htblakaindorf
Leistung mit Menschlichkeit

informatik

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

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

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.

(*Flutter for Beginners*, n.d.)

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.

("flutter/README.md at master · flutter/flutter", 2025) (Dagne, 2019)

2.4 Backend

2.4.1 Java Spring

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2.4.2 PostgreSQL

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2.5 Version Control

2.5.1 Git

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2.5.2 GitHub

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2.6 Map Data

2.6.1 OpenStreetMap

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2.6.2 Graphhopper

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2.7 Development Tools

2.7.1 VS Code

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2.7.2 IntelliJ

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2.7.3 Android Studio

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2.7.4 Postman

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2.7.5 Figma

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2.8 Deployment

2.8.1 Docker

2.8.2 Uberspace

2.8.3 Webmin

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 Area Borders

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

6.1 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.

6.2 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.

6.3 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.

6.4 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.

6.5 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.

6.6 Integration of the Algorithm into the Backend

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

6.7 Challenges and Adjustments

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

7 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.

7.1 Controller Layer

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

7.2 Service Layer

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

7.3 Repository Layer

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

7.4 Persistence Layer (Entity Classes)

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

7.5 Applied Design Principles (DTOs)

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

8 Defining usability

8.1 Why it is important

8.2 Fundamental concepts of usability

8.3 Challenges in designing for a broad user spectrum

9 Usability in context of maps

9.1 Basic Analysis of the Google Maps interface

9.2 Identifying Flaws in Googles Design

9.3 How could specific user groups struggle with this design

10 Adaptive algorithms and real-time data integration

10.1 Theoretical Framework

10.1.1 Traditional Methods for Address Database Management

10.1.2 Adaptive Algorithms: Concepts and Applications

10.1.3 Real-Time Data Integration Frameworks

10.2 Technical Framework

10.2.1 Data Sources

10.2.1.1 GPS Data

10.2.1.2 External APIs

10.2.1.3 User Inputs

10.2.2 Adaptive Algorithms

10.2.2.1 Fuzzy Matching

10.2.2.2 Machine Learning Model

10.2.2.3 Rule-Based Filters

10.2.2.4 Dynamic Duplicate Resolution

10.2.2.5 Real-Time Address Normalization

10.2.3 Evaluation Metrics

10.2.3.1 Accuracy

10.2.3.2 Latency

11 Traditional Methods for Address Database Management

12 Adaptive Algorithms: Concepts and Applications

13 Real-Time Data Integration Frameworks

14 Implementation of the Backend

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

14.1 Config of Spring Boot (application.properties)

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

14.2 Entity Classes (Structure/Purpose)

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

14.3 JPA-Repositories (DB Access and CRUD Operations)

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

14.4 Service Classes

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

14.5 Rest Controller (API Endpoints and their Functions)

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

15 Working out the Wireframes

15.1 Map View

15.2 List View

15.3 Possible improvements for future versions

16 Functional implementation behind the application

16.1 Address-Provider

16.2 HTTP-Requests

16.3 Implementation of the Flutter Map Component

17 The app in use

17.1 Introducing new users

17.2 The app in operation

17.3 User Feedback

18 Final Thoughts

18.1 Leon Edlinger

18.2 Paul Gigler

18.3 Andreas Weissl

19 Meetings

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

20 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: Arbeitszeitnachweis

21 Source code directory

Source Code directory, kein plan was des is

22 List of figures

23 List of tables

24 Bibliography

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25 Abbreviation

ADC	Analog Digital Converter
API	Application Programming Interface
BLE	Bluetooth Low Energy
CPU	Central Processing Unit
DAC	Digital Analog Converter
DAVE	Digital Application Virtual Engineer
DSP	Digital Signal Processor
FPU	Floating Point Unit
FPV	First Person View, First Pilot View
GPIO	General Purpose Input/Output
GPS	Global Positioning System
GUI	Graphical User Interface
HDMI	High Definition Multimedia Interface
I^2C	Inter-Integrated Circuit
IDE	Integrated Development Environment
IP	Internet Protocol
RPI	Raspberry Pi
SD	Secure Digital
SPI	Serial Peripheral Interface
USB	Universal Serial Bus
TCP	Transmission Control Protocol
UART	Universal Asynchronous Receiver Transmitter
WLAN	Wireless Local Area Network
WPA	WiFi Protected Access
XML	Extensible Markup Language