System design sketch

Henrik Ahlinder, Sebastian Andersson, Martin Dahl, Christian Gustavsson,
Joel Henneberg, Tiger Kylesten.

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Status

Reviewed	Martin Dahl	2022-09-19
Approved	Danyo Danev	2022-09-27

Project Identity

Group E-mail: CDIOProjektgrupp@liuonline.onmicrosoft.com

Homepage: wavecounter.xyz

Orderer: Danyo Danev
Phone: +46 (0)13 28 13 35
E-mail: danyo.danev@liu.se

Customer: Danyo Danev
Phone: +46 (0)13-28 13 35
E-mail: danyo.danev@liu.se

Supervisor: Sai Subramanyam Thoota
Phone: +46 (0)13-28 68 59
E-mail: sai.subramanyam.thoota@liu.se

Course Responsible: Danyo Danev
Phone: +46 (0)13-28 13 35
E-mail: danyo.danev@liu.se

Participants of the group

Name	**Role**	**E-mail**
Christian Gustavsson	Project Manager, PM	chrgu102@student.liu.se
Henrik Ahlinder	Interface Manager, IM, and deputy CD	henah490@student.liu.se
Joel Henneberg	Chief of Hardware, CH, and deputy PM	joehe862@student.liu.se
Martin Dahl	Documentation Manager, DM	marda545@student.liu.se
Sebastian Andersson	Test Manager, TM	seban218@student.liu.se
Tiger Kylesten	Chief of Design, CD	tigmo832@student.liu.se

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DOCUMENT HISTORY

Version	Date	Changes made	Sign	Reviewer
1.1	2022-09-26	Clarified Bit-error-rate	Henrik Ahlinder	Martin Dahl
1.0	2022-09-19	Final version.	Henrik Ahlinder, Sebastian Andersson	Martin Dahl
0.1	2022-09-12	First draft.	Henrik Ahlinder, Sebastian Andersson	Martin Dahl

1 INTRODUCTION

The product is a system using software-defined radio to count the number of people entering and exiting a room, thus keeping track of the number of people in the room. This document provides a rough sketch of the system design, which will serve as a basis when dividing the project into activities and designing a time plan for the project's execution.

2 SYSTEM DESCRIPTION

The system consists of a hardware part consisting of several Software Defined Radio (SDR) units described in section 3, a software part consisting of the human detection algorithms described in section 4 and a GUI part described in section 5. An overview of the modules and the communication and data flow between them can be seen in figure 1

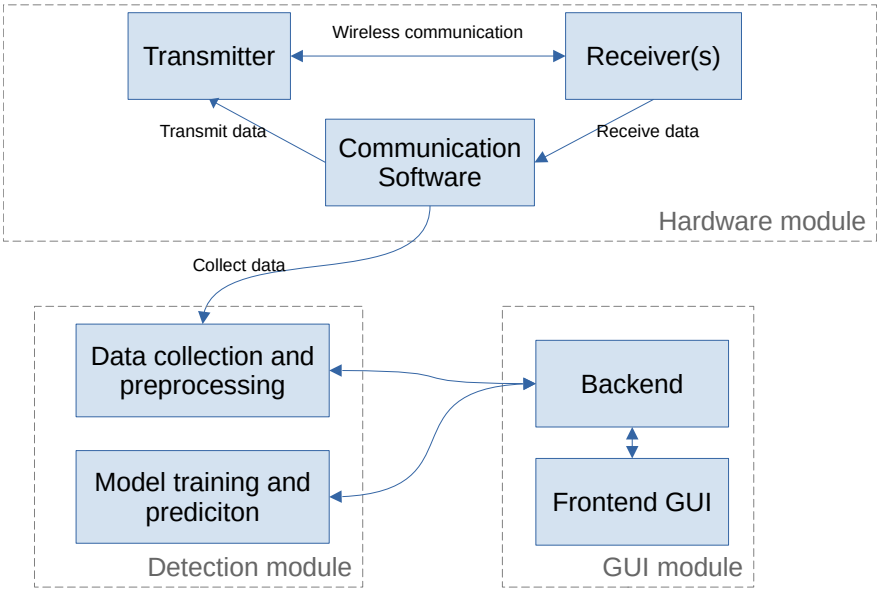

Figure 1: System overview. Lines indicate data flow and/or control signals

3 HARDWARE

The hardware module will consist of Pluto SDR devices and software for the communication between the host computer and the Pluto devices. There will be one transmitter device and several receiver devices. Each Pluto device has the following specification:

- Two SMA connectors for instrumentation and antennas,
- 300 MHz - 3.8 GHz radio frequency coverage,

- 200 kHz - 20 MHz channel bandwidth and
- USB2 port (480 Mb/s at 100% utilization) with the possible modes: network device, USB serial device, mass storage device

3.1 Communication software

The hardware module comes bundled with software for controlling and collecting data from the Pluto devices. The software is supplied by the orderer and the project will not put any substantial resources in further development of this software. The data collection is handled by the communication software but only in short-term memory. Persistent storage is handled by the *Software module*.

3.2 Data collection

The data collection will consist of a gathering of training, validation, and test data. During a session, the system will be set up and disturbance will be done during the recording. The disturbance to the signal will be people or object that moves back and forth in the environment where the transmitter and receiver are located. Each recording will contain multiple samples of data that each needs to be labeled. In figure 2 a flowchart of the data collection is shown.

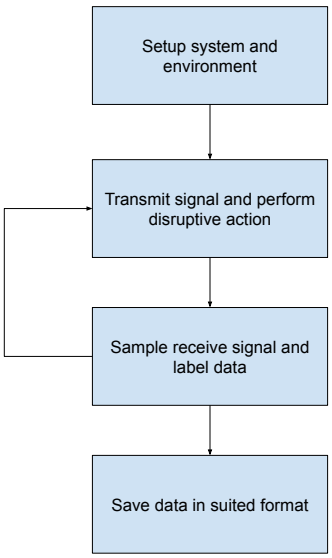

Figure 2: The flowchart describes the data collection.

3.3 Environment

Both the data collection for training and evaluation is going to be performed in the same controlled and fixed lab environment.

4 SOFTWARE

The software module is responsible for the collection, preprocessing, and extracting of relevant features from the data, training, validation, and testing of the machine learning modules. The software subsystem will be written in Python 3 using machine learning libraries and frameworks such as PyTorch and scikit-learn. A flowchart describing the software subsystem can be seen in Figure 3.

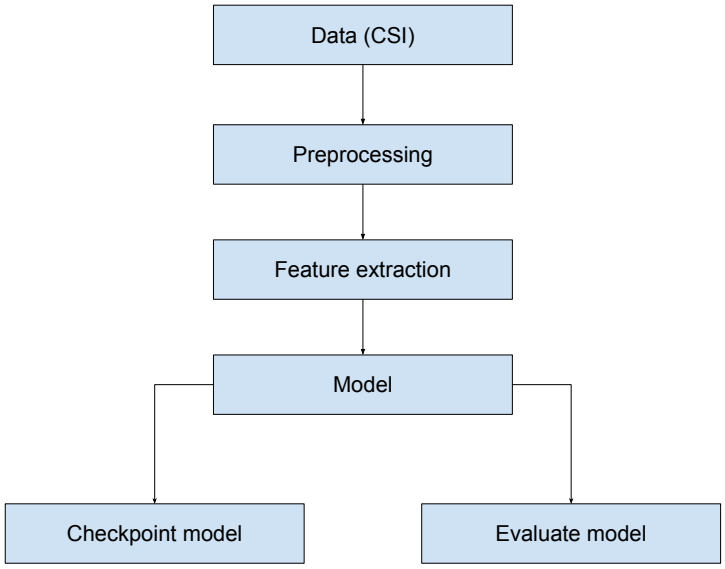

Figure 3: The flowchart describes the software subsystem.

5 USER INTERFACE

The user interface is the interface from which the system is controlled. The user may use the interface to calibrate the hardware parameters, collect and store data, train and run the classification algorithms, and compare classification results of different algorithms [1]. The user will also be able to see the channel logs, the bit error rate (BER) of the Wifi-channel currently in use, and a system log. A mock-up of the user interface is shown in Figure 4.

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Figure 4: A mock-up of the user interface, displaying buttons (black) and different windows.

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."