

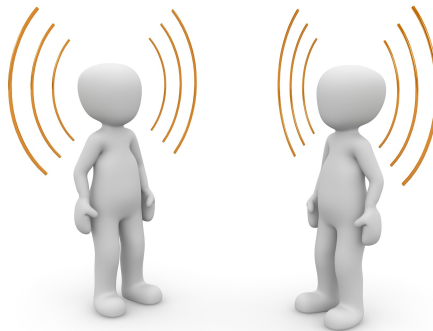


Project Plan

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Joel Henneberg, Tiger Kylesten.

September 12, 2022

Version 1.0



Status

Reviewed	Martin Dahl	2022-09-19
Approved	Orderer, Danyo Danev	TBD



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DOCUMENT HISTORY

Version	Date	Changes made	Sign	Reviewer
1.0	2022-09-19	Final version	Project Group	Martin Dahl
0.2	2022-09-12	Joint draft	Project Group	Martin Dahl
0.1	2022-09-06	First draft for discussion	PM	Project group



1 PROJECT OVERVIEW

Being able to count the number of people walking in and out through doorways comes in handy in numerous applications. This came to be even more important when COVID-19 struck the world with its pandemic and came with restrictions on how crowded certain areas could be. With the use of received RF (Radio Frequency) signals and machine learning algorithms, it should be possible to classify in which direction an object is traveling through a doorway using the ADALM Pluto Software-Defined Radio (Pluto SDR) devices.



Figure 1: The system in its surroundings

The goal of the project is to develop a system that can detect the direction of movement of an object passing through a doorway at walking speed in an indoor environment. The project has been supplied with a number of Pluto SDR devices which will be used to collect the data necessary for classification. With the use of collected training data, a machine learning algorithm will be trained to determine whether there is an object approaching the doorway or not. If an object is approaching the doorway, data will be sent to another machine learning classification algorithm to determine the object's direction of movement. The result from the algorithm will be displayed to the user through a user-friendly GUI. The algorithm will operate on a few seconds worth of data collected in a controlled lab environment indoors.

The purpose of the Project Plan is to outline how the described project will be carried out. It will lay a foundation for delivering on the aims of the project.

1.1 Deliverables

The project will deliver a final product and a set of documents associated with the project and the product. Those deliveries are:


Table 1: Documents to be produced.

Item	Purpose	Target	Date
Project Plan	Describe plan to deliver on requirements	Customer	2022-09-19
Requirement Specification	Describe what must be delivered to customer	Customer	2022-09-19
System Design Sketch	Describe how to implement the technical parts of the Project Plan	Customer	2022-09-19
System Design Specification	Detailed description on how to implement the technical parts of the Project Plan	Customer	2022-10-07
Test Plan	Describes how the project system will be tested	Customer	2022-10-14
User Manual	Describes how to use the system	Customer	2022-12-09
Final product	A study on how the project was performed and what could have been better	Customer	2022-12-09
Technical Documentation	Describes in detail how the final system works	Customer	2022-12-16
Website	A study on how the project was performed and what could have been better	Customer	2022-12-16
Poster	A study on how the project was performed and what could have been better	Customer	2022-12-16
Meeting Protocols	For reference on what has been said during meetings with Project Group	Project Group	2023-01-08
After study	A study on how the project was performed and what could have been better	Customer	2023-01-08

The project will also deliver a website for the product and a poster.

Dates for each delivery are specified under Activities, 10. At delivery, documents will be sent to the customer by e-mail.

1.2 Limitations

The project is limited in the following way:

- The project is limited to the provided hardware and will not evaluate other options.
- For the communications part of the project, the project will be based on work produced by students during previous years.
- Product limitations are listed in the document System Requirements [1].

Further limitations to product use can be specified in the product documentation.



2 PROJECT PHASES

The project will be partially conducted using the LIPS project model [2]. The model divides the project into three phases: before, during, and after. The before-phase is dedicated to planning, and the during-phase is for development, implementation, and testing. Finally, the after-phase is for evaluating and presenting the final product.

2.1 Before-phase

The formation of the project group marks the beginning of the project. The project is then chosen in agreement with the customer. The internal roles of the project are established.

A suggestion for the product's system requirements is written to specify what the final product should be and its functionality. A Project Plan is written to structure the project work. This is supplemented by a Time plan that includes the work needed for the project, broken down into more minor activities, and when to work on them. Each activity is assigned hours, in addition to the lead person for that activity.

Finally, a System Design Sketch is developed where the group describes how the product is designed. This is based on theory and work from previous years and relevant articles.

The before-phase ends when the Project Plan, Time plan, System Requirements, and Design Specification are accepted by the customer.

2.2 During-phase

During the during-phase, the product and its functionality are developed. This is done based on the Design Specifications and following the time plan and stated activities. Tests will be defined in a Test Plan to ensure that the product meets the requirements listed in the Requirements Specification. Meetings will be held weekly to ensure the project is on track and manage resources.

When all requirements with priority 1 are fulfilled, the during-phase can be considered complete. However, if the group finishes the priority 1 conditions ahead of time, the project group will decide how to best proceed with working on requirements with priority 2 and optionally priority 3.

2.3 After-phase

In the after-phase, the finished product is delivered to the customer with the User Manual and the Technical Documentation. The product should be presented on a website, on a poster, and in an oral presentation for the customer.

The Technical Documentation is written to describe the technical details of the product and to enable continued development. The User Manual is an easy-to-understand description of how to use the product. To evaluate the work within the project, an After Study will be conducted by the project group.

The phase is completed when the product, the presentation, and all the above-mentioned documents have been delivered.



3 PROJECT ORGANISATION

The project group has decided how to organize the work to complete the project within the time frame and its requirements. The project is based on the LIPS project model [2]. A model for the project organization can be found in Figure 2.

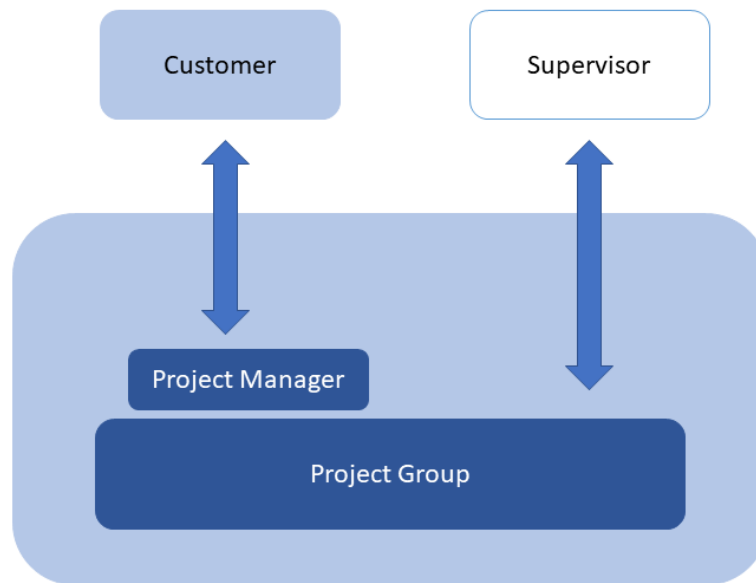


Figure 2: Project organization and channels for communication.

3.1 Letter of Agreement

The group members have written and signed a Letter of Agreement to facilitate a good working relationship and set guidelines for the project. It can be found in Appendix A.

3.2 Definition of Project Roles

Each member is assigned a specific role within the project to organize the day-to-day work. The roles, and responsibilities, are assigned as follows:

- **Project Manager:** Christian Gustavsson (Joel Henneberg)
The Project Manager is responsible for overall project administration and communication between the project group and the customer. The PM is also responsible for leading the work on the After study.
- **Document Manager:** Martin Dahl
The Document Manager, DM, is responsible for keeping the project's documentation in good order and will



have final approval of documents before sending them to the customer. The DM is also responsible for leading work with the presentation and project poster.

- **Hardware Manager:** Joel Henneberg
The Hardware Manager is responsible for the project hardware.
- **Product Design Manager:** Tiger Kylesten
The Product Design Manager, PDM, is responsible for the overall design and functionality of the product. The PDM is also responsible for leading the work on the project's technical documentation.
- **Interface Manager:** Henrik Ahlinder
The Interface Manager, IM, is responsible for the product Graphical User Interface. The IM is also responsible for leading the work on the User Manual and website.
- **Test Manager:** Sebastian Andersson
The Test Manager is responsible for planning product testing to ensure that the product meets the stated requirements.

The project is provided with a supervisor. The project group will communicate with the supervisor continuously throughout the project.

3.3 Communication

The project group will use Microsoft Teams as its main communication tool for project matters. A Messenger group is also created for fast alerts and more leisurely discussions.

4 DOCUMENT PLAN

Several documents will be produced during the course of the project. These documents should be based on the LIPS project model [2] and follow the IEEE reference system [3]. All documents are listed in Table 2, together with the file format for delivery to the target group and the primary storage place for the source document.

5 DEVELOPMENT METHOD

To make sure that the product development is conducted smoothly, the group will work according to a few guidelines stated below:

- **Follow the plan**
During the weekly meetings, the project group will decide on priorities for the upcoming week. The project members commit to sticking to this plan and completing their assignments on time. It is every project member's responsibility to take an active part in the planning as a whole and alert other members when plans cannot be met.
- **Co-working**
To facilitate cooperation, and have a good time while working, availability for co-working will be checked at


Table 2: Project documentation

Document	Purpose	Target group	Format	Storage
Project Plan	Describes the project and its phases.	Customer	PDF	Overleaf
Time Plan	Activities and allotted time.	Customer	PDF	Google Drive
Requirements Specification	Specifies the requirements on the product.	Customer	PDF	Overleaf
Design Specification	A detailed description of the product design.	Customer	PDF	Overleaf
Test Plan	Specifies the tests to be carried out in order to ensure that stated requirements are met.	Customer	PDF	Overleaf
Meeting minutes	Documentation of project group meetings and decisions	Project Group	Google Docs	Google Drive
Technical Report	Detailed description of the product and how it operates.	Customer	PDF	Overleaf
User Manual	A easy-to-use description on how to operate the product.	Customer	PDF	Overleaf
Poster	A Presentation of the product.	Customer	PDF	-
After study	A compilation of the group's experience working on the project.	Customer	PDF	Overleaf

every weekly meeting. These sessions can be started with a stand-up meeting to see how everyone is doing on their assignment and to raise issues one would like ideas on how to solve.

- **Ask for help**
Everyone should try to complete their responsibilities. If clear that a task will require more time or someone else's knowledge, it is crucial to ask for help as soon as possible. Delays in important steps of the project need to be avoided.
- **Code comments**
All code should be commented to make sure that others can continue the work. No ifs, no buts.
- **Use Git**
GitLab will be used for the project. Branches should be used to enable work on different features in parallel. Commitments to each feature branch should be made often, and merges back to the master branch should be made frequently. **Only well-tested and working code can be on the master branch.** To ensure this, instructions available in the README file should be followed. The final merge back to master must be approved by one other project member.

6 REPORTING PLAN

A weekly status report will be sent to the customer on Mondays. The report is a compilation of ongoing, finished, and pending activities. Any problems and opportunities regarding the project will also be described in the report. The information will ensure to update the customer on the project's progress. After the project plan is accepted by the customer, the belonging Time Plan will be appended every week.



The Project Manager will send the status report at 10 a.m. Mondays. Each project member is responsible for adding to the report by describing what has been accomplished by the group and adding their time usage to the Time Plan.

If activities require more or less time than planned, the Time Plan will be revised.

7 MEETING PLAN

The project group will have at least one meeting each week, to check up on the status of the project and plan for the upcoming week. Any problems, of a technical, social, or planning nature, will be raised in the meetings. An agenda will be available in advance for planned meetings. Everyone in the project should add to the agenda based on their needs and keep the project moving. The group can decide to hold more meetings if necessary.

8 RESOURCES

The project has a set of resources available:

- **Group members:** The project group consists of six students, each expected to spend 240h on the project. The project members have other courses in parallel to completing this project. Therefore, no one is expected to be available at all times and on short notice.
- **Material:** The project group has access to at least two ADALM Pluto SDR devices and multiple antennas.
- **Supervision:** The project group has access to a project supervisor (15h).
- **Expert consultation:** The project group has access to expert consultation (25h).
- **Premises:** The project group has access to one lab and one test facility at Linköping University.

9 TOLLGATES

The project is partially following the LIPS model, and in this model, a number of tollgates are defined. The ones applicable to our project are listed in Table 3.

Table 3: The tollgates that should be passed during the project.

Number	Description	Date
0	Project group formed and topic selected.	2022-08-29
2	Approval of the Requirement Specification.	2022-09-19
2	Approval of the Project Plan, Time Plan.	2022-09-19
2	Approval of the System Design Sketch.	2022-09-19
3	Approval of the System Design Specification.	2022-10-14
3b	Approval of the Test Plan.	2022-11-03
5	Approval of the functionality of the product, decision to deliver.	2022-12-09
6	Approval of the delivery, decision to dissolve the project group.	2022-12-16



10 ACTIVITIES

The required tasks in the project have been broken down into smaller activities. This was done to help ease with the project's work flow. The activities are shown in the Table 4. The table contains information about the activity, the expected time required to work with it, and possible dependencies on other activities. An activity with one or several dependencies can not be started or sometimes completed without first completing the aforementioned dependencies.

Table 4: Activities for the project, including expedited time requirement and dependencies

No	Activity	Description	Dependencies	Time
1	Weekly meetings	Internal meetings with the project group.		168
2	Status Reports	Write and send Status Reports to Customer.		32
3	Requirement Specification	Write the Requirement Specification.		40
4	Project Plan	Write the Project Plan, incl. Time Plan.	3	20
5	System Design Sketch	Write the Design Sketch.	3	20
6	System Design Specification	Write the Design Specification.	3,5	40
7	Test Plan	Writing of Test plan	3,6	40
8	Research	Research and read articles relevant to the project.		120
9	Hardware Setup	Setting up the hardware.	-	10
10	Implement provided code	Implement provided code from previous years.	9	20
11	GUI	Basic functionality (prio 1)		80
12	Extended GUI	Functionality (prio 2)	11	40
13	Defining Data	Defining and setting up for data collection		20
14	Data collection	Gathering data for relevant scenarios, labeling, cleaning	13	40
15	Data exploration	Analyzing collected data	14	40
16	ML-models for prio 1	Implement models	14	120
17	ML-models for prio 2	Implement models	16	60
18	Devops	Git management	-	40
19	Testing	Model and product testing	9-17	40
20	Create website	Create the website	21	10
21	Website material	Create material for the website	20	20
22	Poster	Create the project poster for the presentation	c	20
23	Presentation	Create and prepare for presentation	9-17,18	42
24	User Manual	Write the User Manual	9-17,18	30
25	Technical Report	Write the Technical Report	9-17,18	80
26	After Study	Write After Study	All above	30
27	Project closing	Returning stuff	-	6
28	Buffer time	Buffer time for activities taking longer than estimated.	-	212
			Sum	1440



11 TIME PLAN

The project group has decided on a Time plan where activities and estimated time needed are specified. The time plan also states the order of when the activities should be started and which project member(s) are responsible for the activity. The initial Time plan will be revised when needed during the project. Then Time plan is attached as Appendix [B](#).

12 PRODUCT QUALITY

To ensure that the final product is of a high standard, meeting the customer's expectations, a set of principles for quality control and testing is set.

An important part of meeting the expectations is having a good relationship with the customer throughout the project and providing updates on the progress. There will also be continuous dialogue with the supervisor, heeding their advice when needed.

12.1 Review

To ensure that documents produced by the project hold a high quality, all project members must review each document. This is also done to ensure that every project member is aware of all the aspects of the product and has a good knowledge of the document's contents.

Principles for code review are specified under Development Method, [5](#).

12.2 Test plan

A Test plan will be produced and implemented. This ensures that the final product meets the requirements set in the Requirements Specification. The plan contains information on how iterations of the product will be tested during development, as well as quality control of the final product. The test plan includes, but is not limited to, different test cases for the algorithms used.

13 RISK ANALYSIS

There are several risks that can materialize in the project, both technical and people-oriented.

The project work is, in part, based on work from previous students. Documentation is provided, but the project is somewhat dependent on code and documentation working properly. If not, the project group has limited knowledge within the area of communications.

The provided hardware must be handled and operated correctly. The success of the project is also somewhat dependent on the product being set up in a controlled environment. Creating protocols for setting up the product in exactly the same way every time is one way to mitigate the risk.

An unfair workload within the project group is a risk and can cause a lot of friction if not handled properly. To minimize the risk, a letter of agreement has been signed by the group members. At least weekly updates to the time plan and status report is also a way to keep everything, and every one, on track. If the workload is systematically



unbalanced, the group will decide on a plan for solving the issue. If a group member is not actively working and contributing to the project, this will be discussed and, if necessary, brought to the attention of the customer.

There is always a risk of a group member falling ill and missing both meetings and the opportunity to work on the project. If this occurs, the other members should update the person who has been away so that it is easier to continue with the project when well again. To ensure that others can continue one's work when sick, it's important that code is commented on and work otherwise documented.

14 PRIORITIES

All project members should follow the plan agreed upon, or raise a discussion on changing the plan. It is important to alert the group of any problems or delays. This makes it possible for the group to find a solution together. A delay in one activity might cascade delays into others' work, which needs to be avoided. Re-prioritizing work might be necessary.

In case of unexpected issues and delays regarding the deliveries, it is important to maintain a good dialogue with the customer. This should be done by informing the customer as early as possible. This will make it possible to discuss renegotiating requirements if needed.

15 PROJECT CLOSING

The project is completed when all the activities have been finished. This means that the finished product and documentation have been delivered to the customer. The project group will also publish a website and produce a poster advertising the product.

Finally, an After Study will be written to reflect on the project and the group's experiences. Once this is completed, the project is formally completed. This will also be a suitable time for the project group to celebrate its combined success.



REFERENCES

- [1] H. Ahlinder, S. Andersson, M. Dahl, C. Gustavsson, J. Henneberg, and T. Kylesten, "Detection of an object movement direction indoors: Requirement specification, 2022."
- [2] T. Svensson and C. Krysanter, *Projektmodellen Lips*, 1st ed. Liber AB, Stockholm, 2011, iSBN9789144075259.
- [3] I. Periodicals, "Ieee editorial style manual," http://journals.ieeeauthorcenter.ieee.org/wp-content/uploads/sites/7/IEEE-Editorial-Style-Manual_081920.pdf, [Online; accessed January 26, 2021].



Detection of an object movement direction in the indoors

September 12, 2022



A LETTER OF AGREEMENT

TSKS23 CDIO


Group 1, 2022


Letter of Agreement


The purpose of this document is to set guidelines and outline the conditions of cooperation within the group for the duration of the project course.

- (1) Every group member is expected to attend the weekly meeting and every meeting with the orderer. If the group member cannot partake in a meeting the group member will inform the project manager about their absence in advance.
- (2) The workload within the group will be distributed equally among the project members so that each member's workload is roughly the same amount (240 h).
- (3) Each project member is assigned a primary role within the project. In key roles, a deputy can be assigned as a backup or to alleviate a high workload. All members must be well prepared and informed to answer questions about their primary responsibility.
- (4) Each member respects the internal and external deadlines set by the project group and the orderer respectively. If there is an issue with meeting a deadline, the group member shall inform the rest of the group well in advance so that assistance can be provided.
- (5) It is important to give feedback, both positive and negative. When doing so it should be done constructively.
- (6) The ambition of each project member is to make the final product as good as possible, within the set requirements and restrictions of the project.
- (7) During a normal week, project members should be reachable sometime during the day, 8:00 - 17:00 (weekdays). During periods of deadlines, tollgates, and milestones the group can decide on extensions.
- (8) Every deliverable document must be approved by the document manager before submission. This does not include weekly status reports submitted by the project manager.
- (9) The project manager will upload an agenda, in the form of an outline of meeting minutes, at least one day in advance. Group members are encouraged to add topics for discussion in advance.
- (10) The group members agree to start the project with a kick-off and celebrate after handing in the final report.


Christian Gustavsson


Joel Henneberg


Sebastian Andersson


Henrik Ahlinder


Martin Dahl


Tiger Kylesten




Detection of an object movement direction in the indoors

September 12, 2022



B TIME PLAN

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