Lastenheft

Julian Hatzky

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Part I

Introduction

Introduction

These specifications contain the functional and non-functional requirements for the product to be developed. It serves as the basis for tendering and contract design and thus forms the basis for tender preparation. The specifications are a result of multiple conversations between Dr. Krawutschke and Mr. Hatzky within the project of the Cologne University of Applied Sciences. The requirements determine the framework conditions for the development, which are detailed by the contractor in the specifications.

Note: Since the project is a University project Lastenheft und Pflichtenheft are containing the exact same information.

Part II

General Information

Aim and purpose of the document

The following describtions should give a bright overview about the needs and wishes of the fictional customer. It should lead to a better understanding of the Milestones and implementations that were chosen.

Baseline Situation

The TH-Köln had a discussion with Deutsche Bahn about a possible project. The goal of the project was to develope an application for the FPGA that can detect the so called curve screech - the noise a train sometimes produces while bending through curves - using Neural Networks. The project never started but the idea was still present and the audio data of the screeching noise was accessible. After a discussion with Dr. Krawutschke a realization of the project within the Eingebettete Systeme Praktikum was possible.

Project Reference

The project is realized within the Eingebettete Systeme Praktikum of the TH Köln.

Shortcuts

NN - Neural Network
CNN - Convolutional Neural Network
PO - Product Owner

Distribution and release

Role	**Name**	**Mail Address**
Product Owner	Dr. Tobias Krawutschke	t.krawutschke@smail.th-koeln.de
Developer	Julian Hatzky	j.hatzky@smail.th-koeln.de

Part III

Concept

Objective(s) of the provider

The goal of the project is to reduce the noise of trains that are driving through curves. It should letter to a better user experience of people who are in the zone where the noise signal can reach them. Possible customers can be any kind of company that uses trains. However the offered solution can be changed to detect other noise signals as welll.

Part IV

Functional Requirements

Audio Signal Detection

7.1 Data Augmentation

The amount of audio samples is very limited. There are only three files containing the nose signal with a 1 minute length each. To train a Neural Network this is not a sufficient amount of data, hence a augmentation has to be done to create more data artificially. The data still has to be similiar to the initial signal.

7.2 Selection of the Machine Learning Framework

There are a bunch of different frameworks for Machine Learning out there each with its advantages and disadvantages. They differ in performance, useable languge(s), scalability and many more. That is why a proper research and comparison has to be done in advance in order to select the most apropriate framework for our project.

7.3 Selection of the Neural Network architecture

The proper selection of the Neural Network architecture is very important because it is most influential to the accuracy and performance of the audio signal detection.

7.4 Training of the Neural Network

The selected Neural Network (architecture) should be trained on a computer, in advance, in order to verify its correctness. It is a proof of concept and first

big milestone.

7.5 Architecture Design for FPGA

The routing process of the audio data all the way to its classification (trained noise signal or not) needs a huge architecture. The development of this architecture is the main part of the project

7.6 Implementing the Neural Network on the FPGA

To write the Neural Network in VHDL is highly cutting-edge research and therefore needs a lot of time. Several tests and development circles are important.

Part V

Non-Functional Requirements

Fast calculation

Due to the nature of FPGAs the calculation (detection of audio signals) should be faster than with the usual computer programs run on GPUs.

Scalable and easy usable

It should be straightforward to get the system in production and use it for a lot of trains in different environment without having a lot of knowledge of the inner system.

Part VI

Acceptance Requirements

Acceptance Requirements

Since it is a University project there is a fixed end date of the project, which is 12th of July 2019. The evaluation of the quality of the project will be done by the supervisor of the course, Dr. Tobais Krawutschke.

Part VII

Attachment

Drive Folder containing Milestones with Code etc., Audio Data and Presentations:

Link to Google Drive
(Access is only granted to selected persons)