
TODO: Headhight noch zu 12pt zurückstellen

Höhere Technische Bundeslehranstalt Kaindorf an der Sulm

Abteilung Informatik

Diplomarbeit

im Rahmen der Reife- und Diplomprüfung

Königskarte



informatik

Leon Edlinger
Paul Gigler
Andreas Weissl

5BHIF
2024/2025

Betreuer: Prof. DI Johannes Loibner, BSc
Projektpartner: Prof. DI Robert Müllerferli
Datum: MISSING DATE

All rights reserved. No part of the work may be reproduced in any form (printing, photocopying, microfilm or any other process) without the written permission of all authors or processed, duplicated or distributed using electronic systems. The authors assume no liability for the functions of individual programs or parts thereof. In particular, they assume no liability for any consequential damages resulting from the use.

The reproduction of utility names, trade names, product descriptions, etc. in this work, even without special marking, does not justify the assumption that such names are to be regarded as free within the meaning of trademark and trademark protection legislation and may therefore be used by everyone.

Statutory declaration

I declare under oath that I have written the present diploma thesis independently and without outside help, have not used sources and aids other than those indicated and have identified the passages taken from the sources used literally and in terms of content as such.

Ort, Datum

Leon Edlinger

Ort, Datum

Paul Gigler

Ort, Datum

Andreas Weissl

Abstract

Abstract in English

Kurzfassung

Kurzfassung in Deutsch

Thanks

It would not have been possible to carry out this thesis to this extent without the active support of a number of people. We would therefore like to thank everyone who supported us in the implementation of this thesis.

...

Table of Contents

1	Introduction	1
1.1	Team	2
1.2	Motivation	2
2	Technologies	3
2.1	LaTeX	3
2.2	Project Management	3
2.2.1	Trello	3
2.2.2	Sharepoint	3
2.2.3	Discord	3
2.3	Frontend	3
2.3.1	Dart	3
2.3.2	Flutter	4
2.4	Backend	5
2.4.1	Java Spring	5
2.4.2	PostgreSQL	5
2.5	Version Control	7
2.5.1	Git	7
2.5.2	GitHub	7
2.6	Map Data	8
2.6.1	OpenStreetMap	8
2.6.2	GraphHopper	8
2.7	Development Tools	9
2.7.1	VS Code	9
2.7.2	IntelliJ	9
2.7.3	Android Studio	9
2.7.4	Postman	9
2.7.5	Figma	9
2.8	Deployment	10
2.8.1	Docker	10
3	Wireframes	10
3.1	Admin Ansicht	10
3.2	User Ansicht	10
4	Research Questions	10
4.1	Leon Edlinger	10
4.2	Paul Gigler	10
4.3	Andreas Weissl	10
5	Spring Framework	10
5.1	Spring Boot	10
5.2	Spring Data JPA	11
5.3	Lombok	11
5.4	Advantages	11
6	Structure of the Backend	11
6.1	Controller Layer	11
6.2	Service Layer	11
6.3	Repository Layer	11
6.4	Persistence Layer (Entity Classes)	11
6.5	Applied Design Principles (DTOs)	11

7	Area Borders	12
7.1	Purpose of Area Borders in the App	12
7.2	Overview of the Convex Hull Algorithm	12
7.3	Use Cases of the Convex Hull in Industry	12
7.4	Alternate Methods for Area Border Calculation	12
7.5	Rationale for Choosing the Convex Hull Method	12
7.6	Integration of the Algorithm into the Backend	12
7.7	Challenges and Adjustments	12
8	Implementation	12
8.1	Config of Spring Boot (application.properties)	13
8.2	Entity Classes (Structure/Purpose)	13
8.3	JpaRepositories (DB Access and CRUD Operations)	13
8.4	Service Classes	13
8.5	Rest Controller (API Endpoints and their Functions)	13
9	Final Thoughts	13
9.1	Leon Edlinger	13
9.2	Paul Gigler	13
9.3	Andreas Weissl	13
10	Meetings	14
11	Working Hours	15
12	Source code directory	16
13	List of figures	17
14	List of tables	18
15	Bibliography	19
16	Abbreviation	20

1 Introduction

TODO: Bitte noch anpassen falls euch der Wortlaut net so passt

Mobile Apps get used for quite literally everything in today's World. So after we noticed that there is no application that allows the efficient planning of campaigns like the "Sternsinger-Aktion" we asked ourselves why, and furthermore, how hard it would be, to create an App with intuitive Usability for the sole purpose of simplifying the process of managing such a campaign and gaining a general overview of the progress made.

TODO: Vielleicht noch kürzen, wirklich nur die groben Themen?

The research part of this thesis will be dedicated to how components should act and look, so that new users can use this tool without requiring a long "onboarding" phase. It should feel familiar to interact with elements and the borders of what users can and can't do need to be clearly defined. Because our application also needs a somewhat reliable data source to guarantee the consistency and accuracy of marked addresses in our app. For this purpose we researched ways to keep our database up-to-date, without the need of much manual intervention. After defining the projects requirements, we noticed that we need to somehow calculate which addresses are "Border" addresses. So we decided to take a look into different algorithms for this task and compare them concerning their efficiency and then decide on one of them and implement it.

This thesis contains an in-depth description of our thought and development process, as well as any other steps we took to achieve our goal of a functional mobile application that can be used by volunteers in course of the "Sternsinger-Aktion 2025" taking place in the parish of Lieboch.

TODO: Wortwiederholung austauschen

The result of this thesis should be a mobile app that provides users with the addresses that they need to visit on this day. They then should be able to easily mark the houses they already visited. If something unusual happens at this address, the user should be able to take note of this, so the organizers have knowledge of it and can account to it in the following year.

TODO: Maybe auf verschiedene Parts aufteilen, also das man zuerst sagt Problemstellung, dann Zielsetzung damit die Introduction übersichtlicher ist

1.1 Team

This thesis was created by three Students attending the BHIF20 at the HTBLA Kaindorf Computer Science Department.

TODO: andis bild anpassen

Leon Edlinger



Database, Admin-Panel

Paul Gigler



Deployment, Mobile App

Andreas Weissl



Backend

1.2 Motivation

2 Technologies

Development would not have been possible to implement without making use of many tools, frameworks and environments. In this chapter each tool used in the creation of our software will be described briefly.

2.1 LaTeX

Hier kommt eine Beschreibung zu Latex hin

2.2 Project Management

Hier kommt Text zum Project Management hin

2.2.1 Trello

Hallo, das ist Trello

2.2.2 Sharepoint

und das ein Text zu sharepoint, wieso eigentlich

2.2.3 Discord

und hier nochmal kurz Discord, kennt eh jeder

2.3 Frontend

2.3.1 Dart

Dart is a programming language initially designed for web development, with the goal, of replacing JavaScript, in mind. Today it gets used in a variety of software products, mainly because of the flutter framework. It can be compiled for many platforms and architectures (ARM, x64, RISC-V, JavaScript or WebAssembly) and is loved for its combination of High-Level Features, with practical language features like Garbage collection and optional Type annotation. It was developed by Google and is now an open-source project.

[2]



Fig. 1: Dart Logo (Source: <https://dart.dev>)

2.3.2 Flutter

Flutter is an Open-Source software development framework. It allows programmers to compile their application for different platforms including Web, macOS, iOS as well as Windows and any type of Linux-based systems, all from one code-base, written in Dart. This allows for more efficient and faster cross-platform development. Another benefit of Google's toolkit are the highly customizable predefined UI components. Developers can mix and match these components however needed which makes them an applicable choice.

We chose flutter mainly for these reasons, but also because of our previous experience with Java to which Dart is quite similar. Through it, we were able to get started quickly, learn what we need along the way. Having a design through the components was also very helpful and saved us some time.

[3] [1]



Fig. 2: Flutter Logo (Source: <https://flutter.dev/>)

2.4 Backend

2.4.1 Java Spring

Lorem ipsum dolor sit amet, consetetur sadipscing elitr, sed diam nonumy eirmod tempor invidunt ut labore et dolore magna aliquyam erat, sed diam voluptua. At vero eos et accusam et justo duo dolores et ea rebum. Stet clita kasd gubergren, no sea takimata sanctus est Lorem ipsum dolor sit amet. Lorem ipsum dolor sit amet, consetetur sadipscing elitr, sed diam nonumy eirmod tempor invidunt ut labore et dolore magna aliquyam erat, sed diam voluptua. At vero eos et accusam et justo duo dolores et ea rebum. Stet clita kasd gubergren, no sea takimata sanctus est Lorem ipsum dolor sit amet. Lorem ipsum dolor sit amet, consetetur sadipscing elitr, sed diam nonumy eirmod tempor invidunt ut labore et dolore magna aliquyam erat, sed diam voluptua. At vero eos et accusam et justo duo dolores et ea rebum. Stet clita kasd gubergren, no sea takimata sanctus est Lorem ipsum dolor sit amet.

Duis autem vel eum iriure dolor in hendrerit in vulputate velit esse molestie consequat, vel illum dolore eu feugiat nulla facilisis at vero eros et accumsan et iusto odio dignissim qui blandit praesent luptatum zzril delenit augue dui dolore te feugait nulla facilisi. Lorem ipsum dolor sit amet,



Fig. 3: Java Logo (Source: <https://logodownload.org/java-logo/>)

2.4.2 PostgreSQL

Lorem ipsum dolor sit amet, consetetur sadipscing elitr, sed diam nonumy eirmod tempor invidunt ut labore et dolore magna aliquyam erat, sed diam voluptua. At vero eos et accusam et justo duo dolores et ea rebum. Stet clita kasd gubergren, no sea takimata sanctus est Lorem ipsum dolor sit amet. Lorem ipsum dolor sit amet, consetetur sadipscing elitr, sed diam nonumy eirmod tempor invidunt ut labore et dolore magna aliquyam erat, sed diam voluptua. At vero eos et accusam et justo duo dolores et ea rebum. Stet clita kasd gubergren, no sea takimata sanctus est Lorem ipsum dolor sit amet. Lorem ipsum dolor sit amet, consetetur sadipscing elitr, sed diam nonumy eirmod tempor invidunt ut labore et dolore magna aliquyam erat, sed diam voluptua. At vero eos et accusam et justo duo dolores et ea rebum. Stet clita kasd gubergren, no sea takimata sanctus est Lorem ipsum dolor sit amet.

Duis autem vel eum iriure dolor in hendrerit in vulputate velit esse molestie consequat, vel illum dolore eu feugiat nulla facilisis at vero eros et accumsan et iusto odio dignissim qui blandit praesent luptatum zzril delenit

augue dui dolore te feugait nulla facilisi. Lorem ipsum dolor sit amet,

2.5 Version Control

2.5.1 Git

Git is a VCS that was developed by Linus Torvalds in 2005. The benefit of using a VCS is to easily keep track of different versions of files. Git is the most widely used option, concerning this area of application, due to the fact it is open-source, therefore free, as well as reliable and easy to learn. It gets used in almost every, but not only, development project, not just for tracking the history of files, but also for developing cooperatively making use of its branching feature. This allows for development while maintaining a stable version on the main branch.

TODO: Besseres bild suchen und quelle angeben



Fig. 4: Git Logo (Source: <https://git-scm.com/>)

2.5.2 GitHub

GitHub is a platform maintained by Microsoft. As the Name implies, it is based on Git and provides the opportunity to easily share your Git repositories with other users. It is free to use for non-commercial applications and a very popular option when it comes to developing in a team. Furthermore, it also implements handy extensions that integrate tightly with Git, for example GitHub-Actions, which is their solution for CI/CD Pipelines. There are many alternatives to GitHub, like, GitLab, which is open-source and can be self-hosted or BitBucket, a solution by Atlassian.

TODO: Quelle suchen



Fig. 5: GitHub Logo (Source: <https://github.com/>)

2.6 Map Data

2.6.1 OpenStreetMap

The project OpenStreetMap (OSM) is an open-source initiative that aims to make high quality map data available to everyone for free. It was created in 2004 by Steve Coast. It was later widely adopted, with the main push being the pricing Google introduced to Google Maps, so that today it can be found in all kinds of application areas. Reaching from simple embedded web-components, all the way into video games like the Microsoft Flight Simulator, which relies on OSM for its building models. The GIS behind OSM gets maintained by volunteers and is fed not only using GPS-Data but also image data and other different formats.

OSM is the backbone of this thesis and without it, it wouldn't have been possible to develop this tool.

[6] [10]



Fig. 6: OSM Logo (Source: <https://wiki.openstreetmap.org/>)

2.6.2 GraphHopper

GraphHopper (GH) in its core is an open-source routing engine written in Java. It can be deployed as a web server and is used to calculate the optimal route, distance or time between multiple different points. It supports multiple modes of transportation as well as "snap to road" technology. [4] GH also provides a ready to go API that you can access for free, but we choose to deploy our own instance since the requests we needed to make exceed the limits of the free version. [5]



Fig. 7: GraphHopper Logo (Source: <https://brandfetch.com/graphhopper.com>)

2.7 Development Tools

2.7.1 VS Code

Visual Studio Code (VS Code) is a version of the Code - OSS project with Microsoft-specific customizations included which makes it a closed-source product licensed by Microsoft. VS Code is highly customizable, with support for community made plugins and many opportunities for the user to define how things should act and look. [8] There are also many handy features implemented out of the box, like native VCS support. Due to the fact VS Code is an electron based application, it can not only be used on desktop apps but also directly in the browser of any device. [9] [7]

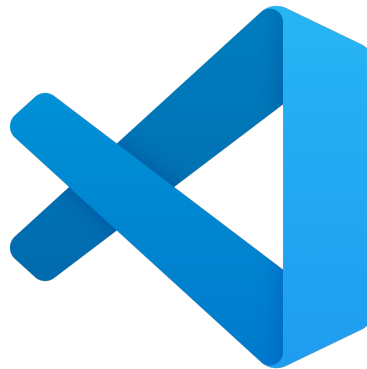


Fig. 8: VS Code Logo (Source: <https://code.visualstudio.com/brand>)

2.7.2 IntelliJ

IntelliJ IDEA is an IDE primarily designed for Java and Kotlin developers, published by JetBrains. In comparison to VS Code, it is much heavier with the reason being the included tools like the direct integration of a database connection via the embedded DataGrip version. It is the base framework used for other, even more specific IDEs by JetBrains, like Android Studio, WebStorm or DataGrip.

2.7.3 Android Studio

Lorem ipsum dolor sit amet, consetetur sadipscing elitr, sed diam nonumy eirmod tempor invidunt ut labore et dolore magna aliquyam erat, sed diam voluptua. At vero eos et accusam et justo duo dolores et ea rebum. Stet clita kasd gubergren, no sea takimata sanctus est Lorem ipsum dolor sit amet.

2.7.4 Postman

Lorem ipsum dolor sit amet, consetetur sadipscing elitr, sed diam nonumy eirmod tempor invidunt ut labore et dolore magna aliquyam erat, sed diam voluptua. At vero eos et accusam et justo duo dolores et ea rebum. Stet clita kasd gubergren, no sea takimata sanctus est Lorem ipsum dolor sit amet.

2.7.5 Figma

Lorem ipsum dolor sit amet, consetetur sadipscing elitr, sed diam nonumy eirmod tempor invidunt ut labore et dolore magna aliquyam erat, sed diam voluptua. At vero eos et accusam et justo duo dolores et ea rebum. Stet

clita kasd gubergren, no sea takimata sanctus est Lorem ipsum dolor sit amet.

2.8 Deployment

2.8.1 Docker

Docker is a tool for containerization and one of the most popular options in this field. Through containerization, it is possible to isolate a process from the host machine, in a virtual environment. Furthermore, docker is portable which makes it a great choice for software projects that many developers with different environments work on. It is used to create a controlled infrastructure which guarantees the correct configuration for the production server. We used Docker to host our PostgreSQL database across multiple different systems throughout the development process.



Fig. 9: Docker Logo (Source: <https://www.docker.com/>)

3 Wireframes

3.1 Admin Ansicht

3.2 User Ansicht

4 Research Questions

4.1 Leon Edlinger

4.2 Paul Gigler

4.3 Andreas Weissl

5 Spring Framework

The backend leverages the **Spring Framework**, a comprehensive framework for enterprise Java development. This section explores its key components and advantages.

5.1 Spring Boot

Spring Boot simplifies configuration and deployment with embedded servers and opinionated setups. This reduces boilerplate code and accelerates development.

5.2 Spring Data JPA

Spring Data JPA provides abstractions for database interactions, streamlining CRUD operations and custom query creation.

5.3 Lombok

Lombok reduces boilerplate code by generating getters, setters, and other methods at compile time, improving code readability and maintainability.

5.4 Advantages

Using Spring enhances productivity, reduces setup complexity, and ensures scalability, making it ideal for this project.

6 Structure of the Backend

The backend follows a layered architecture to promote separation of concerns, scalability, and maintainability. This section outlines the roles of each layer.

6.1 Controller Layer

The controller layer acts as the interface for incoming HTTP requests, delegating them to appropriate service methods.

6.2 Service Layer

The service layer contains business logic, validating data and coordinating interactions between controllers and repositories.

6.3 Repository Layer

Repositories abstract database operations, allowing the backend to interact with the database without explicit SQL queries.

6.4 Persistence Layer (Entity Classes)

Entity classes define the data model and its mapping to the relational database, ensuring a consistent schema.

6.5 Applied Design Principles (DTOs)

Data Transfer Objects (DTOs) enhance encapsulation and optimize data transfer between layers and external clients.

7 Area Borders

The area borders feature addresses the research question by implementing computational geometry algorithms for precise geographical boundary calculations.

7.1 Purpose of Area Borders in the App

Accurate area borders are essential for defining regions based on user input, supporting the app's mapping functionality.

7.2 Overview of the Convex Hull Algorithm

The convex hull algorithm identifies the smallest convex polygon enclosing a set of points, making it a suitable choice for this project.

7.3 Use Cases of the Convex Hull in Industry

Applications of convex hulls in mapping, computer graphics, and robotics highlight their importance in solving real-world problems.

7.4 Alternate Methods for Area Border Calculation

Alternative methods like Voronoi diagrams and alpha shapes were considered but found less suitable due to complexity or computational demands.

7.5 Rationale for Choosing the Convex Hull Method

The convex hull algorithm offers a balance of simplicity, efficiency, and accuracy, aligning with the project's requirements.

7.6 Integration of the Algorithm into the Backend

The algorithm is implemented in the service layer, ensuring smooth integration with other backend components.

7.7 Challenges and Adjustments

Challenges included handling edge cases like collinear points, which were resolved through specific algorithm adjustments.

8 Implementation

The backend implementation combines theoretical concepts with practical solutions to ensure functionality and scalability.

8.1 Config of Spring Boot (application.properties)

The `application.properties` file configures essential settings, including database connections, logging, and server parameters.

8.2 Entity Classes (Structure/Purpose)

Entity classes define the application's data model, using annotations to map fields to database tables.

8.3 JpaRepositories (DB Access and CRUD Operations)

Repositories simplify database access by providing methods for CRUD operations and enabling custom queries.

8.4 Service Classes

Service classes encapsulate business logic, coordinating data flow between controllers and repositories.

8.5 Rest Controller (API Endpoints and their Functions)

REST controllers define API endpoints, processing requests and returning responses to ensure seamless interaction with the frontend.

9 Final Thoughts

9.1 Leon Edlinger

9.2 Paul Gigler

9.3 Andreas Weissl

10 Meetings

Protokolle der Meetings, vielleicht auch ein zeitplan wann immer und wie lang

11 Working Hours

Arbeitspaket-Nr.	Beschreibung	Dauer
1	Einführung und Einarbeitung	8 h
2	Grundkonzept erstellen	8 h
3	Struktur der App festlegen	6 h
5	Wifi-Socket in App implementieren	39 h
6	Write-Funktionalität in App implementieren	14 h
7	Read-Funktionalität in App implementieren	19 h
8	Trim-Funktionalität in App implementieren	10 h
9	Konfigurationsmöglichkeiten für Flug in App implementieren	16 h
10	Höhenregelung-Funktionalität in App implementieren	14 h
12	Graphische Darstellung der Flugdaten	18 h
14	App testen und debuggen	19 h
26	Gesamtkonzept testen und debuggen	16 h
Summe		187 h

Table 1: Arbeitszeitznachweis

12 Source code directory

Source Code directory, kein plan was des is

13 List of figures

1	Dart Logo (Source: https://dart.dev)	3
2	Flutter Logo (Source: https://flutter.dev/)	4
3	Java Logo (Source: https://logodownload.org/java-logo/)	5
4	Git Logo (Source: https://git-scm.com/)	7
5	GitHub Logo (Source: https://github.com/)	7
6	OSM Logo (Source: https://wiki.openstreetmap.org/)	8
7	GraphHopper Logo (Source: https://brandfetch.com/graphhopper.com)	8
8	VS Code Logo (Source: https://code.visualstudio.com/brand)	9
9	Docker Logo (Source: https://www.docker.com/)	10

14 List of tables

1	Arbeitszeitznachweis	15
---	--------------------------------	----

15 Bibliography

- [1] Lukas Dagne. “Flutter for cross-platform App and SDK development”. In: (2019).
- [2] *Flutter for Beginners*. URL:
https://books.google.at/books?hl=de&lr=&id=pF6vDwAAQBAJ&oi=fnd&pg=PP1&dq=benefits+dart+language&ots=dZJWUGVs4x&sig=a196WqhXmQzuy23cmcKpEpIqn_k&redir_esc=y#v=onepage&q=benefits%20dart%20language&f=false.
- [3] *flutter/README.md at master · flutter/flutter*. [Online; accessed 23. Jan. 2025]. Jan. 2025. URL:
<https://github.com/flutter/flutter/blob/master/README.md>.
- [4] *graphhopper*. [Online; accessed 30. Jan. 2025]. Jan. 2025. URL:
<https://github.com/graphhopper/graphhopper>.
- [5] *Host Your Own Worldwide Route Calculator With GraphHopper - GraphHopper Directions API*. [Online; accessed 30. Jan. 2025]. Apr. 2024. URL:
<https://www.graphhopper.com/blog/2022/06/27/host-your-own-worldwide-route-calculator-with-graphhopper>.
- [6] *OSM: The simple map that became a global movement*. [Online; accessed 28. Jan. 2025]. Jan. 2025. URL:
<https://web.archive.org/web/20240420144212/https://www.directionsmag.com/article/1163>.
- [7] *Visual Studio Code for the Web*. [Online; accessed 30. Jan. 2025]. Jan. 2025. URL:
<https://code.visualstudio.com/docs/editor/vscode-web>.
- [8] *vscode*. [Online; accessed 30. Jan. 2025]. Jan. 2025. URL:
<https://github.com/microsoft/vscode>.
- [9] *What is the Visual Studio Code editor built on*. [Online; accessed 30. Jan. 2025]. Jan. 2025. URL:
<https://stackoverflow.com/questions/29966093/what-is-the-visual-studio-code-editor-built-on>.
- [10] *OpenStreetMap Wiki. Main Page — OpenStreetMap Wiki*. [Online; accessed 28-January-2025]. 2024. URL:
https://wiki.openstreetmap.org/w/index.php?title=Main_Page&oldid=2752444.

16 Abbreviation

VCS	Version Control System
API	Application Programming Interface
CI CD	Continuous Integration & Continuous Deployment
OSM	Open Street Map
GIS	Geo Information System
GH	GraphHopper
IDE	Integrated Development Environment
GPS	Global Positioning System
GUI	Graphical User Interface