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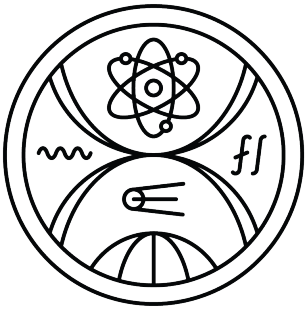
FACULTY OF MATHEMATICS PHYSICS AND INFORMATICS



ANALYSIS, DESIGN AND IMPLEMENTATION OF MICRO-FRONTEND ARCHITECTURE

Diploma thesis

2024 Bc. Pavol Repiský

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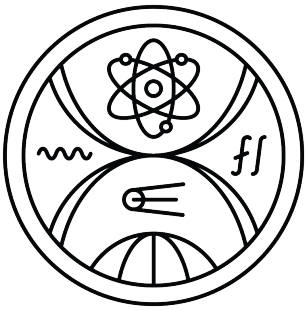

ANALYSIS, DESIGN AND IMPLEMENTATION OF MICRO-FRONTEND ARCHITECTURE

Diploma thesis

Study program:	Applied Computer Science
Branch of study:	Computer Science
Department:	Department of Computer Science
Supervisor:	RNDr. Ľubor Šešera, PhD.
Consultant:	Ing. Juraj Marák

Bratislava, 2024 Bc. Pavol Repiský

37862688

Univerzita Komenského v Bratislave
Fakulta matematiky, fyziky a informatiky

ZADANIE ZÁVEREČNEJ PRÁCE

Meno a priezvisko študenta: Bc. Pavol Repiský
Študijný program: aplikovaná informatika (Jednoodborové štúdium, magisterský II. st., denná forma)
Študijný odbor: informatika
Typ záverečnej práce: diplomová
Jazyk záverečnej práce: anglický
Sekundárny jazyk: slovenský

Názov: Analysis, Design and Implementation of Micro-frontend Architecture
Analýza, návrh a implementácia mikrofrontendovej architektúry

Anotácia: Mikrofrontendy predstavujú ďalší logický krok vo vývoji architektúry webových aplikácií. Tento prístup si však vyžaduje zvýšenie zložitosti architektúry a vývoja projektu. Problémy ako smerovanie, opätovná použiteľnosť, poskytovanie statických aktív, organizácia úložiska a ďalšie sú stále predmetom značnej diskusie a komunita ešte musí nájsť riešenia, ktoré dokážu efektívne spustiť projekt a riadiť výslednú zložitosť. Aj keď boli navrhnuté a diskutované niektoré prístupy, existuje veľké množstvo poznatkov a potenciálu na objavenie nových prístupov.

Cieľ: Preskúmajte existujúcu literatúru o prístupoch k návrhu a vývoju webových aplikácií pomocou mikro-frontend architektúry.
Porovnajte existujúce prístupy z hľadiska opätovnej použiteľnosti, rozšíriteľnosti, zdieľania zdrojov a správy stavu aplikácií.
Identifikujte prístupy, ktoré sú najvhodnejšie pre vývoj podnikových aplikácií, potom navrhnite a implementujte prototypovú mikrofrontendovú aplikáciu pomocou jedného vybraného prístupu.

Literatúra:
https://www.researchgate.net/publication/351282486_Micro-frontends_application_of_microservices_to_web_front-ends
https://www.angulararchitects.io/blog/micro-apps-with-web-components-using-angular-elements/
https://www.diva-portal.org/smash/record.jsf?pid=diva2%3A1570726&dswid=5530
https://www.diva-portal.org/smash/record.jsf?pid=diva2%3A1778834&dswid=-4588
https://www.scientificbulletin.upb.ro/rev_docs_arhiva/reze1d_965048.pdf

Vedúci: RNDr. Ľubor Šešera, PhD.
Konzultant: Ing. Juraj Marák
Katedra: FMFI.KAI - Katedra aplikovanej informatiky
Vedúci katedry: doc. RNDr. Tatiana Jajcayová, PhD.

Spôsob sprístupnenia elektronickej verzie práce:
bez obmedzenia

Comenius University Bratislava
Faculty of Mathematics, Physics and Informatics

THESIS ASSIGNMENT

Name and Surname:	Bc. Pavol Repiský
Study programme:	Applied Computer Science (Single degree study, master II. deg., full time form)
Field of Study:	Computer Science
Type of Thesis:	Diploma Thesis
Language of Thesis:	English
Secondary language:	Slovak

Title: Analysis, Design and Implementation of Micro-frontend Architecture

Annotation: Micro-frontends represents the next logical step in the development of a web-application architecture. However, this approach necessitates an increase in the complexity of the project architecture and development. Issues such as routing, reusability, static asset serving, repository organization, and more are still the subject of considerable discussion, and the community has yet to find any solutions that can effectively bootstrap a project and manage the resulting complexity. While there have been some approaches proposed and discussed, there is a great deal of knowledge and potential for new approaches to be discovered.

Aim: Review existing literature about approaches to design and development of web applications using micro-frontend architecture.
Compare existing approaches from aspects of reusability, extendibility, resource sharing and application state management.
Identify approaches best suited for enterprise application development, then design and implement a prototypical micro-frontend application using one selected approach.

Literature:
https://www.researchgate.net/publication/351282486_Micro-frontends_application_of_microservices_to_web_front-ends
https://www.angulararchitects.io/blog/micro-apps-with-web-components-using-angular-elements/
https://www.diva-portal.org/smash/record.jsf?pid=diva2%3A1570726&dswid=5530
https://www.diva-portal.org/smash/record.jsf?pid=diva2%3A1778834&dswid=-4588
https://www.scientificbulletin.upb.ro/rev_docs_arhiva/reze1d_965048.pdf

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Head of department:	doc. RNDr. Tatiana Jajcayová, PhD.

Assigned: 05.10.2023

Approved: 05.10.2023 prof. RNDr. Roman Ďurikovič, PhD.
Guarantor of Study Programme

Acknowledgement

Tu môžete poďakovať školiteľovi, prípadne ďalším osobám, ktoré vám s prácou nejako pomohli, poradili, poskytli dáta a podobne.

Abstrakt

Slovenský abstrakt v rozsahu 100-500 slov, jeden odstavec. Abstrakt stručne sumarizuje výsledky práce. Mal by byť pochopiteľný pre bežného informatika. Nemal by teda využívať skratky, termíny alebo označenie zavedené v práci, okrem tých, ktoré sú všeobecne známe.

Kľúčové slová: jedno, druhé, tretie (prípadne štvrté, piate)

Abstract

Abstract in the English language (translation of the abstract in the Slovak language).

Keywords:

Contents

List of Figures

List of Tables

Chapter 1

Introduction

1.1 Background and Motivation

Provide an overview of the background that led to the initiation of the research, addressing the historical context and the driving forces that underscore the significance of the study

1.2 Objectives and Scope

Outline the specific objectives that the study aims to achieve, the scope of the investigation.

1.3 Scope and Limitations

Acknowledging the constraints and boundaries of the study, transparently discuss the limitations and delimitations inherent in the research

Chapter 2

Literature Review

2.1 A Brief History of Web App Architecture

Mention following technologies:

- Static Web Pages
- CGI-Bin
- Client-Server Architecture
- Model-View-Controller
- Service-Oriented Architecture
- Single-Page Applications

2.2 Modern Architecture Patterns

2.2.1 Progressive Web app

2.2.2 Serverless Architecture

2.2.3 Microservices

2.2.4 Micro-Frontends

Chapter 3

Theoretical Framework

The chapter will encompass the essential theoretical information necessary for comprehending the thesis.

Chapter 4

Analysis

Provide a description outlining the purpose and content of this chapter, detailing the topics being discussed herein.

4.1 Micro-Frontends in a Nutshell

- Define microfrontends and highlight its significance in addressing the limitations of traditional monolithic frontend development.
- Discuss the essential features and characteristics of microfrontends, such as modularity, independent deployment, and technology agnosticism...

4.2 Implementation Approaches

Provide introduction for different implementation approaches.

4.2.1 Edge-side composition

Provide a brief overview of this implementation approach.

4.2.2 Server-side template composition

Provide a brief overview of this implementation approach.

4.2.3 Build-time integration

Provide a brief overview of this implementation approach.

4.2.4 Run-time integration via iframes

Provide a brief overview of this implementation approach.

4.2.5 Run-time integration via JavaScript

Provide a brief overview of this implementation approach.

4.2.6 Run-time integration via WebComponents

Provide a brief overview of this implementation approach.

4.3 Strengths

List all the benefits of microfrontends.

4.4 Drawbacks

List all the negatives of microfrontends.

4.5 Success stories

Mention some notable companies such as Zalando, Upwork, and Dazn that have adopted microfrontends, and discuss their experiences with this approach.

Chapter 5

Design

5.1 Introduction

Provide a brief introduction to the app, its purpose, target audience, and any relevant background information.

5.2 System Architecture

Provide a comprehensive overview of the overall architecture of the microfrontends system.

5.2.1 Functional Requirements

5.2.2 Nonfunctional Requirements

5.3 Tech Stack

- List all tools, frameworks and libraries which will be utilized.
- Explain what they do and reason for their selection.

5.4 Components

- Specify the micro-frontends the app will be divided into.
- Describe all the components the app will consist of.
- Develop a comprehensive component diagram.
- Elaborate on the implementation of communication protocols.

5.5 Graphical User Interface

- Sketch wireframes depicting the GUI of the app.
- Sketch wireframes depicting the GUI of the app.

Chapter 6

Implementation

Provide a description outlining the purpose and content of this chapter, detailing the topics being discussed herein.

6.1 Overview

- Describe the application implementation process.
- Highlight key considerations and the overall approach to implementing micro-frontends.

6.2 Styling & Sharing

- Describe the challenge posed by CSS in a micro-fronted architecture, where styles are global, inherit, and cascade without the support of a module system, namespacing, or encapsulation.
- Highlight the necessity of ensuring that each micro frontend doesn't conflict with others regarding CSS properties.
- Explain the approach taken to address these challenges, emphasizing the need for consistency in the graphical user interface (GUI) across all micro frontends.
- Discuss the implementation of a shared UI component library as a solution to promote consistency and streamline development efforts.
- Describe how was static assets sharing managent.

6.3 Routing

- How was the routing issue resolved

- Which technologies are utilized for both internal and external routing

6.4 Cross-application communication

- Discuss when micro-frontends must communicate with each other.
- Explain the techniques utilized for communication.
- Discuss how was tight coupling avoided.

6.5 Versoning & Infrastructure

- Discuss the type of repository employed (Mono-repo/Multi-repos) and reasons behind its selection.
- Enumerate all automated workflows which were utilized.
- Highlight any additional tools employed
- Describe the deployment process

6.6 Testing

- Detail the types of tests utilized.
- Explain the testing process, including any automation implemented.
- List the testing tools utilized.

Chapter 7

Conclusion

Provide a description outlining the purpose and content of this chapter, detailing the topics being discussed herein.

7.1 Implementation Results

- Presents the findings and outcomes from the implementation and analysis of microfrontend architectures.
- Cover key metrics, performance indicators, and notable observations to support the thesis's conclusions.

7.2 Practical Implications

Discuss the circumstances under which microfrontends are suitable and when they may not be the optimal solution.

7.3 Recommendations for Future Work

Outline potential areas for future research and improvement in microfrontend architectures.

[1]

Bibliography

[1] Tobias Oetiker, Hubert Partl, Irene Hyna, and Elisabeth Schlegl. *Nie príliš stručný úvod do systému LaTeX2e.* 2002. Preklad Ján Buša ml. a st.