be finished. The priority level 3 is extra requirements that do not need to be fulfilled. They will only be started if all level 1 and 2 are fulfilled and if the project group has time for them.



17 PROJECT CLOSING

Before the project closes all the requirements of priority 1 and 2 shall be done except if some requirements have been renegotiated. The code shall be available in the project's repository. All the required documents shall be finished and approved. A movie, a web page and a poster shall also have been produced and a presentation of the project should have been held.



REFERENCES

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