

***Cyprian Szczepański***

***Nr dyplomu***

PRACA DYPLOMOWA

~~magisterska~~/inżynierska/~~licencjacka~~

na kierunku …………Informatyka…………………………….

**Temat pracy w języku prowadzenia studiów**

**Rozproszony system promujący aktywność studencką**

Katedra Mikroelektroniki i Technik Informatycznych

*(nazwa instytutu/katedry)*

Promotor: dr inż. Przemysław Sękalski

(*tytuł/stopień naukowy, imię i nazwisko*)

Opiekun pomocniczy\*)

(*tytuł/stopień naukowy, imię i nazwisko*)

Promotor uczelni partnerskiej\*\*)

(*tytuł/stopień naukowy, imię i nazwisko*)

ŁÓDŹ 2024

\* jeśli został powołany

\*\* w przypadku procedury uznania

# Abstract

The primary purpose of this thesis is to create a distributed system to promote and settle activities by students in an academy. This application allows students to show their abilities during their studies through academic activity, which the academy might reward them or be evidence of gaining additional knowledge for their careers. The project uses blockchain technology by showing new information technology solutions in areas like verifying students’ abilities and securing the data for gaining competencies. Still, the project also creates an internal nodes on the network only seen by people related to the academy.

# Streszczenie pracy

Głównym celem tej pracy dyplomowej jest stworzenie rozproszonego systemu do promowania i rozliczania działań przez studentów na uczelni. Dzięki aplikacji, studenci są w stanie wykazać się zdolnościami poznanymi podczas trwania swojej nauki poprzez aktywność akademicką, która może być wynagrodzona przez uczelnię lub też może stanowić dowód nabytych dodatkowych umiejętności dla swojej kariery zawodowej. Projekt wykorzystuje technologie blockchain w celu przedstawienia nowych rozwiązań informatycznych w obszarze weryfikacji umiejętności studentów oraz bezpieczeństwa danych nabywanych kompetencji. Mimo to w ramach projektu tworzone są również wewnętrzne węzły w sieci, które widzą tylko osoby powiązane z uczelnią.

# Keywords

Blockchain, Ethereum, WalletConnect v2, Rust, Flutter, Microservices, Kubernetes, Helm, Argo CD, Github Actions, PostgreSQL, MongoDB, Firebase Auth, Tokio, Tonic, Axum

Table of Contents

[Abstract 2](#_Toc152580312)

[Streszczenie pracy 2](#_Toc152580313)

[Keywords 2](#_Toc152580314)

[List of Figures 5](#_Toc152580315)

[List of Tables 5](#_Toc152580316)

[List of Listings 5](#_Toc152580317)

[1 Introduction 6](#_Toc152580318)

[1.1 Problem Definition 6](#_Toc152580319)

[1.2 Objectives 8](#_Toc152580320)

[1.3 Structure 8](#_Toc152580321)

[2 Fundamentals 9](#_Toc152580322)

[2.1 Blockchain 9](#_Toc152580323)

[2.2 Ethereum 9](#_Toc152580324)

[2.3 ERC-20 9](#_Toc152580325)

[2.4 WebAssembly 9](#_Toc152580326)

[3 Implementation 9](#_Toc152580327)

[3.1 Requirements Analysis 9](#_Toc152580328)

[3.2 Data Flow Diagram 9](#_Toc152580329)

[3.3 Architecture 10](#_Toc152580330)

[3.4 Entity-Relationship Diagram 10](#_Toc152580331)

[3.5 Backend services 10](#_Toc152580332)

[3.6 Client Side 10](#_Toc152580333)

[4 Deployment 10](#_Toc152580334)

[5 Testing 10](#_Toc152580335)

[6 Discussion & Conclusion 11](#_Toc152580336)

[6.1 Results 11](#_Toc152580337)

[6.2 Related Work & Contributions 11](#_Toc152580338)

[6.3 Conclusion 11](#_Toc152580339)

[Literature 11](#_Toc152580340)

[Websites 11](#_Toc152580341)

[Bibliography 11](#_Toc152580342)

[Terminology 11](#_Toc152580343)

# List of Figures

[Figure 1. How many students work for the university according to the survey 7](#_Toc152531744)

[Figure 2. Reasons why students do not work for the university 7](#_Toc152531745)

# List of Tables

# List of Listings

# Introduction

## Problem Definition

In today’s reality, more and more people are committing to studying at universities. The purpose of this trend is so that people can have better possibilities in their future work; employees need academic education. Within this fact, there are two main questions:

* Is the academy diploma, course certificate, and other activities an applicant provides to an employee not defrauded?
* Can the faculty program fulfill employees’ requirements to recruit a student?

In the first question, people need to be convinced to trust the description in the CV fully; they need proof, but it is hard to create a document with appropriate approval for every student’s activity; it can take too much time and effort for academy workers.

Universities host diverse academic activities, from traditional coursework to research projects, internships, and extracurricular involvement. Documenting these activities is demanding due to the myriad forms they can take. Hence, the next problem is standardized documentation for academic achievements, and even individual professors may have distinct methods of recording and certifying student accomplishments.

Students might be tempted to mispresent their achievements because of the lack of foolproof documentation university can create from their system.

To overcome these challenges, a solution must streamline the verification process and ensure its efficiency and accuracy. Technology-driven solutions and standardized frameworks can alleviate the administrative burden, enhance reliability, and contribute to a more transparent and trustworthy verification system for academic credentials.

In the second question, the reality of today’s market is changing more rapidly than the program of each university faculty. Also, academies provide a basis for each lecture that a student can develop on his/her own in the future. Employees want specialists, so naturally, students should dive into subjects that are in demand. What has stayed the same is that employees always look forward to students, voluntary work, and working with people on something that could solve specific problems. Academies are open for students to help them advance their soft skills, but this community rarely takes up this activity. Thanks to investigators from managements studies at the University of Technology in Lodz, who surveyed people currently studying, we can notice why students do not accept this action; most are unaware.

A pie chart with numbers and text

Description automatically generated

Figure 1. How many students work for the university according to the survey

In the following survey question, we can better understand why students do not contribute to academic work. This question can be divided into three parts:

* Students are focused on other activities.
* Students need more motivation to do voluntary work.
* There needs to be more information for people who could take additional work for the academy.

A graph with blue and white text

Description automatically generated

Figure 2. Reasons why students do not work for the university

The challenge for solving this issue could be creating a platform that enables everyone in the university, for students who can see all possible activities in the tutor’s projects and the other activities, but also for academy workers where they can create tasks for students.

Moreover, this platform needs gamification methods for students to create better perspective for themselves. For example, students can get points and rewards for completing a new activity that ends successfully and is accepted by the tutor.

Unfortunately, there are no suitable sources to show all student’s trustworthy activities and motivate this community to consider another type of experience employees seek during recruitment. This paper will introduce a solution that can solve these two questions provided at the start of this section.

## Objectives

The following outlines the objectives of this thesis that will, step by step, make a move for solving the placement in the problem definition section.

The first objective is to develop entirely scalable backend services for this product. We want our services to continuously work on the server regardless of service updates and scale our services when there is significant usage. This aspect could be resolved using microservice architecture. The provided architectural pattern is an approach for creating loosely coupled, fine-grained services that communicate using lightweight protocols like REST API.

Our secondary goal is to develop a versatile client-side application accessible through mobile phones and websites In today’s market, it is essential to accommodate multiple platforms for maximum reach. To achieve this, we will create the front end using a language that can compile smoothly various Android, iOS, and websites.

The third objective responds to the challenges posed by the problem definition; the proposed solution is a system that addresses academic verification student activity recording and introduces a token-based incentive mechanism. We can divide the solution into three parts:

1. Implementing a blockchain system using Ethereum and ERC-20 standards for immutable and decentralized verification. The framework involves recording academic achievements securely on the blockchain, providing transparent and tamper-resistant proof of qualifications.
2. Extending the blockchain framework to capture diverse student activities, such as voluntary work, collaborative projects, and academy contributions. The system ensures transparent accountability and enables a broad-based view of a student’s capabilities.
3. Introducing a token-based incentive system where students earn tokens for their various achievements. While devoid of external value, these tokens can be exchanged within the application for rewards. The framework fosters well-rounded development and complements academic qualifications by showcasing a student’s proactive involvement.

## Structure

This thesis will be structured as follows. Chapter 2 will provide a theoretical discussion of all aspects of the project that will be covered after this chapter. They will appear with a comprehensive explanation of computer science aspects utilized in this work. The following elements emerge sequentially: Blockchain, Microservices, DevOps, Database, and technology in use.

Chapter 3 is the central chapter and shows an innovative approach to solving this problem provided in the Introduction. The first part shows the abstraction of the solution, like the specification of requirements, diagrams, and architecture of the solution. The second part focuses on presenting backend services in action and client-side applications.

Chapter 4 and 5 will evaluate the tools needed to distribute a fully working product. Chapter 4 focuses on continuous integration and continuous development (CI/CD) that I use to maintain my solution. Chapter 5 will show how backend services were tested, including concepts like checking security tests and stress tests.

Chapter 6 will conclude this work by discussing the results and the relevance of the contribution of the problem provided in the Introduction.

# Fundamentals

## Blockchain

## Ethereum

## ERC-20

## WebAssembly

# Implementation

## Requirements Analysis

## Data Flow Diagram

## Architecture

* Why microservice architecture was the best choice for this solution?

## Entity-Relationship Diagram

## Backend services

* Why do I use Rust?

## Client Side

* Why do I use Flutter?

# Deployment

* Explain technology like: Kubernetes, Helm, ArgoCD, Github Actions

# Testing

* Integrational tests & unit tests
* Security tests
* Stress tests

# Discussion & Conclusion

## Results

## Related Work & Contributions

## Conclusion

# Literature

# Websites

# Bibliography

# Terminology

* Soft skills
* Gamification
* CI/CD
* REST API
* Decentralized