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MYGENELEC CUSTOMER INTERACTION PLATFORM

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THESIS
Abstract

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The aim of this thesis was to explain the development of customer interactive platform MyGenelec, what tools, methods and approaches have been used, and the success of the project.

The method involved a detailed study of the interactive platform's architecture, integration with existing technological frameworks, and functionalities. Emphasis was placed on the platform's design using the Vue.js framework, its integration with Keycloak for authentication, and deployment strategies utilizing GitLab's Continuous Integration and Continuous Delivery CI/CD pipeline, Docker, Kaniko, Rancher, and Harbor. It offers an intuitive interface for managing product portfolios, room design optimization, and efficient product placement.

The results demonstrate that the portal significantly enhances customer engagement and product management. The integration with tools mentioned earlier ensured secure, agile deployment and optimal cloud performance. The development project not only serves as an advanced product management system but also signifies Genelec's commitment to pioneering the future of digital interaction in the audio technology sector.

Keywords
Vue JS, cloud platforms, Docker, Keycloak, GitLab, Rancher, Harbor, plugins.

CONTENTS

1 INTRODUCTION

In the contemporary landscape of digital technology, applications and platforms play a crucial role in connecting businesses with their customers. In today's world, users expect more than just basic functionality. They demand quick, adaptable, and seamless experiences. Therefore, updating a customer interaction platform to align with these changing user expectations is not only beneficial but crucial for the continued relevance of a platform. A significant challenge in our digital era is to ensure that the customer interaction platforms are not only effective for current needs but also prepared for future technological developments. Being adaptable and forward-looking is essential in a landscape where rapid advancements are commonplace. The digital domain is constantly evolving, driven by powerful technologies like AWS (Amazon Web Services 2023), Docker (Docker 2023), and Kubernetes (The Kubernetes Authors 2023). These tools expand the possibilities, urging companies to innovate and keep pace with technological progress.

This thesis discusses the development of the "MyGenelec" digital platform in Genelec Oy, motivated by the aim to enhance the interaction between the company and the customers regarding their audio products, offering new functionalities such as easy registration of new products, efficient warranty management, and user profile customization.

By using modern cloud-based tools and the Vue JS framework and others, the present work aims to elevate the digital portal's capabilities to not only meet current standards but also to anticipate and adapt to future trends in digital customer-product interaction. The study successfully integrates advanced features into the development, leveraging the capabilities of modern cloud-based technologies and front-end frameworks. The technologies used to create the portal result in a more intuitive user interface, improved performance, and better alignment with the user expectations. (Evan You 2023.)

2 THE EVOLUTION OF CUSTOMER INTERACTION ON THE INTERNET

2.1 Motivation of the Transition

The evolution of customer interaction on the Internet reflects a significant shift in the digital landscape, moving from a "one-size-fits-all" approach to personalized, user-centric services. This background discussion explores the transition from fragmented web services to integrated digital platforms and the underlying motivations for this shift.

In the earlier stages of the Internet, businesses like Genelec primarily relied on multiple, separate web pages to interact with their customers. Each service, whether for product registration, customer support, or profile management, existed on different platforms. This approach, while functional, posed several challenges. Customers had to navigate through multiple websites to access different services. This fragmentation often led to a disjointed experience, where the user's journey was not only inconvenient but also confusing. With services scattered across various platforms, the efficiency of delivering customer support and managing user data was compromised. It resulted in higher operational costs, a longer response time, and difficulties for clients. The "one-size-fits-all" nature of these separate platforms offered limited scope for personalization. Users received a generic experience, devoid of customization based on their individual preferences, history, or needs.

Historically, the audio technology industry, much like many others, operated on traditional business models that were largely linear and product centric. Customer interactions were mostly transactional, limited to physical or basic digital engagements, and lacked a unified digital platform for comprehensive engagement. This approach presented several limitations, particularly in terms of scalability, flexibility, and customer data analytics. The absence of an integrated digital ecosystem resulted in fragmented customer experiences and inefficiencies in managing product portfolios and customer support. (Alstyne, Parker & Choudary 2016.)

The transition to digital platforms was further motivated by contemporary market trends that prioritized user experience, integration with mobile technology, and seamless customer service. Industry reports and case studies of successful digital platforms illustrated how integrating with cloud computing not only bolstered operational efficiency but also enhanced user engagement and satisfaction. The transition from a "one-size-fits-all" approach to personalized, user-centric services in digital platforms is a global phenomenon, impacting various industries (Alstyne, Parker & Choudary 2016.). This shift is underscored by several examples from around the world, which demonstrate the move towards more integrated and tailored digital experiences. Amazon's Personalized Shopping Experience changed the e-commerce industry by shifting from a standard online storefront to a highly personalized shopping experience. Using sophisticated algorithms and data analytics, Amazon offers product recommendations based on individual user browsing history, purchases, and preferences. This personalization enhances customer engagement and increases sales (Amazon.com 2023). Netflix transformed from a DVD rental service to an online streaming platform offering highly customized viewing experiences. By analysing viewer data, Netflix not only recommends content tailored to individual tastes but also uses these insights to produce original content that resonates with its diverse audience (Netflix 2023). Spotify's shift towards personalized music streaming services illus-

trates the move away from one-size-fits-all. Using advanced data analysis, Spotify creates custom playlists for users based on their listening habits, offering a unique and individualized experience for each subscriber (Spotify AB 2023).

Salesforce, a leader in customer relationship management (CRM) software, offers personalized CRM solutions that adapt to the specific needs of businesses. Unlike traditional, rigid CRM systems, Salesforce provides a flexible platform that can be customized to match the unique processes and workflows of different organizations (Salesforce 2023). Starbucks' mobile app is another example of personalized customer service. The app not only streamlines the ordering and payment process but also tailors offers and rewards to individual preferences, enhancing the customer experience and fostering brand loyalty (Starbucks Coffee Company 2023). IKEA moved from standard catalogues to an augmented reality app that allows users to visualize furniture in their own homes before purchasing. This shift towards a more interactive and personalized shopping experience has been a significant development in retail (Inter IKEA Systems B.V 2023).

These examples illustrate the global trend towards personalized digital platforms. The old strategy of one-size-fits-all has been replaced by a more customer-centric approach, where digital interactions are tailored to meet the specific needs and preferences of individual users. This change not only enhances the user experience but also leads to better customer engagement and loyalty.

2.2 Customer Experiences

In today's data-centric business environment, companies are consistently exploring strategies to refine their operations and enhance customer experiences. Cloud technology, particularly Amazon Web Services (AWS), stands as an enabler in this pursuit, offering scalable and reliable solutions essential for modern businesses (see Figure 1). (Amazon Web Services 2023.)

Figure 1. Logo for Amazon Web Services (Amazon Web Services. Amazon. 2017)

Burns and Oppenheimer, in their work "Designing Distributed Systems" (2018), emphasize the multifaceted benefits of cloud platforms like AWS. These benefits cater to the core needs of contemporary businesses. Cloud infrastructure's ability to adapt to fluctuating demands is vital, allowing busi-

nesses to efficiently manage peak periods and data surges. With built-in redundancy and fault tolerance, cloud platforms ensure minimal downtime, a critical feature for applications needing constant uptime. By eliminating the need for extensive physical infrastructure, cloud computing reduces capital expenses and streamlines IT operations, offering a pay-as-you-use model. AWS provides a broad spectrum of customizable services, empowering businesses to experiment with modern technologies and adapt swiftly to market shifts.

Cloud technology helps businesses achieve several key goals. Cloud solutions simplify the storage, processing, and analysis of vast data volumes, offering deeper insights into customer behaviours and preferences. The adaptability of cloud platforms enables businesses to offer scalable and customizable services, fostering rapid innovation and market responsiveness. Cloud environments streamline the rollout of new application features, bypassing the complexities of traditional on-premises infrastructure.

In summary, cloud technology has significantly reshaped business operations, equipping companies with the necessary tools to succeed in the digital economy. AWS and similar platforms provide the foundation for scalable, resilient systems, effective data management, flexible services, and quick feature deployment. This technology is important in cultivating agile, customer-focused, and data-oriented business models.

The emergence of integrated digital platforms signifies a strategic response to the previously fragmented service model prevalent in the industry. This evolution is elaborated upon in Andrew Joe Weinman's and Fred Wiersema's (2018) and Veluru Pavithra (2023) works. These sources of the information underscore how user-centric platforms are redefining the way businesses interact with their customers.

2.3 Digital Platform Transformation

The transition to digital platforms marked a significant shift from traditional linear business models to networked, customer-centric ecosystems. This shift was essential in shaping the design requirements for the digital platform. The new strategy emphasized leveraging technology to enhance product offerings and create value through improved customer engagement and data-driven insights. (Alstyne, Parker & Choudary 2016.)

In the traditional business model, value flow was linear and direct, focusing on producing and selling goods to consumers. This approach, while straightforward, had limitations such as limited market reach and inefficient buyer-seller interactions. Traditional models also lacked the utilization of data for gaining deeper insights into consumer behaviour and market trends.

In contrast, digital platforms function as intermediaries, connecting producers, consumers, and other parties. This networked approach expands market reach beyond what individual companies could achieve alone. It also improves the efficiency of buyer-seller connections, reducing transactional costs and friction. Furthermore, digital platforms capitalize on data analytics to enhance product offerings, personalize user experiences, and optimize marketing strategies.

The evolution to a digital platform model required a comprehensive understanding of these dynamics to ensure the design of the platform was customer-focused and technologically adept. This understanding influenced the project's approach to creating a platform that was not only aligned with current market trends but also capable of providing a superior customer experience.

One of the critical advantages of digital platforms is the network effect, where the platform's value increases as more users engage with it. This escalation in value encourages further growth and adoption, fostering a cycle of continuous expansion and enhanced utility. The rise of these platforms has led to the development of innovative business models catering to various market needs.

For instance, marketplaces like Amazon and Airbnb (Airbnb 2023) have transformed the way transactions are facilitated between buyers and sellers. These platforms earn commissions by connecting people and providing a platform for their transactions. On the other hand, Software as a Service (SaaS) models, such as those offered by Salesforce and Adobe Creative Cloud (Adobe 2023), provide cloud-based software solutions. These services eliminate the need for users to install or maintain software, offering convenient access to applications over the internet.

Furthermore, Content as a Service (CaaS) platforms have changed how we access entertainment and information. Platforms like Netflix and Spotify are prime examples, providing users with digital content, including music, movies, and TV shows. These platforms personalize content delivery based on user preferences, enhancing the overall user experience. (Blokdyk 2018.)

Digital platforms have changed the customer experience. Utilizing data and advanced technology, they offer personalized services, relevant recommendations, and seamless integration with various services, enhancing customer satisfaction and fostering loyalty.

In essence, the rise of digital platforms marks an important evolution in the business world. These platforms are carving out new avenues for value creation, intermediation, and innovation. Businesses that adeptly using the power of digital platforms are ready for rising in this transformed landscape.

2.4 Evolution in Development Project

MyGenelec project marks a departure from the traditional approach where separate services were scattered across multiple platforms, leading to a disjointed user experience. Instead, it brings together a range of services, from product registration to customer support and profile management, into one cohesive digital environment. This integration offers users a seamless and intuitive experience, where all necessary functionalities are easily accessible within a single portal.

Moreover, the application exemplifies the shift towards personalized customer interaction. Leveraging user data, the platform is able to offer experiences that are connected to the individual needs and preferences of each user. This personalization reflects a growing trend in the digital marketplace, where businesses seek to understand and cater to the unique characteristics of their customers.

In addition to enhancing user experience, the platform streamlines service delivery. The consolidation of services into one platform reduces operational complexities and results in more efficient pro-

cesses. This efficiency is not only beneficial to the users in terms of quicker response times and enhanced service quality but also advantageous for the business from an operational standpoint.

Lastly, company's approach to data management is a critical aspect of its design. By centralizing various services, the platform is able to gather comprehensive user data, which can be analysed to extract valuable insights. This data-driven approach allows for continuous improvement of the platform, ensuring that it evolves in line with user behaviours, preferences, and emerging trends.

Overall, personalized interaction platform stands as a testament to the influential power of integrated digital platforms. It not only improves the user experience by offering a unified and personalized interface but also enhances operational efficiency and leverages data for ongoing refinement and innovation. This development of MyGenelec platform exemplifies the industry-wide evolution towards comprehensive, integrated portals. It stands as a manifestation of modern digital strategy, delivering tailored, efficient, and engaging user experiences and aligning with industry trends in digital customer interaction.

3 DESIGN REQUIREMENTS

3.1 System Level Requirements

3.1.1 Unified Portal

The development initiated with the vision of aligning with current technical trends while adapting to the rapidly evolving digital landscape, presents a comprehensive strategy to address key challenges and meet technical requirements. Development project aimed to consolidate various services, previously scattered across multiple platforms, into a unified portal. This integration included services like product registration, customer support, QR-registration, displaying grade reports, and profile management, streamlining the customer experience.

3.1.2 Universal Design for All Platforms

The personalized interaction platform was designed with a customer-centric approach, ensuring an intuitive and engaging interface that caters to the needs of the company's customer base. Recognizing the importance of cross-platform compatibility due to the wide variety of devices and browsers used by consumers today, the application was crafted to work smoothly and quickly across all platforms, including desktops, tablets, and smartphones. It was vital that the application's behaviour remained consistent across different browsers and devices, necessitating a responsive design that could adapt seamlessly to varying screen sizes and specifications. This uniformity ensures that users have a consistent experience, regardless of their choice of technology.

3.1.3 Security of the Project

High-level security measures were imperative to protect user data, including reliable authentication mechanisms and compliance with data protection regulations. Scalability and efficient load management were also key considerations, enabling the portal to remain stable and responsive during peak traffic times.

3.1.4 Effective Version Control and Continuous Integration

A cloud-based architecture, primarily utilizing AWS, provided scalability, flexibility, and enhanced features. It allowed for better resource management and cost efficiency, with the ability to adapt quickly to changing demands. Effective version control and continuous integration practices were crucial for systematic updates and integration of new features without disrupting the platform's functionality. Integration with the company's existing technical infrastructure was also essential, ensuring compatibility with current systems and the ability to incorporate new technologies.

3.1.5 Modern Technologies and Trends

Adaptability and modernity were essential factors in the project, as the rapid emergence of new technologies necessitates a platform that can swiftly adjust to contemporary trends and user requirements.

4 USER INTERFACE IMPLEMENTATION

4.1 Development Framework Vue 3

In the centre of this technical work was the decision to use Vue 3 as the primary development framework (Vue.js Official Guide 2023). This choice was influenced by the company's positive experience with Vue 2, which had already proven itself as a reliable and responsive platform in other company applications (see Figure 2).

Figure 2. Vue 3.0 Logo

Vue 3's evolution in the Vue.js framework is important for developing due to its streamlined approach to code management and enhanced efficiency. The framework's Composition API is particularly crucial, as it allows developers to structure and reuse code easily, making it exceptionally suited for complex component management. This functionality is essential for handling the multifaceted features of platforms, where various elements and user interactions need to be seamlessly integrated and managed. Additionally, Vue 3's improved reactivity system plays a significant role in optimizing data-binding processes. This ensures that the user interface remains dynamic and responsive, enhancing the overall user experience by efficiently updating the UI in real-time as data changes. This combination of features in Vue 3 makes it an ideal choice for the development of sophisticated and user-centric digital platforms (see Figure 3). (Filipova 2016.)

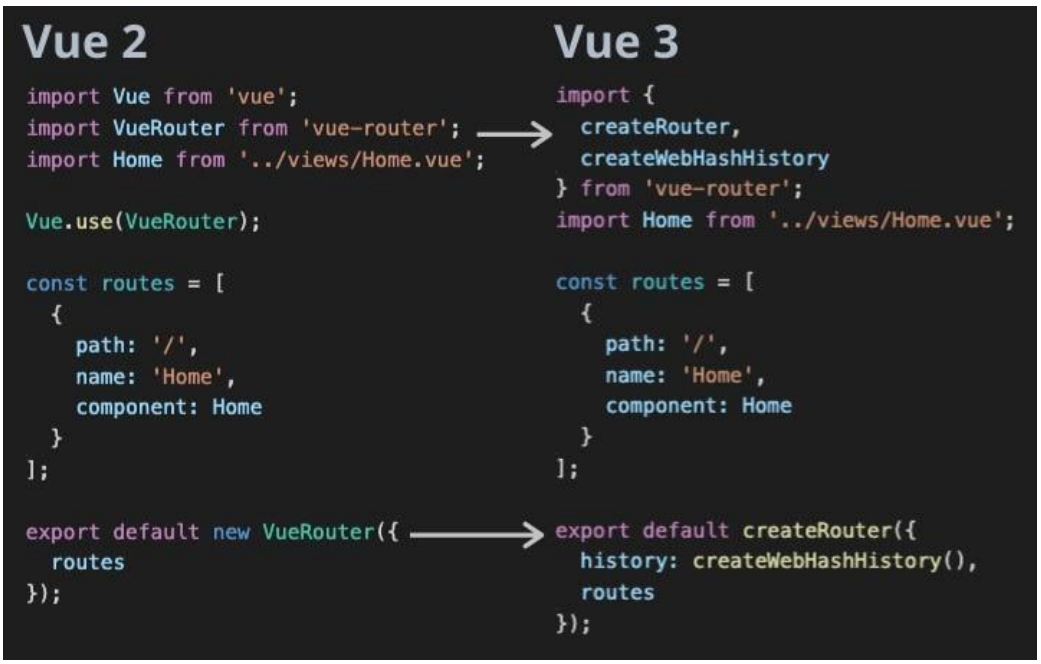

Figure 3. Structure changes in the logic of Vue 3.

The functioning of Vue 3 is centred around its component-based architecture, which allows for modular development. Each part of the application was built, tested, and refined independently, making the development process more efficient and manageable. Vue 3's virtual DOM (Document Object Model) implementation plays a valuable role in this efficiency. It enables the framework to apply changes to an in-memory data structure cache, compute the differences, and then update the browser's displayed DOM efficiently. This process significantly enhances application performance, particularly in rendering and updating the user interface (see Figure 4). (Keith and Sambells 2010.)

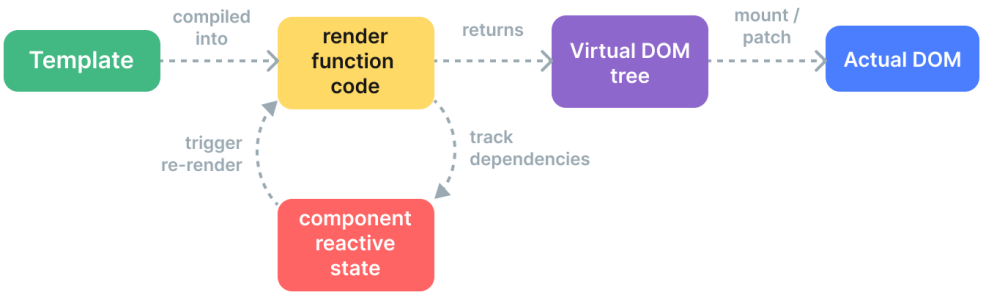

Figure 4. Rendering Mechanism Vue 3.

Incorporating Vue 3 into the project also meant leveraging its comprehensive ecosystem, including tools and libraries that enhance development efficiency. The framework's detailed documentation and supportive community further aided the development team in addressing challenges and implementing best practices.

Using Vue 3 for development was more than a technical decision; it represented an alignment with the latest front-end development standards. This strategic choice ensured that that the application was built on a foundation that was not only technologically advanced but also scalable and adaptable to future enhancements. The use of Vue 3, with its blend of performance, flexibility, and ease of use, significantly contributed to the success and reliability of the platform. More than that using this framework as the platform solved the question about cross-platform compatibility as it is easy to test this framework on different devices.

4.2 User authorization method Keycloak

After selecting Vue 3 JS as the development framework for the project, addressing security concerns became a priority. Initially, there was consideration of developing an in-house authorization application, but the complexity and time constraints led to the selection of Keycloak as the security solution (Keycloak Authors 2023). Keycloak was not a new name in the company's technological set; it had already established its reliability in other applications and was known for its compatibility with Vue 3 JS.

Keycloak is recognized as an essential open-source identity and access management tool, as per Keycloak's documentation from 2023. It has been continually evolving to meet the growing demands of digital security, particularly in reliable authentication. This evolution of Keycloak aligns well with the needs of the development project, where securing user data and access is paramount.

Keycloak is seamlessly integrated into the application as an external JavaScript file, orchestrating access management. This integration is facilitated through the inclusion of Keycloak modules directly within the primary JavaScript file responsible for constructing the application's framework. Keycloak is important in executing three essential functions: "RefreshToken," "GetUUID," and "Initialize," which collectively ensure a secure and smooth user authentication process.

Upon attempting to visit my.genelec.com, Keycloak's "Initialize" function is triggered, initiating the login process. This process is displayed within an iframe, providing users with options to either log in or register. Once a user successfully authenticates, the "GetUUID" function retrieves the user's unique ID from the access token. This ID is then utilized by the application to access and display the user's specific data.

Given that user sessions are designed with security in mind, the initial access token is set to expire after 5 minutes to safeguard against unauthorized access. To maintain session continuity without compromising security, the "RefreshToken" function is employed. This function leverages a refresh token to seamlessly obtain a new access token, ensuring users remain authenticated while interacting with the platform without experiencing disruptions.

The implementation of Keycloak into the application brought several critical features to the forefront. Single Sign-On, two-factor authentication, and identity brokering capabilities of Keycloak played a helpful role in providing a secure yet accessible user experience. Its support for various protocols like OpenID Connect (OpenID Foundation 2023), OAuth 2.0 (oauth.net 2023), and SAML 2.0 (Okta 2023), further enhanced its utility as a comprehensive security solution.

Keycloak is integrated as a separate JavaScript file and manages access to the application. This is achieved by setting Keycloak modules right in the main JavaScript file that builds the application. Keycloak has 3 main functions: "RefreshToken", "GetUUID", and "Initialize". They work all together

When the user tries to access my.genelec.com, Keycloak's "Initialization" is called. This function launches the login iframe, where the user can log in or register.

When the user is authorised, the "getUUID" function is launched. This function fetches the ID from the access token, and later the application uses this ID to get the user's Data.

The session while the user is authorized, is not endless and the access token expires in 5 minutes, that is why there is used "RefreshToken" function, which uses addition, and a refresh token to get a new access token.

Keycloak is a very good tool for managing the application securely. It has its own control panel with all required settings, where users can see the status of the application and changes. Also, it is possible to see the clients' data there and it makes supporting much easier (see Figure 5).

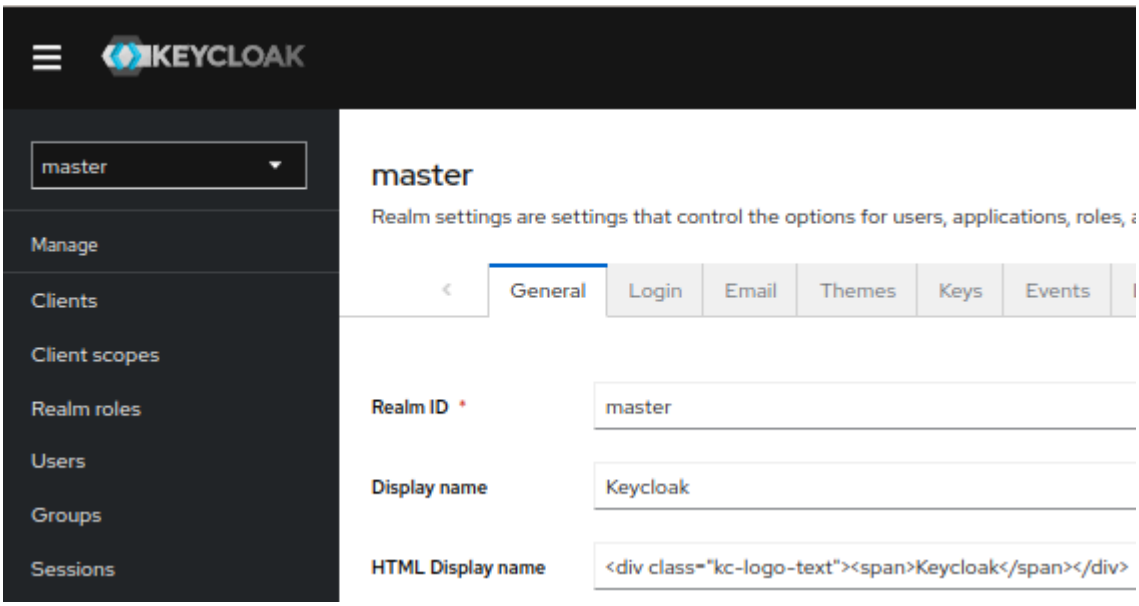

Figure 5. Keycloak management panel

OpenID is an authentication protocol that allows users to log in to multiple websites using a single set of credentials, thus eliminating the need to create and remember separate usernames and passwords for each site. It's part of a broader category of technology known as federated identity management, where a user's identity and credentials are managed across various systems and applications.

In the development project, OpenID was utilized to streamline the login process. By integrating OpenID technology, the project enabled users to access the platform using credentials from a central identity provider. This not only simplified the login experience for users but also added a layer of security, as the authentication process is managed by a dedicated, specialized service.

The use of OpenID in the project represents an alignment with modern web authentication practices. It provided a user-friendly, secure, and efficient way for users to access the platform, enhancing the overall user experience and aligning with contemporary digital security standards (see Figure 6).

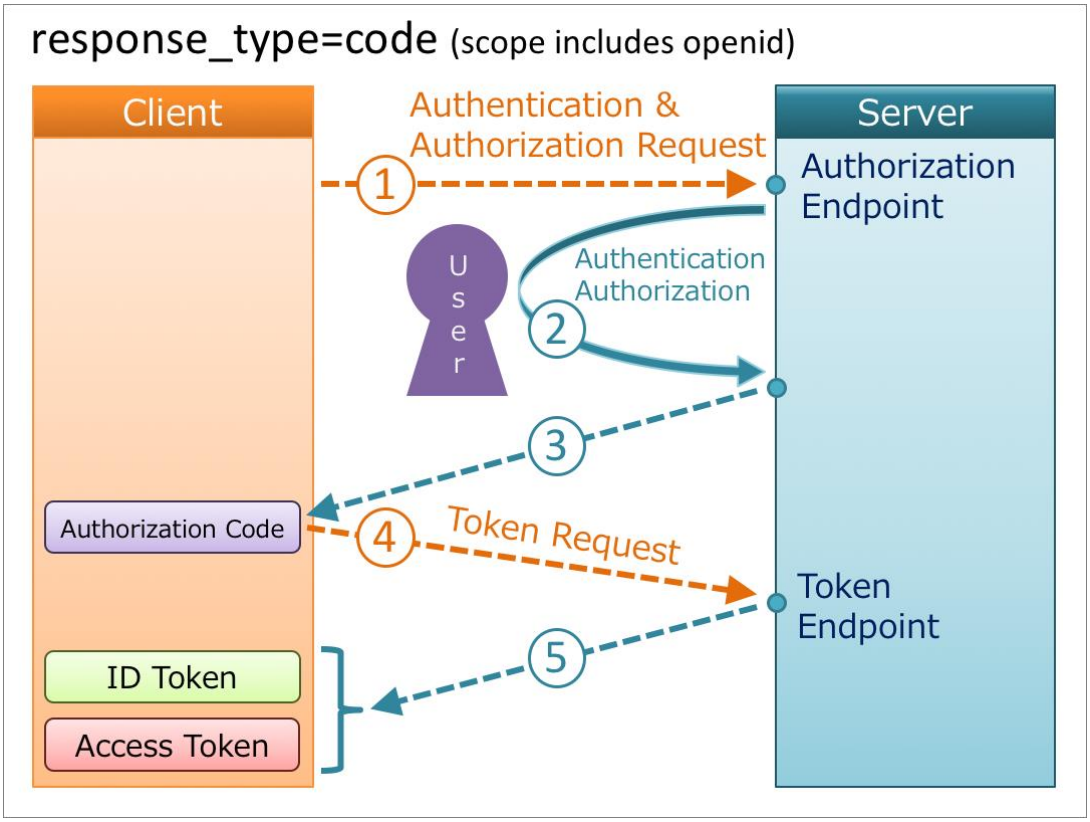

Figure 6. OpenID authorization mechanism

The value of Keycloak's functionalities in real-world applications is further explored by Keycloak Authors (2023). This comprehensive guide provides practical insights into integrating Keycloak into web applications. It details various aspects of Keycloak, including setup, configuration, and customization, making it a useful resource for developers and IT professionals. This involved configuring user roles and permissions, tailoring the login interface to match the platform's design, and setting up user identity brokering to integrate with existing user databases.

In summary, the integration of Keycloak into the application highlights its indispensable role in the realm of digital authentication and security. Its adaptability, reliability, and versatility made it an ideal choice for the application, addressing the complex security needs of a modern digital platform. This integration not only ensured data security but also aligned with the ongoing advancements in digital security, positioning the application at the forefront of secure, user-centric digital experiences.

4.3 Load Management and Cloud-based Architecture

Dockerization, a crucial component of the project, involves encapsulating an application within Docker containers. These containers are lightweight, standalone packages that include everything

necessary to run the application: code, runtime, system tools, libraries, and settings. Dockerization ensures the application runs uniformly across various computing environments. This methodology, enhanced by Kaniko (GoogleContainerTools/Kaniko 2023), a tool for building container images from Dockerfiles, enabled the team to create these containers consistently and securely (see Figure 7). (Docker 2024.)

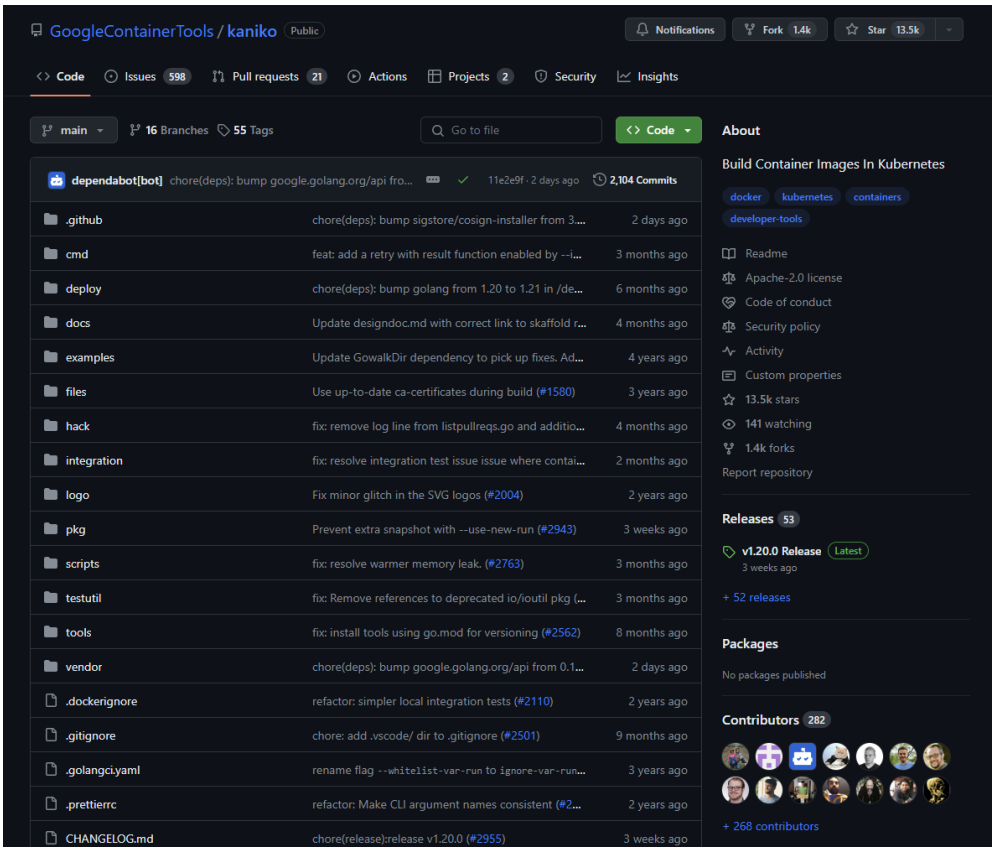

Figure 7. Kaniko GitHub repository

Dockerization is a process that revolves around using Docker (Docker 2023), a technology that packages applications and their dependencies into containers. A container is like a lightweight, standalone package that contains everything the application needs to run: its code, a runtime environment, system tools, libraries, and settings. This encapsulation ensures that the application can run consistently and reliably across different computing environments, be it a developer's laptop or a high-end server (see Figure 8).

```
# Build stage
FROM node:20.8.1 as build-stage

WORKDIR /app

COPY package*.json ./

RUN npm install

COPY ./ .

# Add build-time variables
ARG NODE_ENV
ARG VUE_APP_API_ENDPOINT
ARG VUE_APP_REALM

# Set environment variables
ENV VUE_APP_API_ENDPOINT=$VUE_APP_API_ENDPOINT
ENV VUE_APP_REALM=$VUE_APP_REALM

# Print build-time variables
RUN echo "NODE_ENV: $NODE_ENV"
RUN echo "VUE_APP_API_ENDPOINT: $VUE_APP_API_ENDPOINT"
RUN echo "VUE_APP_REALM: $VUE_APP_REALM"

# Rename the .env file
RUN cp .env.${NODE_ENV} .env


RUN npm run build

# Production stage
FROM nginx as production-stage

RUN mkdir /app

COPY --from=build-stage /app/dist /app

COPY nginx.conf /etc/nginx/nginx.conf
```

Figure 8. Dockerfile code

Dockerfiles are crucial in this process. They are simple text files that contain a set of instructions to automatically build a Docker container image. These instructions can include specifications on what base image to use, which files to include in the container, what commands to run during the build process, and more. Essentially, a Dockerfile is a blueprint for creating a Docker container.

Kaniko, developed by GoogleContainerTools (2023), is a tool that builds container images from a Dockerfile, but with a difference. Unlike traditional Docker builds which require a Docker daemon, Kaniko does not need one, allowing for builds in environments where running a Docker daemon is not possible or desirable. This feature makes Kaniko particularly useful for building Docker images securely and efficiently in cloud environments or continuous integration pipelines (see Figure 7).

In the project, Dockerization was key to ensuring that the application could be deployed and run in any environment without any compatibility issues. By using Docker and Kaniko, the team was able to create and manage container images securely and consistently. This allowed for an efficient de-

ployment process and made sure that the application's environment was predictable and controlled, minimizing the "it works on my machine" problem often faced in software development.

The project addressed key technical challenges of load management, version control, and cloud-based architecture through a strategic combination of AWS and Dockerization (Varia J. 2014). This approach, supplemented by tools like Kaniko, Harbor, and Rancher, streamlined the application's deployment process, ensuring scalability and efficiency.

In the context of the project, which tackled challenges in load management, version control, and cloud-based architecture, the integration of tools like Harbor (Harbor Authors 2023) and Rancher (Rancher 2023) played significant roles in enhancing the deployment process.

Harbor is an open-source container image registry. In the world of Docker and containerization, a container image registry relates to a library where images are stored and managed. Harbor allows teams to securely store and manage their Docker images. It provides features like image vulnerability scanning, user access control, and activity auditing, making it an invaluable tool for maintaining a secure and orderly collection of container images. By using Harbor, the project ensured that all the Docker images were organized and easily accessible, which is critical for version control and efficient deployment of applications (see Figure 9).

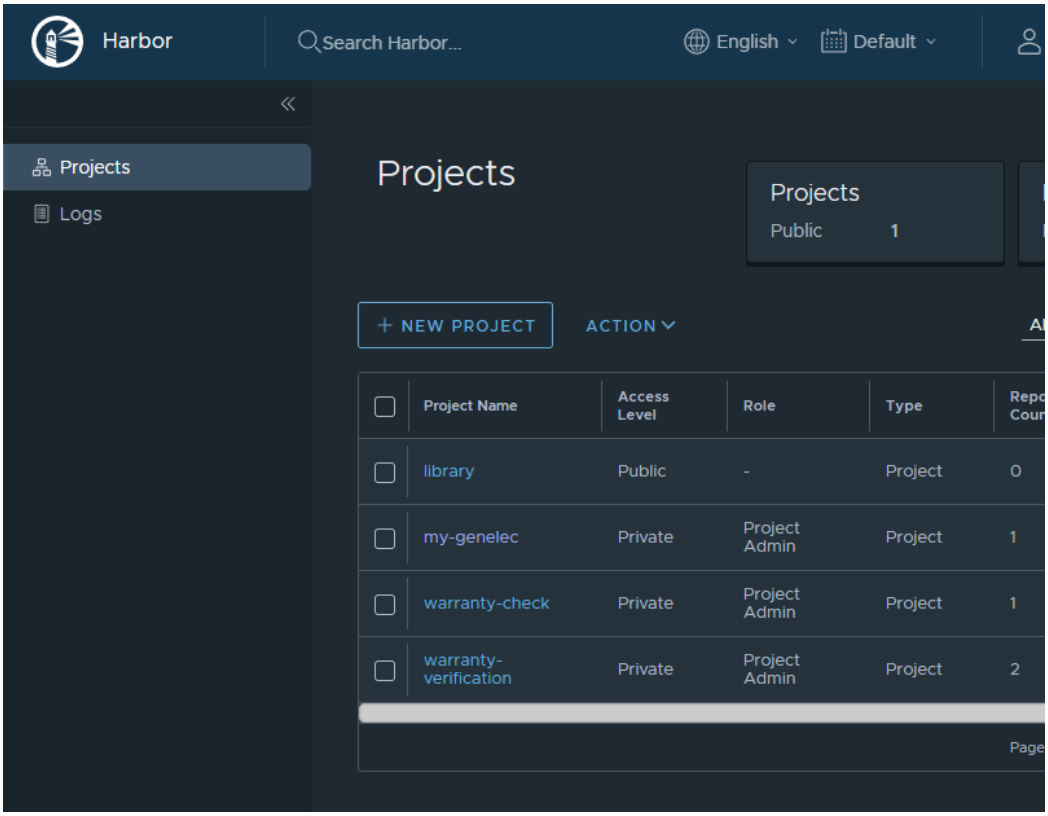

Figure 9. Harbor management application

Rancher, on the other hand, is an open-source container management platform. It simplifies the deployment and running of Kubernetes (Kubernetes Authors 2023), which is an orchestration system

for containers. Think of Rancher as a layer that provides additional tools and services to make managing Kubernetes clusters more user-friendly. With Rancher, you can deploy, manage, and scale your Kubernetes environments across multiple clusters from a single control point. It also offers features like load balancing, monitoring, and logging, which are essential for maintaining the health and performance of containerized applications.

In the project, Rancher was used to orchestrate the deployment and management of the application's containers in the AWS. By utilizing Rancher, the team could efficiently manage the complexities associated with running the application at scale. This included handling aspects such as automated rollouts, rollbacks, scaling, and health monitoring of containers, ensuring the application remained stable and responsive under varying load conditions (see Figure 10).

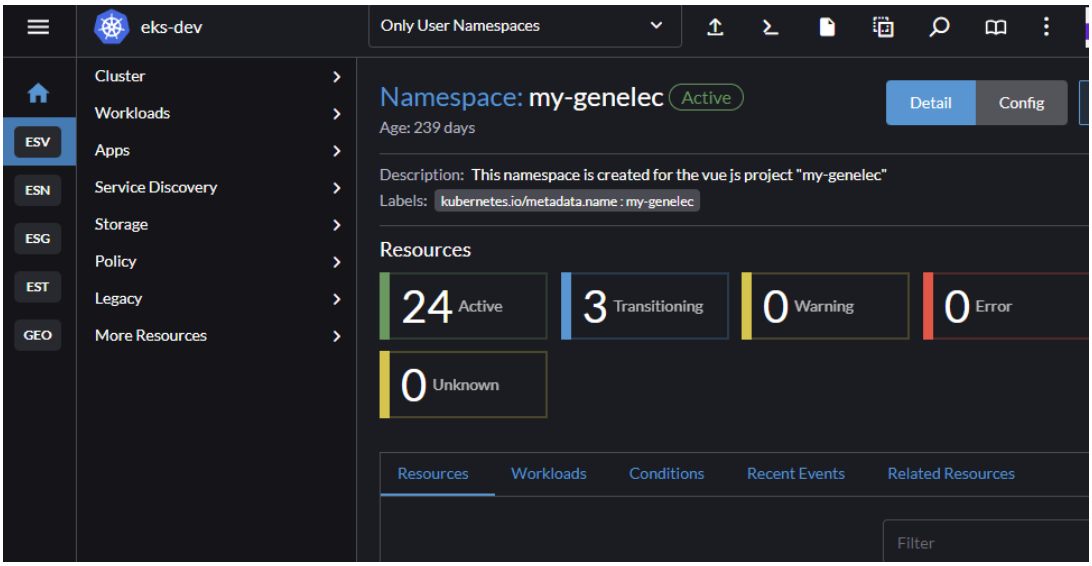

Figure 10. Rancher management application

In summary, the combination of Harbor and Rancher with Dockerization and AWS infrastructure was strategic in overcoming the project's technical challenges. Harbor managed and secured Docker images, while Rancher facilitated the efficient orchestration of these containers within the cloud environment. This comprehensive approach enabled streamlined deployment processes, bolstered scalability, and enhanced overall operational efficiency.

The Continuous Integration and Continuous Deployment (CI/CD) pipeline of GitLab (GitLab B.V. 2023) automates the process of building, testing, and deploying the application. When changes are committed, the pipeline triggers the process. It retrieves the containerized application image from Harbor and deploys it to the AWS cluster. The AWS cluster, a collection of cloud resources, hosts the application, ensuring it can handle varying loads and traffic (see Figure 11).

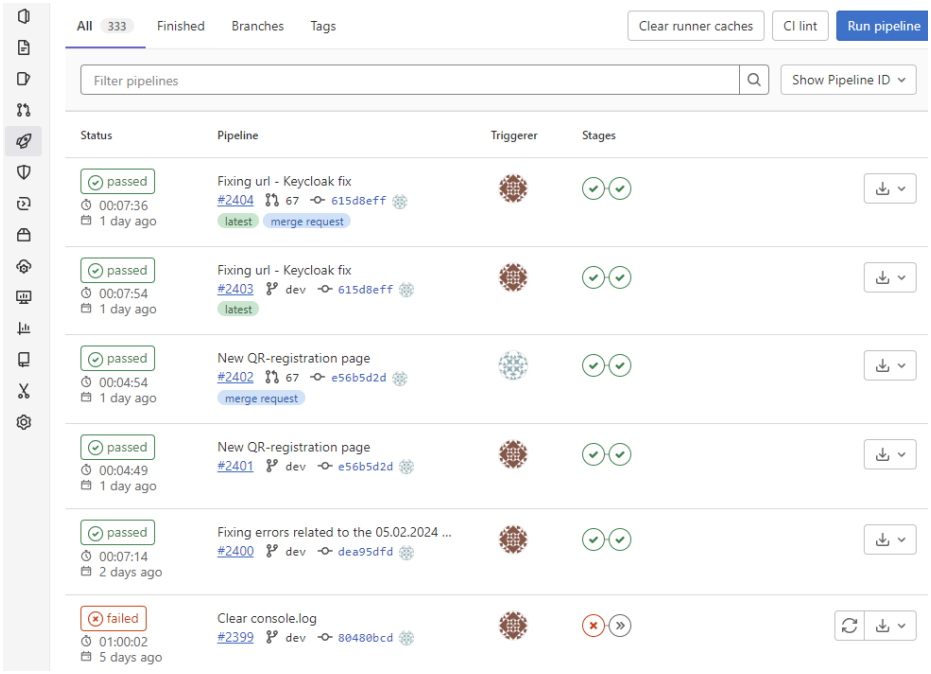

Figure 11. Pipeline in GitLab for MyGenelec Project

The scalability of the cloud-based architecture is a fundamental component in the design and functionality of applications. Utilizing Amazon Web Services (AWS), this feature allows for the dynamic adjustment of resources in response to varying demands, which is essential for optimal performance, especially during peak usage times.

AWS's scalability ensures that resources are not only available when needed but can also be scaled down during quieter periods, leading to cost-effective management. This flexibility is crucial for adapting to fluctuating user traffic without compromising the efficiency or speed of the application. It also eliminates the need for extensive physical infrastructure, which can be both costly and inflexible.

Moreover, scalability contributes significantly to the user experience. By managing high traffic, it ensures that users experience minimal delays or disruptions, maintaining the integrity and reliability of the application. This is particularly important for platforms, where user engagement and satisfaction are closely tied to the application's performance.

Operational costs are also positively impacted by scalable cloud architecture. The ability to scale resources to match demand means that the company only pays for the resources it uses. This pay-as-you-go model is a cost-efficient alternative to maintaining a static level of resources that may not always be necessary.

In summary, the scalability of the cloud-based architecture in the project, powered by AWS, plays a valuable role in ensuring that the application remains responsive, cost-effective, and user-centric. It exemplifies the adaptive capabilities of modern digital platforms, ready to meet the demands of a dynamic user base and the ever-changing digital landscape.

4.4 Creating of the design

The design of the project played a valuable role in its success, serving as the visual embodiment of the platform's features and functions. It was essential for the design to resonate with the company's established brand aesthetics while highlighting innovation and a forward-thinking digital approach.

The initial appearance design, created in 2022 by the team of designers at Genelec, as depicted in Figure 12, prominently featured company's signature colours and fonts, providing an immediate connection to the brand's identity. However, the evolution of the design was marked by significant changes, influenced by various factors, including a shift in the design team. This transition is evident in Figure 13, where the design moved from sharper to more rounded elements, reflecting a modern aesthetic more in tune with the evolving digital landscape. The changes were made by new user interface (UI) designers at the company.

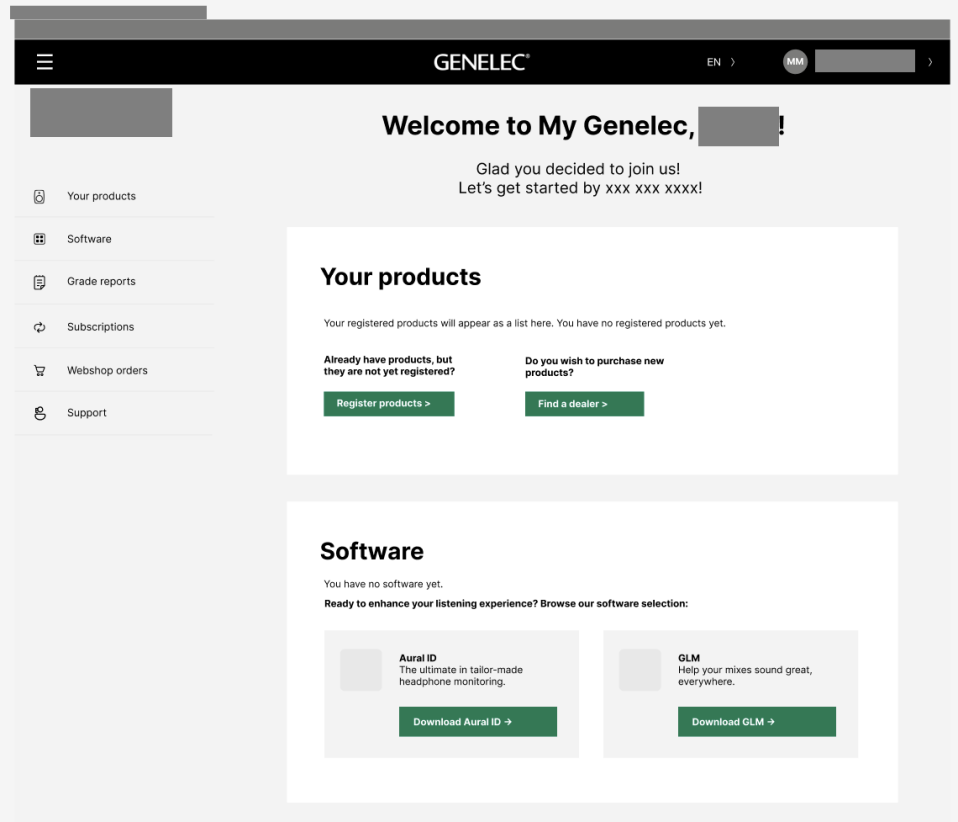

Figure 12. Initial design mockup

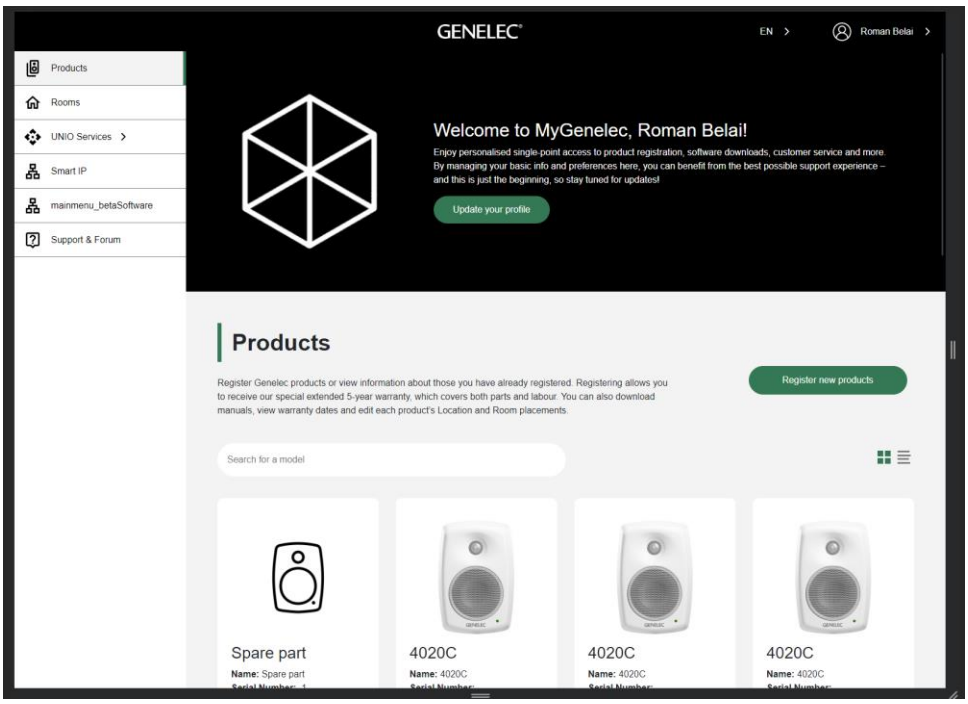

Figure 13. Design of the main page (October 2023)

This evolution was not just about aesthetics but also function. As the platform expanded its feature set, the design adapted to accommodate these new functionalities. This dynamic process underscored the need for flexibility in design to maintain harmony and user-friendliness among ongoing platform growth.

The evolving technology's impact on user expectations was also a key consideration. The design team kept abreast of emerging trends like mobile-first design, responsive interfaces. These contemporary insights ensured that portal's design remained relevant and effective in meeting the changing needs and preferences of its users.

To achieve cross-platform compatibility, three distinct versions of each mock-up were created, catering to mobile, tablet, and desktop formats. Subsequently, each component and page received tailored styling to ensure equal functionality across these different platforms. While most browsers share commonalities, occasional differences can appear, impacting the user interface. To address these issues, the application went through testing across various browsers. This process identified unique browser-specific challenges, leading to the development of additional code to rectify these differences and maintain a consistent user experience.

The author took part in design development in 2023, assisting UI designers in improving the design of the application by sharing the experience and offering new solutions during the development.

In summary, the design of the application was a testament to the importance of adaptability, user-centeredness, and responsiveness in the development of digital platforms. It highlighted the crucial role of design in not just representing a brand but also in enhancing user engagement and experience in the digital domain.

4.5 Specific Functionalities

The application is designed to consolidate most external services into a single, centralized location. Below are described the key functionalities and features that the platform is equipped to provide, in response to the identified requirements.

4.5.1 Product Registration

Central to the platform offerings is the product registration feature. It empowers users to seamlessly add new products to their accounts, unlocking access to associated software and warranties. This feature is valuable in ensuring users maximize the benefits of their products.

Product registration works so, that when users would like to register their product into the system to get access to all benefits, they must write the serial number to the input (see Figure 14).

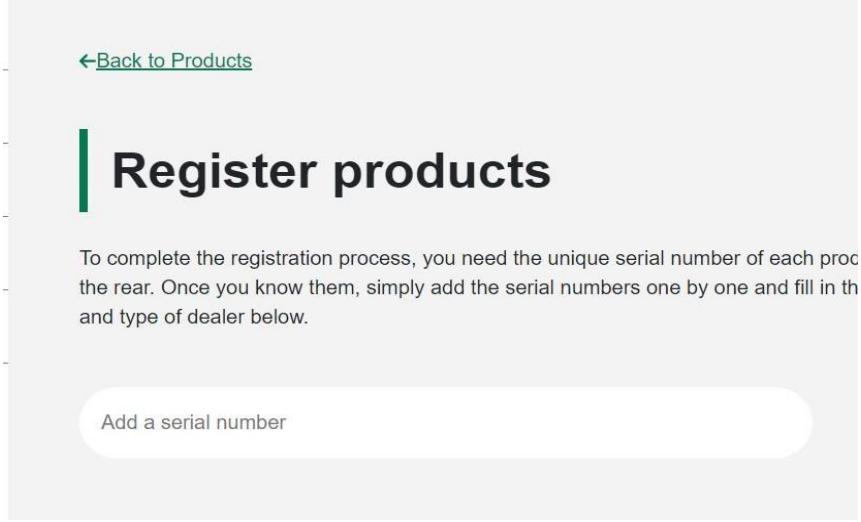

Figure 14. Register products page – input

When the button "check serial number" is clicked there are several functions are launched.

First of all, the application checks if this serial number exists, and is not registered. This is made using a common function (see Figure 15).

```
async function checkProduct(serialnumber, setErrorMessage) {
  const url = `${process.env.VUE_APP_API_ENDPOINT}/product-registry/check-product-serial?serial=${serialnumber}`
  return axiosInstance
    .get(url, {
      headers: getHeaders(),
    })
    .then((response) => {
      if (response.data.results[0].product_exists === true) {
        if (response.data.results[0].is_registered === false) {
          getProductInfoAndAddToStore(serialnumber);
        } else {
          setErrorMessage("Product is already registered");
        }
      } else {
        setErrorMessage("Product does not exist");
      }
    })
    .catch((error) => {
      if (error.response && error.response.status === 500) {
        setErrorMessage("Error during serial number check. Please try again");
      }
      console.error("Error checking the product:", error);
      throw error;
    });
}
```

Figure 15. "checkProduct" function

After that, the product is added to the centralized state management system, commonly referred to as the "Vuex" store. This is the place where the special data is stored and is accessible from all over the application. In the case of registration, this store is used to fill the table, where the user can see the products which are waiting to be registered (see Figure 16).

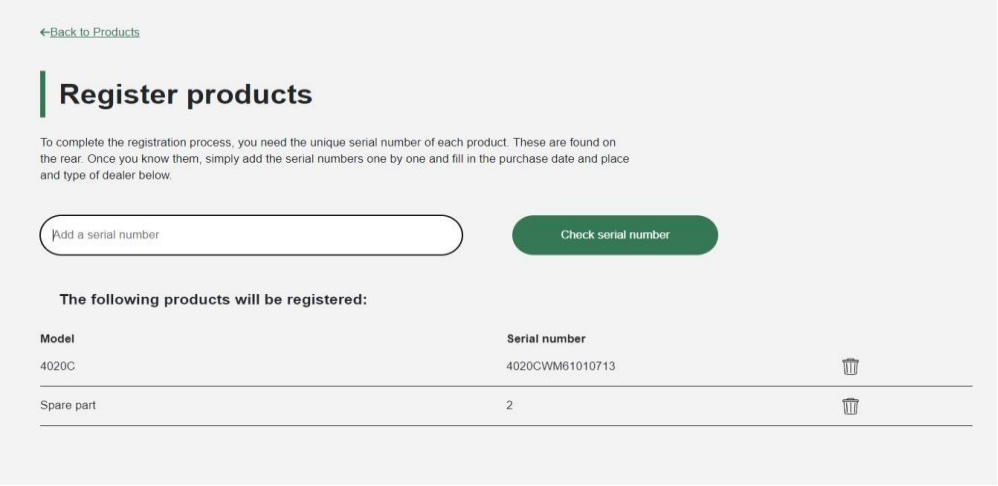

Figure 16. Register products page

If the user decides not to register the products which were added, then they could be easily removed by clicking the delete icon button. As soon as there are any products in the table, the second part of the page is available (see Figure 17).

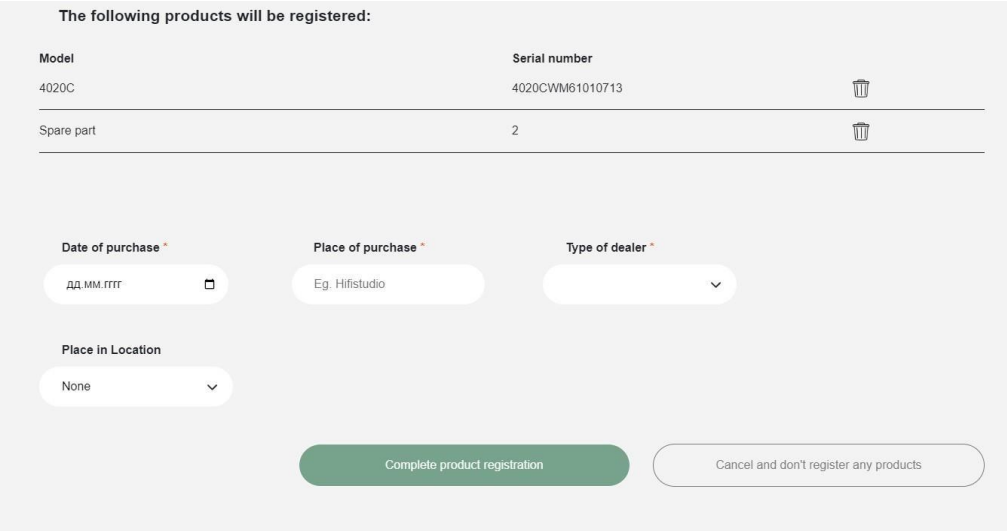

Figure 17. Product registration fields

In the second part, all the required information for the registration is marked by a red star and it could be filled there to finish the registration. The user cannot click the button "complete product registration" until all the required information is filled. Once everything is done, the button will be green and available to click. When the button is clicked, the function "addProductToUserAccount()" is launched (see Figure 18).

```
async function addProductToUserAccount() {
  const organization = store.state.userData.private_organization_id;
  const url = `${process.env.VUE_APP_API_ENDPOINT}/product-registry/register-products`;

  const products = store.getters.getPreRegisteredProducts.map((product) => ({
    place_of_purchase: product.place_of_purchase,
    purchase_date: product.purchase_date,
    serial_number: product.serial_number,
    type_of_place: product.type_of_place,
    room: product.room,
  }));

  const requestData = {
    organization,
    products,
  };

  try {
    await axiosInstance.post(url, requestData, {
      headers: getHeaders(),
    });
    // console.log(response.data);
  } catch (error) {
    console.error(error);
    throw error;
    // store.commit(
    //   "setErrorMessage",
    //   error.config.url + " " + error.response.data
    // );
  }
}

```

Figure 18. "addProductToUserAccount" function

It collects all the information the user has given to it and uses it in the request. Finally, if there were no errors during the request, new products are visible in the tab products.

4.5.2 Product Listing

The application's dashboard provides a holistic view of the user's product portfolio. Here, users can view product images, warranty expiration dates, and, if applicable, the room allocation for each product (see Figure 19). Additionally, a dedicated option allows users to access product manuals with a single click. For bulk actions, users can select multiple products, facilitating operations like batch allocation or deletion (see Figure 20). To cater to varied user preferences, products can be displayed in either a grid or list format (see Figure 19 and Figure 21). The search bar works with different values like model or serial numbers.

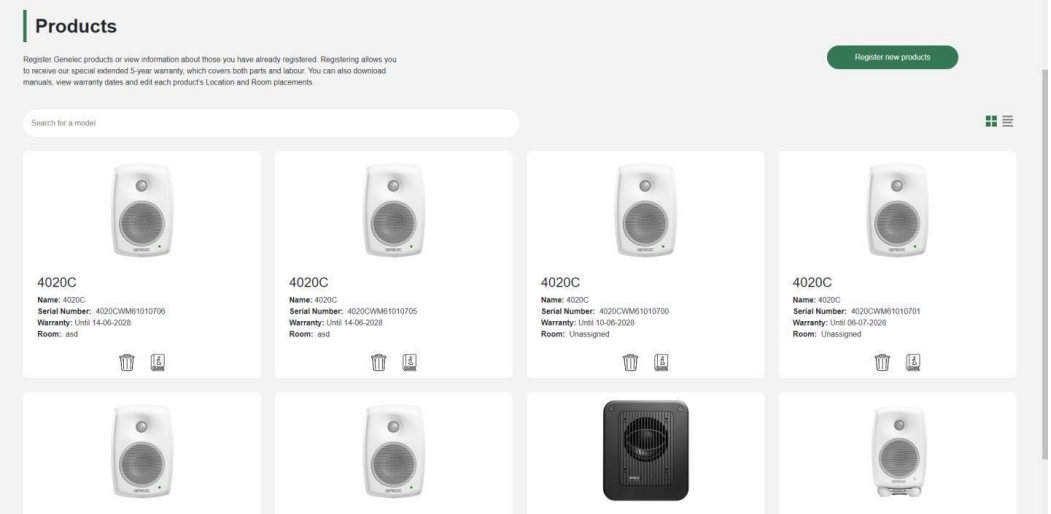

Figure 19. Layout for the grid view

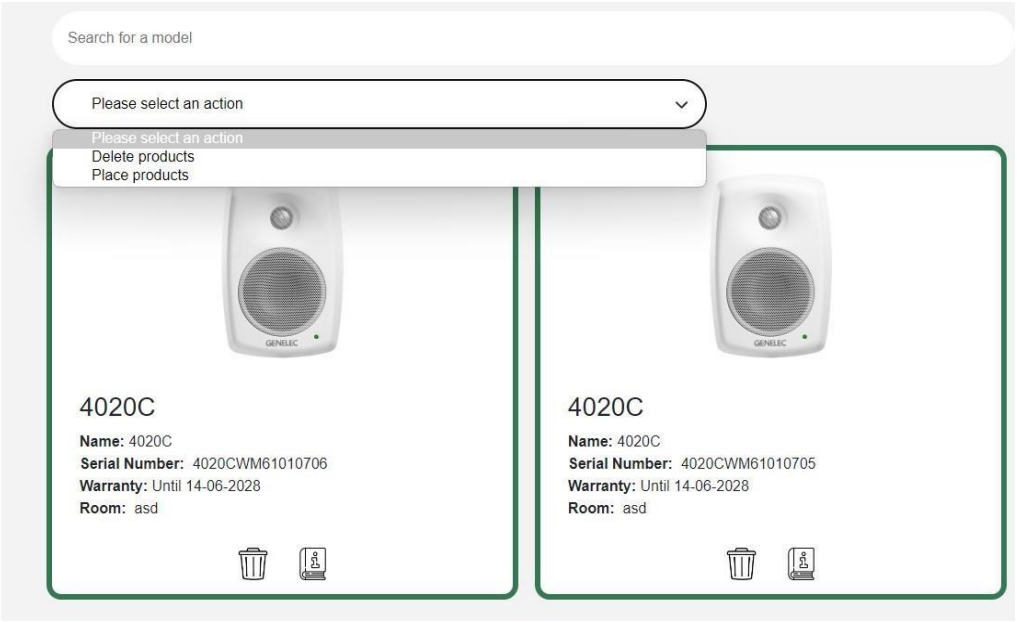

Figure 20. Layout showing the "Delete" call-to-action button

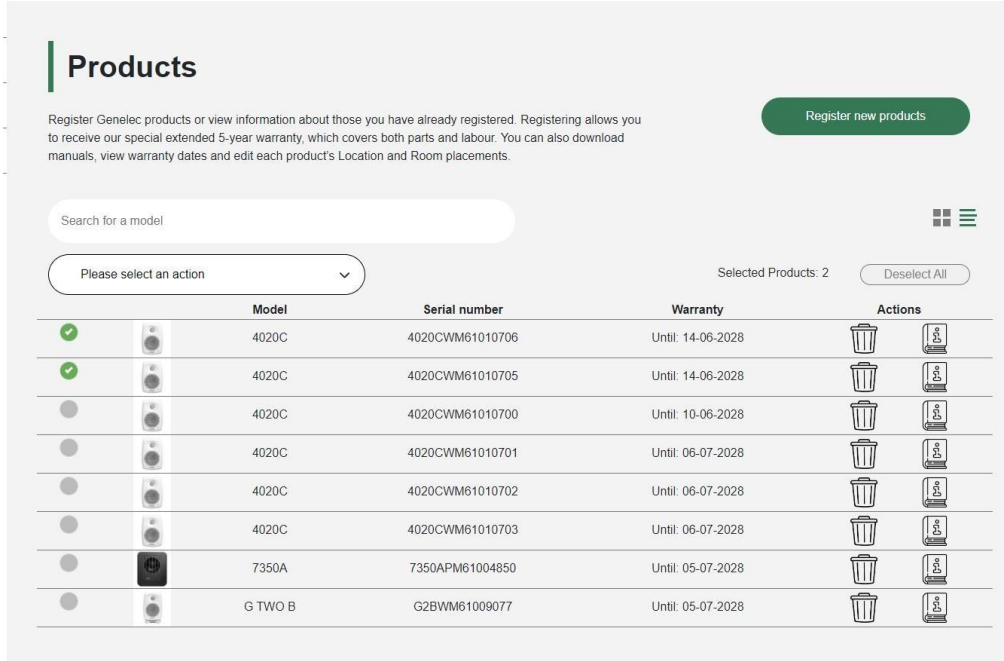

Figure 21. Layout for the list view

4.5.3 Room Allocation

The “Rooms” feature on the platform provides customers with functions like organizing products, setting up locations, and creating rooms. This feature is designed to offer a clear display of products and quick access to information about them. For example, when the location with a room is created, there could be added products and then it is possible to get all information about the product from the rooms page. If there is a need to get the serial number of the product, then the user can simply see what products are added to the room and their full information. The functionalities of the "Rooms" page are limited right now because it is a new feature, there is still development regarding this section.

Future updates may allow users to arrange products using a grid system, enabling them to view GLM (Genelec Oy 2023) information directly on the page (see Figure 22).

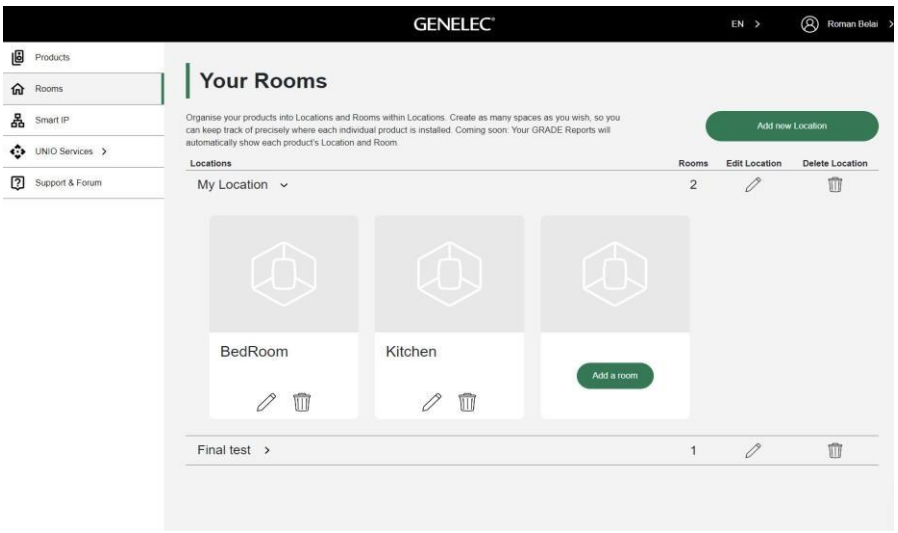

Figure 22. Layout design for the Rooms page

Rooms page is a new feature that the company did not have before. There was written a lot of code for this page at the back and front ends. To add a new location the user must click "Add new Location". It will open a modal window, where the user can fill in the required information (see Figure 23).

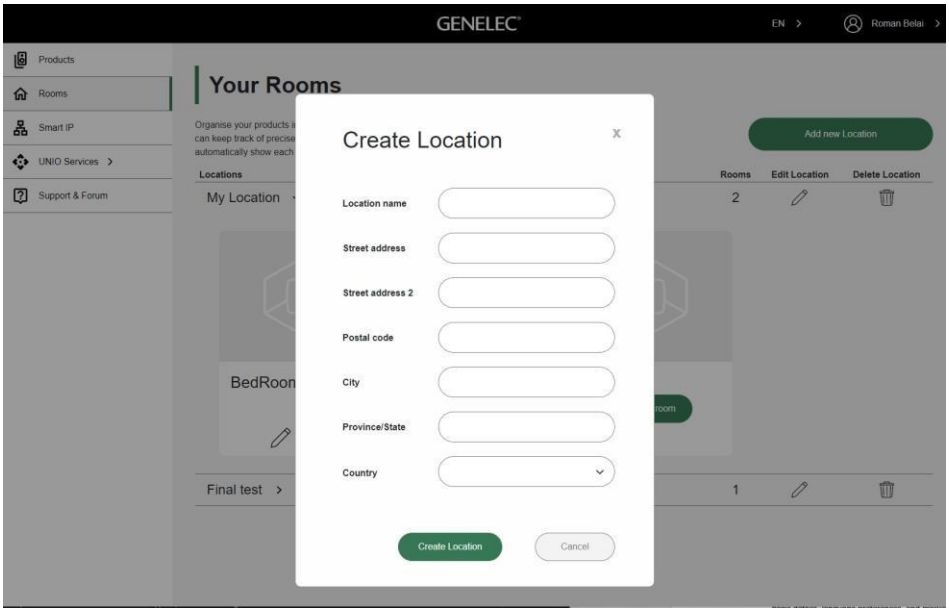

Figure 23. Create location layout modal window

If the user decides to click "create location" earlier than filling in the data, then there will be an error message under the required inputs (see Figure 24).

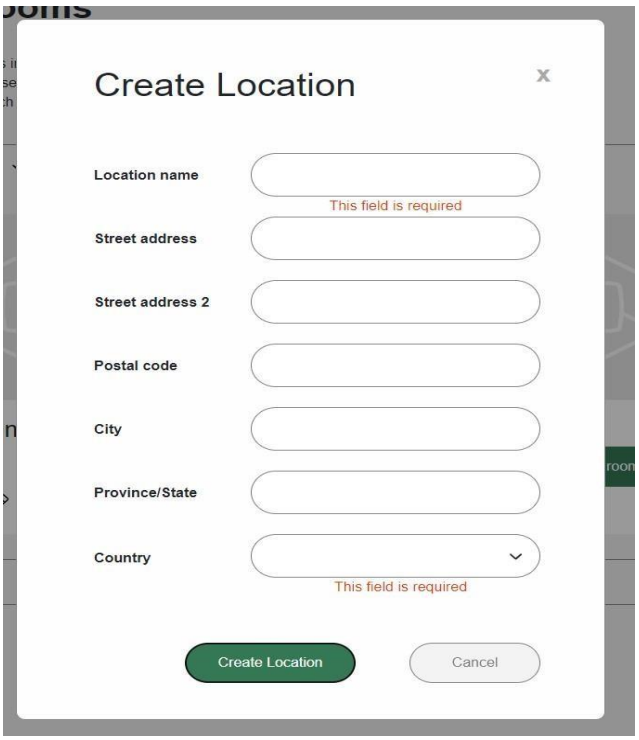

Figure 24. Required fields are indicated to the customer using the red text

It was achieved using the "vee-validate" plugin (Logaretm 2023). The rules are defined in the "main.js" file (see Figure 25).

```
defineRule("required", (value) => {
  if (!value || !value.length) {
    return i18n.global.t("error_required");
  }
  return true;
});

defineRule("lengthBetween", (value, [min, max]) => {
  if (value.length < min || value.length > max) {
    return i18n.global.t("error_lengthBetween", { min, max });
  }
  return true;
});

defineRule("noLeadingSpace", (value) => {
  if (value.startsWith(" ")) {
    return i18n.global.t("error_noLeadingSpace");
  }
  return true;
});

defineRule("email", (value) => {
  // Check if email
  if (!/[A-Z0-9._%+-]+@[A-Z0-9.-]+\.[A-Z]{2,4}/i.test(value)) {
    return "This field must be a valid email";
  }
  return true;
});
```

Figure 25. Defining rules for vee-validate

"Vee-validate" is a very good plugin and is used in almost all forms.

After creating the location, the first room is auto generated. This room could easily be edited by clicking a pencil button or removed by clicking the trash bin button (see Figure 26).

Figure 26. Edit and delete button-icons

Also, it is possible to enter the room if the user clicks the room (see Figure 27).

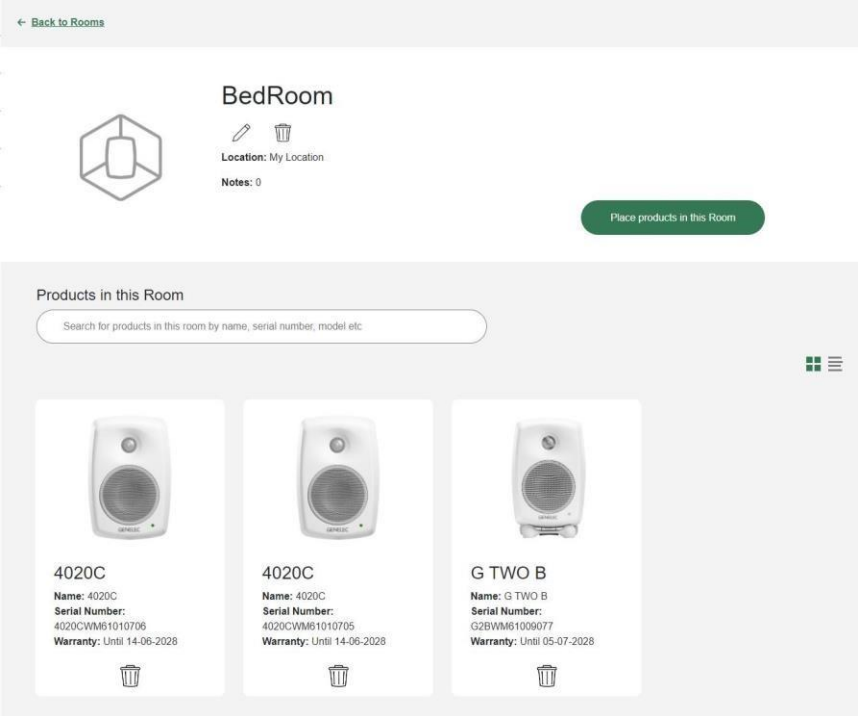

Figure 27. Room information page

The user can assign products to the rooms when a new room is being created or after creating right in the room page (see Figure 28 and Figure 29).

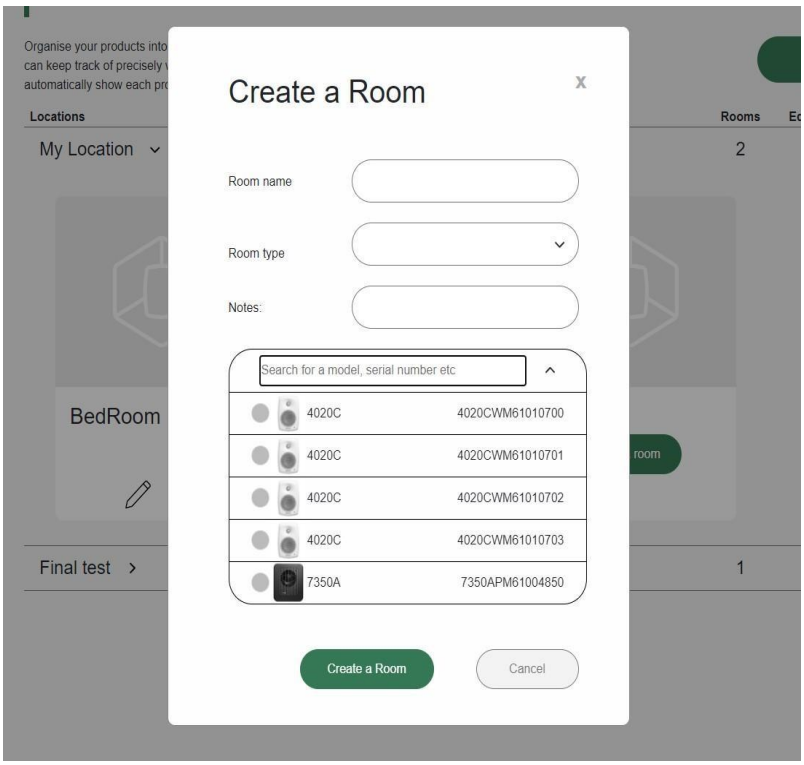

Figure 28. Assigning products to the room from Room page

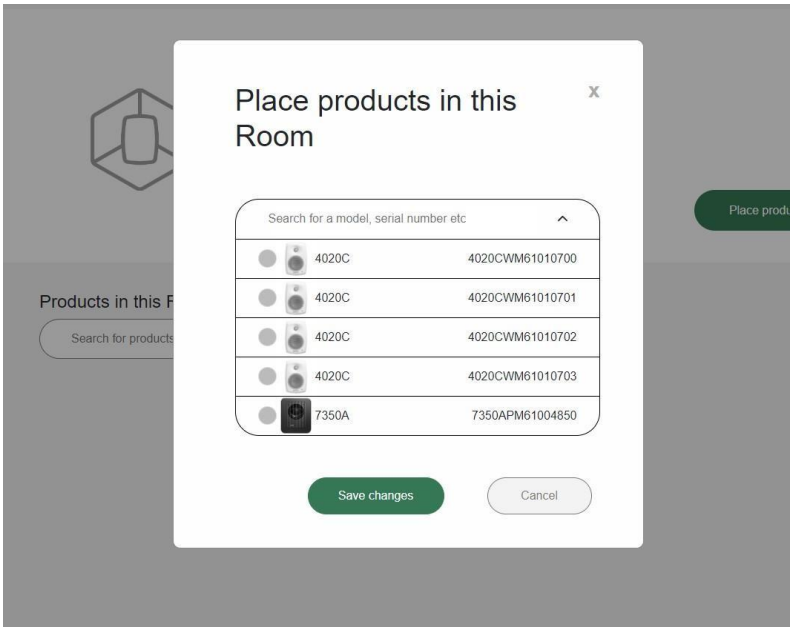

Figure 29. Assigning products to the room from Room information page

This page is still in development mode. That means that there will be much more operations with this page in the future.

4.5.4 Software Access

The software page serves as a gateway to software and plugins associated with products like GLM and Aural ID (see Figure 30) (Genelec Oy 2023). However, access to this page requires users to complete their profile information, ensuring a personalized experience.

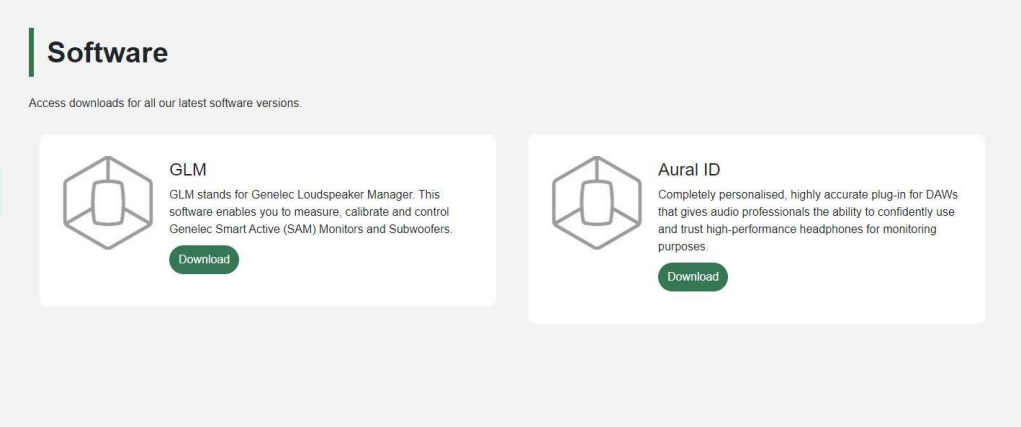

Figure 30. Software page

4.5.5 User Profile Management

The profile section allows users to modify the information provided during registration. This includes basic details, language preferences, and marketing communication settings. As mentioned earlier, the Software page depends on the Profile page. On this page, the user can easily choose the language, and marketing preferences and fill in information (see Figure 31).

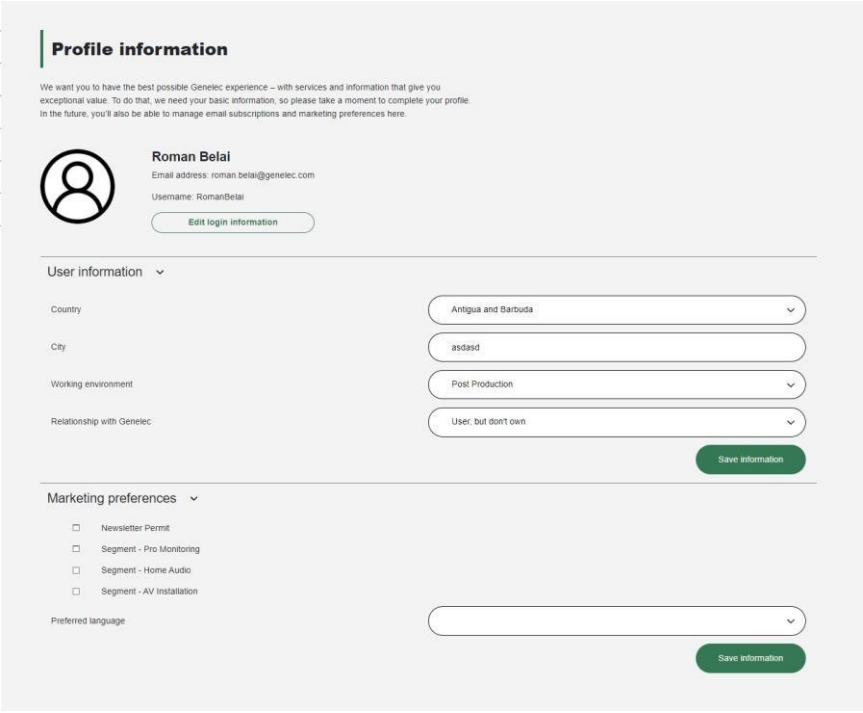

Figure 31. Profile page

4.5.6 Support Portal

For users seeking assistance, the support page redirects them to the company's support portal, ensuring they receive expert guidance (see Figure 32).

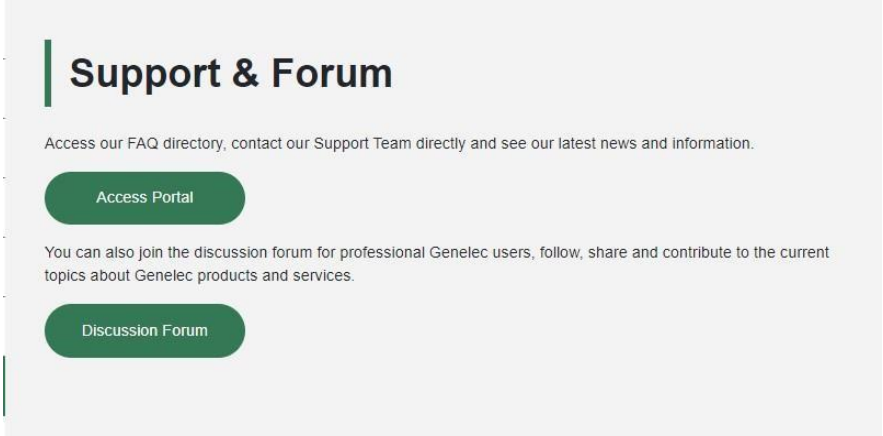

Figure 32. Support and forum page

4.5.7 QR Code Based Product Registration

The QR code-based registration feature facilitates product registration by scanning a QR code using a mobile device with a camera and ability to read QR codes. This initiates a streamlined registration process, marking products with a "pending registration" status and listing them on the registration page (Aric Boyles 2012).

The QR code registration process in the application is designed for efficiency and user convenience. Here's how it works:

1. Scanning the QR Code: When a user scans the QR code on a Genelec product, it is designed to capture the serial number of the product. Typically, this serial number is included at the end of the URL encoded in the QR code.
2. Redirection to the New Portal: After scanning, the user is initially directed to Genelec's original QR registration site. However, they are immediately redirected to the new portal. During this redirection, the serial number is seamlessly transferred along with the redirection URL.
3. Serial Number Extraction: Upon landing on the new portal, the application automatically extracts the serial number from the URL parameters. This number usually comprises the last few characters of the URL.
4. Pre-Registration: The extracted serial number is then automatically added to a pre-registration list within the application. This step is illustrated in Figure 33, which provides a visual representation of how the serial number is identified and listed in the application.

This process streamlines the registration experience for users. By automatically fetching and processing the serial number from the QR code, the application reduces manual input and potential errors, making the registration process quick and hassle-free.

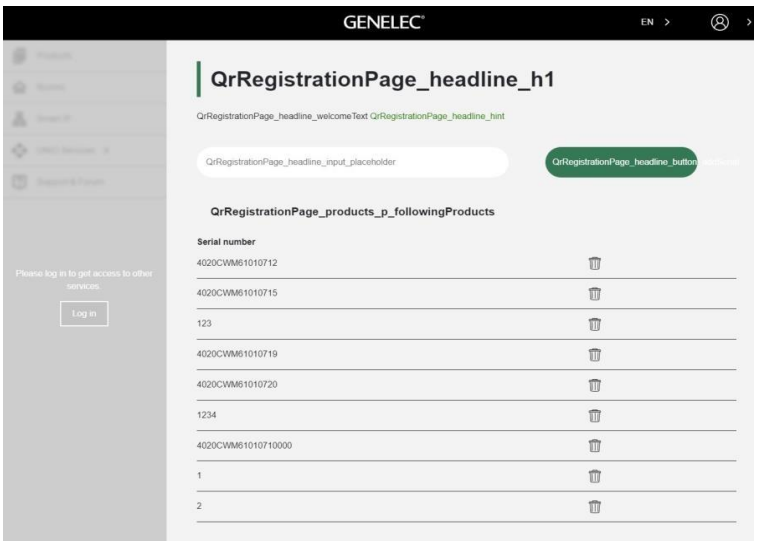

Figure 33. QR code based product limited registration page

The user does not see it but the QR code is taken from the link as a parameter and added to local storage of the browser (see Figure 34).

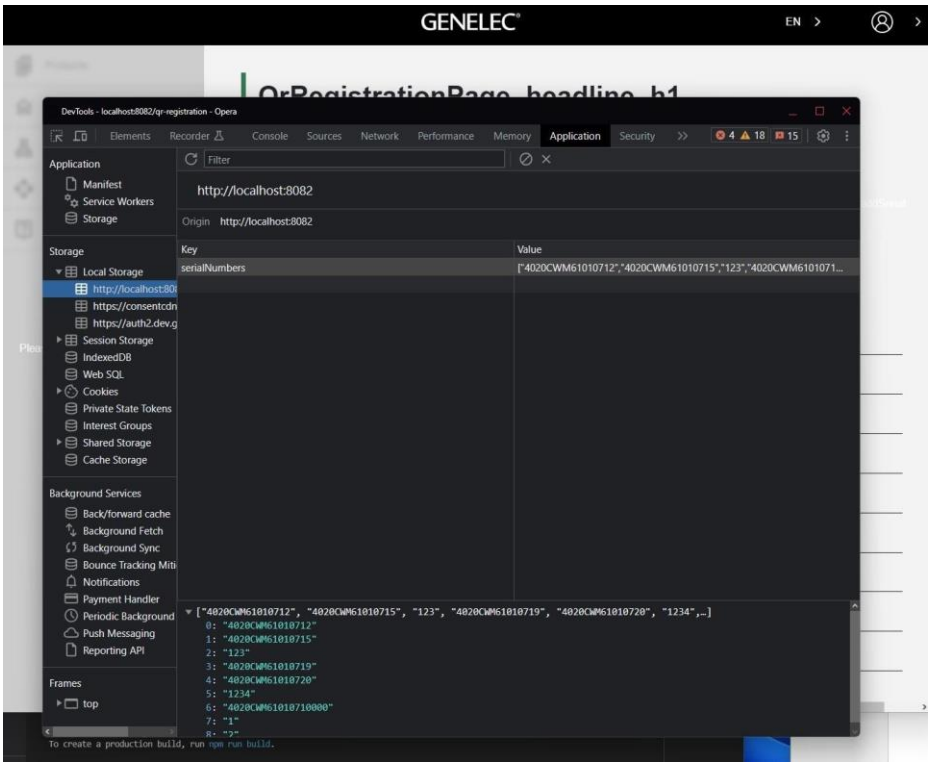

Figure 34. Local storage shown in DevTools (Google 2023) application in the Opera Gx browser (Opera 2023)

The application's QR code registration feature is designed to enhance user convenience through the use of local storage. This functionality addresses two key user scenarios:

- If a user accidentally closes the browser page during the QR code scanning process, the serial numbers extracted from the QR codes are not lost. Instead, they are saved in the browser's local storage. When the user reopens the page, the application retrieves these serial numbers from the local storage, ensuring that the user can continue the registration process without having to rescan the QR codes.
- When a QR code is scanned, it may trigger the opening of a new page in the browser. In such instances, the standard state management tool of the application, Vuex, cannot maintain the scanned information across page reloads or new pages. To overcome this limitation, scanned QR codes are stored locally. This means that even if the page is refreshed or a new page is opened, the scanned information is retained.

Furthermore, there is a distinction in how the application handles product registration through QR codes versus manual product registration

- When QR codes are scanned and an email address is entered, the products associated with those QR codes are pre-registered to the user's account. This pre-registration is done using an endpoint, as shown in Figure 35. This process assigns the products to the customer in the database, linking them with the provided email address.
- In contrast, when products are registered manually on the product registration page, they are added to the Vuex store. This means the registration is temporarily held in the application's state. However, if the user refreshes the page, these manually added products will not be retained, as they are only stored in the Vuex store and not yet committed to the database.

```
144  async function postPreRegisteredProducts(preregisterredproducts) {
145    const url = `${process.env.VUE_APP_API_ENDPOINT}/product-registry/pre-register-products`;
146    return axios
147      .post(url, preregisterredproducts, {
148        headers: { "Content-Type": "application/json" },
149      })
150      .then((response) => response.data)
151      .catch((error) => {
152        console.error("Error updating preregisterred products", error);
153        // store.commit(
154        //   "setErrorMessage",
155        //   error.config.url + " " + error.response.data
156        // );
157        throw error;
158      });
159  }
```

Figure 35. "postPreRegisteredProducts" function

4.5.8 Cross-Platform Compatibility

The project involved adapting the platform for three primary types of devices. Consistent performance and rapid loading speeds were the key objectives, alongside ensuring uniform behaviour across different browsers.

The first category focused on mobile devices, typically having screen widths 768 pixels. It was crucial for the application to be compatible across all browsers and operating systems used on mobile devices.

Tablets formed the second category, with an average screen width of 1024 pixels. The requirements for tablet compatibility mirrored those of mobile devices, including browser compatibility and optimized loading times.

The third category was desktop computers, which, while sharing core requirements with mobile devices and tablets, presented unique design and behaviour aspects due to larger screen sizes and different usage patterns. Adapting to these differences while maintaining the application's fundamental functionality was a significant part of the development process. (see Figure 36, Figure 37 and Figure 38).

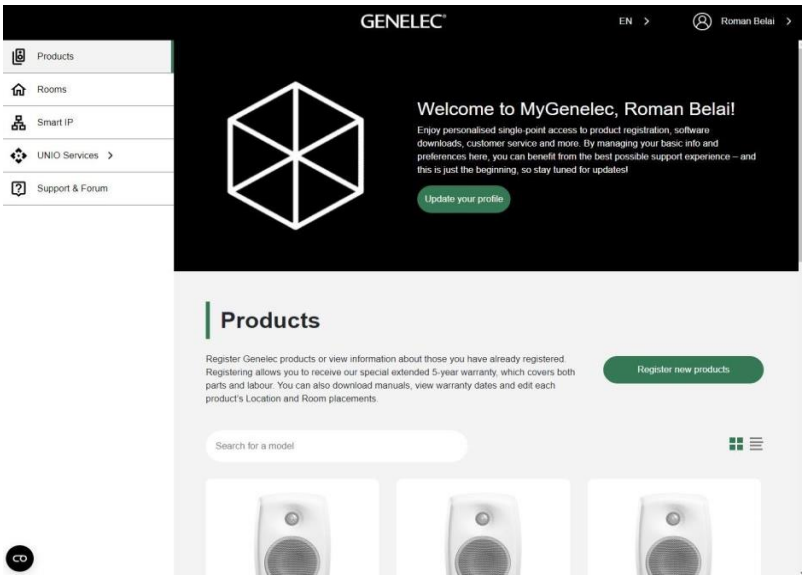

Figure 36. Desktop view of the products page

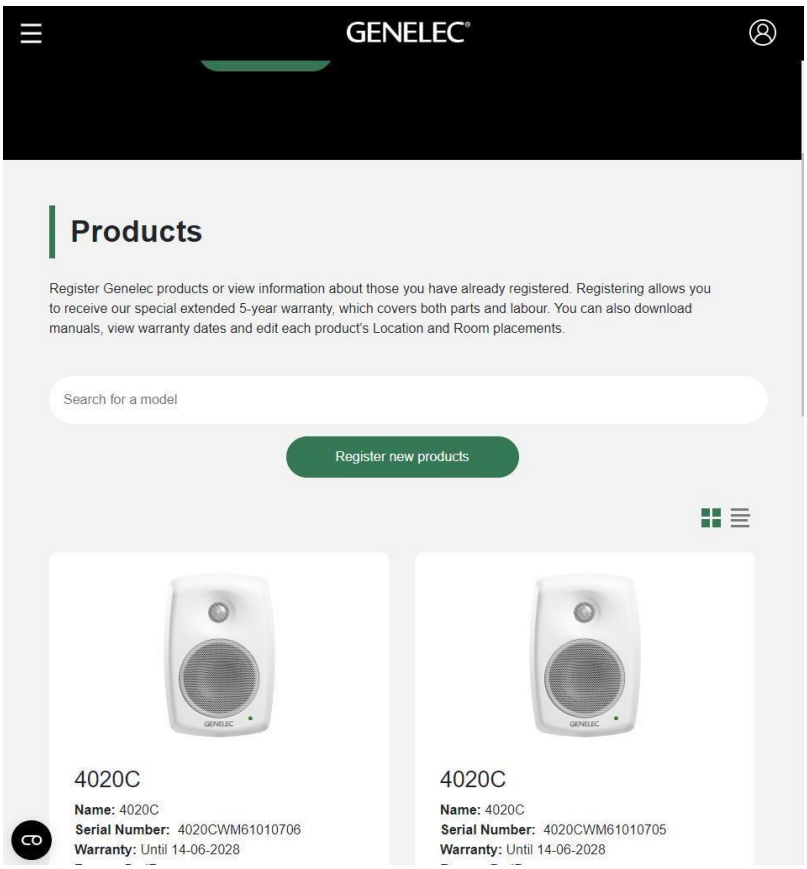

Figure 37. Tablet view of the products page

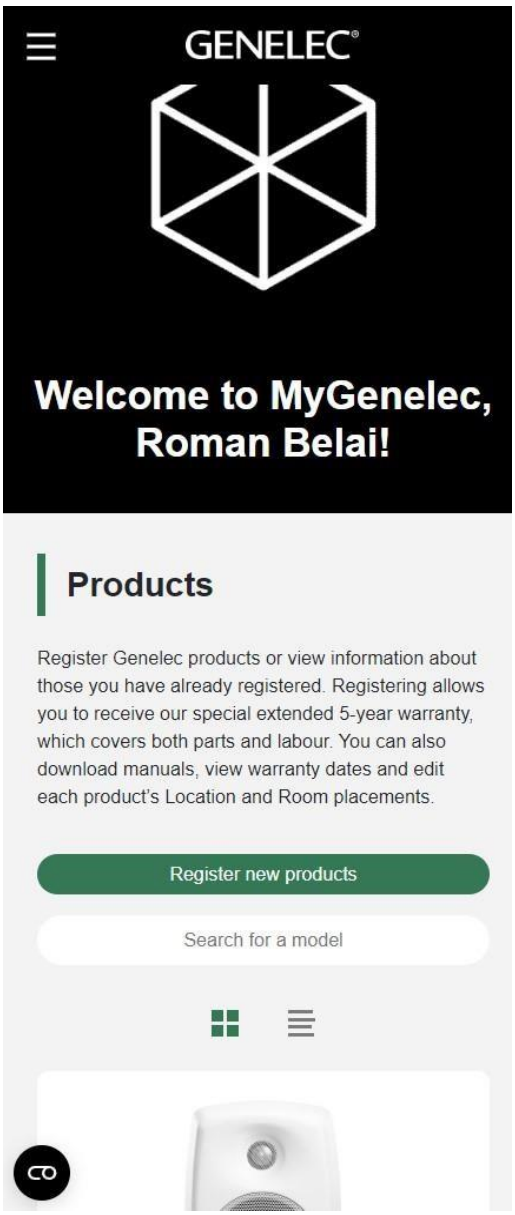

Figure 38. Mobile view of the products page

4.6 Implementation Testing

CI/CD pipeline in the project is strategically divided into three stages: test, staging, and production, each representing a different level of deployment readiness. The test stage ensures the functionality of new changes without bugs or issues. The staging stage replicates a pre-production environment to evaluate performance, while the production stage is where the application is finally deployed for end-user access. This pipeline's design, influenced by methodologies in cloud computing, as discussed by Armbrust et al. (2010) and Varia (2014), ensures that only well-tested changes reach users, maintaining platform integrity and reliability.

The development of the platform benefited from the insights provided by Mell and Grance in "The NIST Definition of Cloud Computing" (2011). Their detailed exploration of cloud service models, including Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS), was instrumental in shaping the project's approach to utilizing cloud technologies. Understanding these service models allowed the development team to effectively leverage Amazon Web Services' extensive capabilities.

This knowledge guided the selection of appropriate cloud services that aligned with the platform's operational needs, ensuring efficient implementation. For instance, IaaS provided the necessary computing infrastructure, PaaS offered a streamlined platform for software development, and SaaS delivered software solutions that were easy to access and use. The application of these cloud models ensured that the portal was built upon a cloud infrastructure that was not only reliable and scalable but also adaptable to the changing demands of the platform and its user base.

By using the strengths of each cloud service model, the platform achieved a high degree of operational efficiency and flexibility, allowing it to accommodate a wide range of functionalities and user requirements. This strategic implementation of cloud services, grounded in the principles laid out by Mell and Grance, was key to the platform's ability to offer a robust, scalable, and user-centric digital experience.

The development of the digital platform significantly benefited from the comprehensive insights provided by Jamsa in "Cloud Computing: SaaS, PaaS, IaaS, Virtualization, Business Models, Mobile, Security and More" (2013). This work offered a thorough understanding of the multifaceted nature of cloud computing, which was vital for the platform's development. Jamsa's book served as a key resource in understanding the broad implications of cloud computing, especially in terms of security. It highlighted the importance of implementing robust security measures to protect sensitive user data, a paramount concern for the digital platform.

This understanding was crucial in ensuring that the platform's cloud architecture was not only efficient but also secure. Moreover, the exploration of various cloud computing business models, including their impact on mobile computing, provided valuable insights. It helped the development team appreciate the flexibility and scalability offered by different cloud solutions. This understanding was instrumental in formulating a cloud strategy that aligned with the operational needs of the platform.

These insights guided the team in creating a cloud infrastructure that was adaptable, scalable, and capable of meeting diverse operational demands.

The knowledge gained from Jamsa's work ensured that the platform was well-equipped to handle a range of functionalities while maintaining a high standard of security and efficiency. This strategic approach to leveraging cloud technology was a key factor in the successful development and deployment of the digital platform. Industry reports and case studies on the use of AWS across different sectors shed light on how companies are leveraging cloud computing for digital transformation. These real-world examples underscore AWS's role in driving innovative cloud solutions and are particularly relevant to understanding how the platform can harness AWS for enhanced performance and scalability.

The review of cloud computing literature emphasizes the critical role of cloud computing, especially AWS, in shaping modern digital ecosystems. It highlights the advancements in cloud service models, the shift towards infrastructure as code, and the all-encompassing nature of cloud computing in today's technological landscape. This analysis demonstrates AWS's versatility and capability in supporting complex projects.

These results not only validate the effectiveness of the cloud computing strategies employed but also set the stage for future enhancements. The ongoing evolution of cloud technology presents opportunities for further innovations. Future work could explore new cloud capabilities, advanced data analytics for personalized user experiences, and the integration of emerging technologies to keep the platform at the forefront of the audio technology industry.

The development phase of the project was meticulously structured and executed, marked by several crucial milestones that collectively steered the project towards its successful completion. The key milestones, spread from March to September 2023, reflect the project's complexity and the team's commitment to a methodical, iterative development process (see Figure 39).

March 2023 - Setting Up the Development Environment:

The journey began in early March with the establishment of the development environment, integrating Vue.js into the project for its adaptability and proficiency in building user interfaces. This initial stage set the groundwork for the subsequent development tasks, ensuring the team had a reliable and flexible foundation to build upon.

Mid-March 2023 - Vue.js Integration:

Shortly after setting up the environment, the team delved into integrating Vue.js into the project. This step was crucial in shaping the application's front-end, focusing on creating a user-friendly and responsive interface that would meet the evolving needs of users.

Early April 2023 - Keycloak Integration for Reliable Authentication:

By early April, attention shifted to integrating Keycloak, a move that fortified security infrastructure. This integration ensured reliable and secure authentication mechanisms, a critical aspect given the emphasis on safeguarding user data.

Late April 2023 - Integration with GitLab, Harbour, and Rancher:

Later in April, the project witnessed the integration of crucial tools like GitLab, Harbour, and Rancher. This stage was important in establishing a continuous deployment pipeline, enabling streamlined updates and rapid deployment of new features.

Mid-May 2023 - Establishing the Continuous Deployment Pipeline:

The continuous deployment pipeline was fully established by mid-May, marking a significant achievement in the project's timeline. This pipeline was helpful in maintaining a consistent development flow and facilitating the efficient release of application updates.

Early June 2023 - Commencement of the Feature Implementation Phase:

The feature implementation phase kicked off in early June. During this phase, the team focused on developing and integrating all the required features of the application. This period was characterized by intensive development efforts, integrating various components into the application.

July 2023 - Iterative Development and Feedback Incorporation:

Through July, the project entered a phase of iterative development, with the team consistently refining and improving the application based on ongoing feedback. This approach ensured that the application was not only functionally sound but also aligned with user expectations and industry standards.

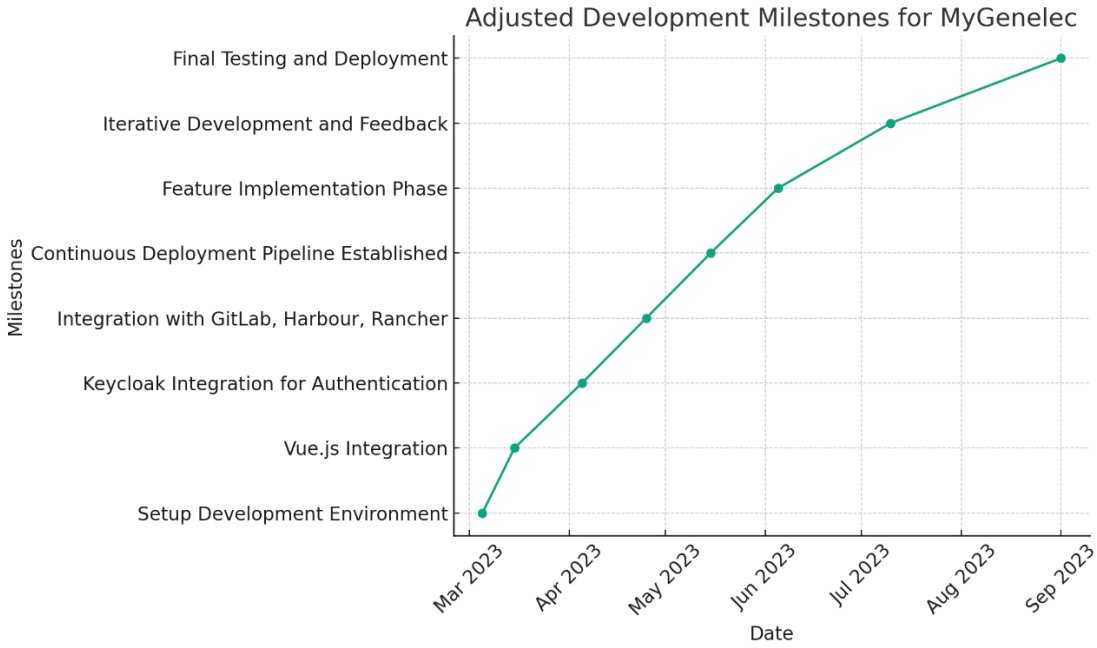

Figure 39. Timeline of the testing phases

The culmination of the project's development phase came in September with the final testing and deployment. This final phase involved rigorous testing to ensure the application's reliability, usability, and compatibility across various platforms and devices. Upon successful testing, the portal was fully deployed, marking the completion of a significant milestone in company's digital transformation journey.

Throughout these stages, the team's commitment to continuous improvement and responsiveness to stakeholder feedback were evident. Each milestone in the development phase was carefully planned and executed, ensuring that the platform not only met its initial design objectives but also evolved to become a more sophisticated and user-centric platform. The thoughtful integration of various technologies and the focus on user experience and security made the development journey of the personalized interaction platform a model of modern software development practices.

The testing phase of the project was an extensive and critical component of the development process, involving multiple stages each requiring a significant amount of time and effort to ensure the highest quality of the final product. Here is a breakdown of the estimated time and work involved in each testing stage:

Unit Testing

Duration: Approximately 2 months.

Effort: Involved rigorous testing of individual components in isolation. This phase was time-consuming due to the need to test each function, module, and class under various scenarios, ensuring that all components operated as expected. Elements were tested by a try-and-catch-error method. It means that every function was executed under various circumstances and if the result after the execution is as expected then the testing unit has passed the testing.

Integration Testing

Duration: Around 1.5 months.

Effort: After unit testing, integration testing required careful examination of how different components interacted. This phase was crucial for ensuring smooth functioning of combined components and identifying any interface defects.

User Acceptance Testing (UAT)

Duration: 1 month.

Effort: This phase involved real-world testing by selected users. UAT was important in gathering feedback on user experience, interface, and overall usability, necessitating adjustments based on user feedback. There were created special serial numbers for testing product registration. The users from different countries were going through the application trying to find weak places or bugs of the application. After that, they were filling a specific Excel form that showed their satisfaction with the application and found bugs (see Appendix 2 or Figure 40. Feedback from internal testers.).

Do you already have a community membership or products registered with this email?	If you have signed up with an excisting email address you should receive and email to set up a new password.	Please enter the Profile page (up on the right) and provide the information.	You will need to test product registration with the test serial numbers below in excel. (In a rare chance your products might be visible if you had account before with the same email)	Test creating a location and a room with products linked to it.	Are you able to see the content as you filled in?	Please test forgotten password process	Please provide descriptions and screenshots of problems/issues	
No I did not have anything set								
 a new on	Yes	OK	Nothing happens after adding the serial and submitting, tried two different serials.	Tried to add products but nothing happens after assigning the model. The serachbox does not offer anything, nothing happens when clicking the "Products in this room" box.	Yes, can see 1 room but nothing more, no possibility to add products	Works fine	GLM link button on the starting page does not work. Software links seem to work.	
No			Nothing happens when I add a serial number?	OK		I tried this and saw a message "You should receive an email shortly with further instructions." but never got that email.	Nothing happens when I try to save User information.	
I had an account that Mikko opened for me.		This was ok, strange that when I pressed "save information" that it then proceeded to close the tab. I would have expected a confirmation pop-up, like "your information has been saved" or something	This worked out fine, again i would have expected a confirmation pop-up that says something like "your product 8020D has been registered" also i tried the "assign to location" and "assign to room" and thought this would probs need an "add new room/location" in the dropdown menu, otherwise its a bit confusing.	works out fine, but when assigning products, I thought that simply selecting the monitor from the drop down menu would be enough to assign it, but you still have to seperately assign it? I think it's one step too much and by selecting the product with the green v mark would be enough to indicate that this product will be assigned to the room. After creating the room, I don't see the assigned products though.	Yes, but it is confusing that I land on a page I had been previously before logout and not on the homepage.	This works, except the message I receive is referring to "credentials" which is a bit confusing term	Visually, there is a lot to fix: the font sizes, the alignment of text, margins, icon sizes, button sizes. These are small fixes, but all together make a big difference to the user experience and premium feel. The top bar is too narrow and the hamburger icon on the left is not doing anything. There should be also a limit on how many words are seen per row, for example on the tab "Grade reports"	We need to also think about the presence of our name in external keycloak actions, for example the password reset process. In the automated email, it comes from cloudservice, and on top of that there is no mention of MyGenelec. Our logo should also be present in the email.

Figure 40. Feedback from internal testers.

The instruction for the testing was the next (see Figure 41):

1. Navigate to the application's login page.
2. Register as a new user via Keycloak, providing necessary details - email, password, username, name, surname and country.
3. Verify successful registration and redirection to the application's homepage.
4. Access the profile page from the homepage.
5. Fill in the profile details (name, address, preferences).
6. Submit the profile information and confirm that changes are saved and displayed correctly.
7. Navigate to the product registration page.
8. Register a single product, providing all required details (name, description, serial number).
9. Repeat the process to register multiple products, noting any differences or issues in batch processing.
10. Verify that all registered products are listed correctly on the user's account.
11. Access the "Rooms" page and create a new location (e.g., Home, Office).
12. Within the location, create multiple rooms specifying their names (e.g., Living Room, Kitchen).
13. Assign previously registered products to the created rooms.
14. Verify that products are correctly associated with their respective rooms.
15. Return to the homepage and confirm that the list of products includes accurate registration and location information.
16. Ensure that product details can be viewed and edited from this page without errors.
17. Navigate through various pages of the application (About, Contact, Settings).
18. Verify that all links work as expected without broken links or errors.
19. Check the application's design for consistency and absence of visible defects across different pages and functionalities.

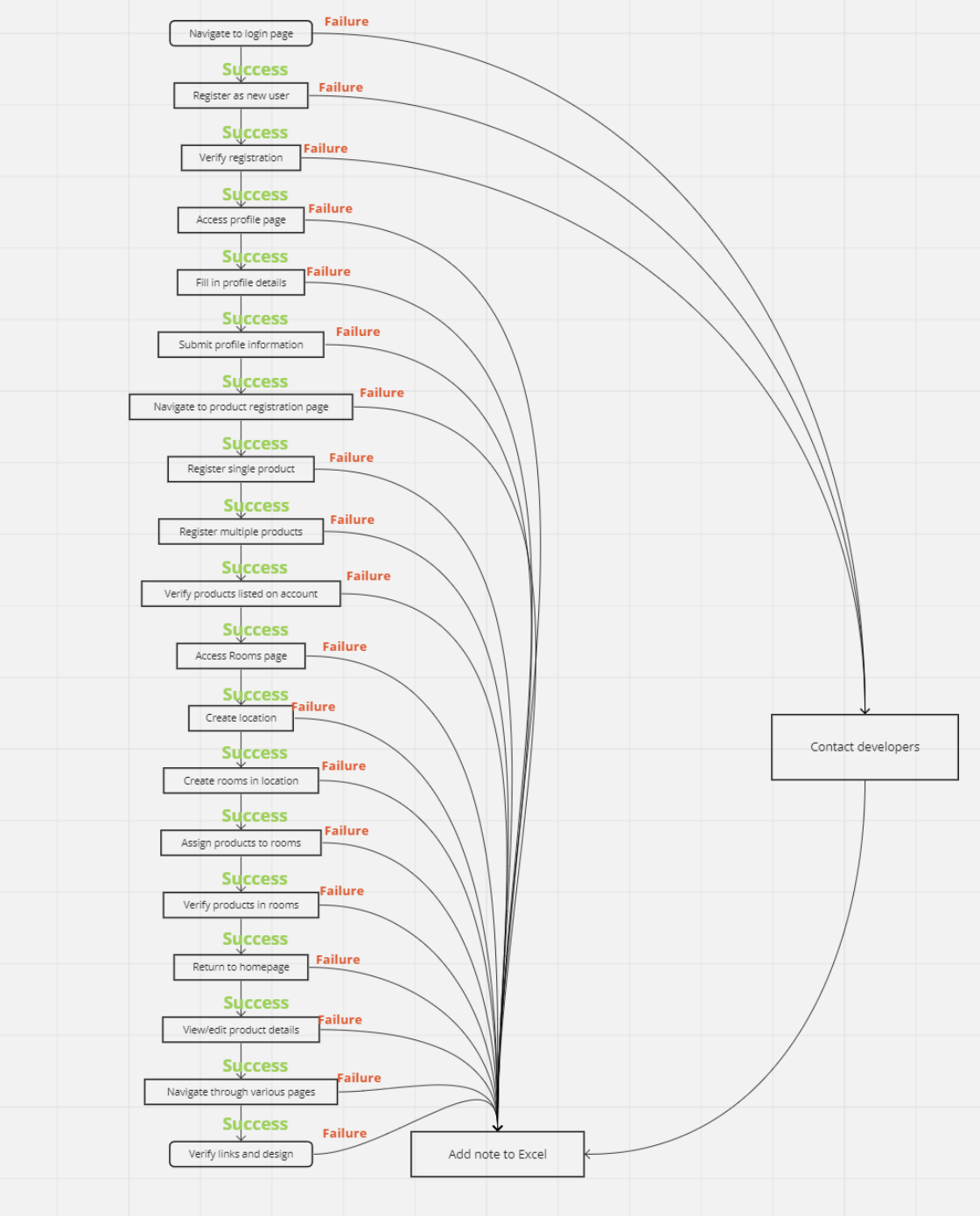

Figure 41. UAT flow chart

Performance Testing

Duration: 3 weeks.

Effort: Performance testing was conducted to assess the application's response time, scalability, and stability under varying conditions. This phase required extensive load and stress testing to ensure the platform could handle expected user traffic and data processing. The result was achieved by creating test scenarios in which functions of the application were called hundred times in a few seconds.

Compatibility Testing

Duration: 2 weeks.

Effort: Ensuring platform's functionality across different devices, browsers, and operating systems required comprehensive testing. This phase was essential for confirming a consistent user experience across various technologies. It was achieved by using various devices such as desktops, tablets and smartphones, and different browsers such as Opera GX, Google Chrome, Safari and Firefox.

The iterative nature of the testing phase meant that findings from each stage fed back into the development cycle, necessitating repeated rounds of testing and refinement. This comprehensive and multi-faceted approach to testing was helpful in delivering an application that was reliable, user-friendly, and aligned with the needs and expectations of the users. The estimated durations for each phase are based on the complexity and scale of the project and could vary depending on the specific challenges encountered during testing.

5 DISCUSSION

5.1 The First Launches and Visitors

The journey to the successful launch of the development project was marked by meticulous planning and strategic phases. Starting with an internal launch on June 16, 2023, the application underwent a final round of testing within the company. This internal phase was crucial, as it provided the first real-world feedback from company employees. Their positive reception and constructive critiques affirmed the technological and design choices made by the team. Despite the overall satisfaction, this phase also helped identify new issues, opening the way for timely updates and upgrades.

Following the internal launch, platform embarked on a soft launch on July 5, 2023. This phase targeted company's existing customer base, particularly those who had previously registered products with the company. This strategic approach ensured the platform was gradually introduced to a familiar audience, easing its entry into the market. The soft launch proved successful, attracting 3,000 users initially, which was a strong indicator of the platform's potential impact.

The culmination of these efforts was the worldwide launch, a milestone that introduced personalized interaction platform to a global audience. This phase was a resounding success, drawing in 8,000 new users and solidifying the platform's global appeal and anticipation. As of now, the MyGenelec portal has amassed 14,000 unique visits, a clear testament to its acceptance and popularity in the digital domain. The user online statistics, as depicted in Figure 42, offer a comprehensive view of the platform's reach and engagement.

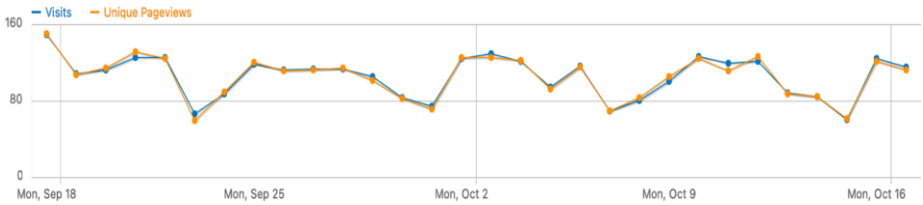

Figure 42. User online statistics

Post-launch, the role of user feedback has been important in further enhancing of the project. Over 200 users have contributed their insights and suggestions since its launch. This user engagement is not only a measure of the platform's success but also a valuable resource for continuous improvement, as highlighted in the feedback compilation presented in Appendix 1 (See Appendix 1).

5.2 The Results of Using Chosen Tools, Design and Methods

The integration of Keycloak into the digital platform significantly bolstered its security framework, setting a high standard for user data protection. The implementation of single sign-on (SSO) and two-factor authentication (2FA) through Keycloak simplified the login process for users while providing an added layer of security against unauthorized access. The flexibility of Keycloak to support

various authentication protocols, including OpenID Connect (OpenID Foundation 2023), OAuth 2.0, and SAML 2.0, enabled the platform to offer a robust and comprehensive security solution tailored to the diverse needs of its user base. This strategic approach to security has played a critical role in maintaining user trust and ensuring the confidentiality, integrity, and availability of user data.

The project's design philosophy focused on creating an engaging and intuitive user experience, seamlessly integrating the company's brand identity with modern digital design trends. The transition to a design featuring more rounded elements reflected a broader industry move towards softer, more approachable aesthetics. This evolution in design not only made the platform more visually appealing but also enhanced usability and accessibility, contributing significantly to user satisfaction and engagement. The design team's commitment to a user-first approach was evident in every aspect of the platform's interface, from the layout and colour scheme to the responsiveness and interaction design, ensuring a cohesive and enjoyable experience for all users.

The architectural foundation of the project, built on AWS and enhanced through Dockerization techniques using tools like Kaniko, Harbor, and Rancher, established a resilient and scalable infrastructure. This infrastructure foundation enabled the platform to manage varying loads with ease, particularly during peak usage times, without compromising on performance. The deployment process, optimized by a well-orchestrated CI/CD pipeline, facilitated rapid and reliable updates, ensuring the platform remained up to date with the latest features and security measures. The choice of Vue.js for front-end development further exemplified the project's commitment to delivering a dynamic, responsive, and aesthetically pleasing user interface. This blend of cutting-edge technology, strategic security measures, and user-centred design underscores the project's success in creating a digital platform that is not only technologically advanced but also deeply aligned with user expectations and evolving digital landscapes.

5.3 The Results of the Development

The development of the personalized interaction platform represents a significant step towards digital transformation for the company, aiming to enhance direct customer contact and improve customer engagement while automating customer support operations. This thesis has presented the challenges, strategies, and chosen implementations for developing the digital platform.

This work is significant for several reasons. It provides a practical case study of digital transformation within a real-world context, offering insights into how traditional businesses can successfully transition to digital platforms. It contributes to the discourse on user-centred design, highlighting the impact of aligning technology solutions with user needs. Moreover, it explores the integration of technologies like Vue.js, Keycloak, and AWS, providing guidance for similar initiatives.

In summary, this thesis extends beyond a single project, encapsulating the interaction between technology, design, and user experience in the context of digital transformation. As a case study for businesses venturing into digital adaptation, the strategies and lessons learned during the portal development offer valuable insights applicable across various sectors.

The launch of the customer portal has been met with positive reception and widespread user adoption, indicating its success in creating a unified and user-friendly platform. This success sets the

stage for future enhancements, with its scalable and cloud-based architecture well-positioned to evolve with user demands and technological advancements.

5.4 Author's contribution

Working in close collaboration with the design team, the author of this thesis played a key role in refining the design, guiding the designers towards more effective solutions. Utilizing these refined mock-ups.

The author developed the user interface for the various devices, and implemented integration of Harbor, Rancher, and GitLab, for seamless cloud service. A majority of the front-end code, approximately 95%, was developed by the author, including interfaces to the company's API endpoints and the user interface. The author had a central role in integrating the Keycloak. Furthermore, the author reviewed the feedback from 140 user reviews, resulting in bug fixes and user experience enhancements. Additionally, the author was responsible for deploying the application to cloud and GitLab servers, and for setting up the CI/CD pipelines, ensuring efficient cloud service operations and rapid deployment.

While the author played a central role in bringing the project to fruition, the project was a collaborative effort and the author received guidance from the Genelec team. Particularly the support and leadership of Enterprise Architect MSc Mikko Martikainen was crucial to the project's success, and the high-quality work of Visual Designer BSc Mari Tervonen in creating the portal appearance, should be mentioned.

6 CONCLUSION

The project to develop the MyGenelec customer interaction platform revealed several key factors essential for digital platform development.

The scalable, cloud-based architecture of the platform implementation supports future enhancements, allowing for adaptability to the evolving user demands and emerging technological trends. The selection of Vue 3 for frontend development and Keycloak for security reflected the focus on meeting user needs while adhering to industry standards. Utilizing AWS for deployment, with containerization techniques, demonstrated the practical benefits of cloud computing in handling scalability and security.

Continuous testing with feedback was crucial in evolving the platform. Furthermore, the evolution of the platform's design from initial concepts to the final interface highlighted the necessity for adaptability in digital design to achieve brand consistency and meeting user needs. The key aspect of integrating services like product registration, product allocation and product listing into a single portal, improved the user experience and operational effectiveness. Emphasis on compatibility across different platforms ensured a consistent experience on various devices, catering to a wide range of use models. The launch of the platform has been positively received, implying that the platform's design aligns with the user expectations with the selected technology and design.

In summary, the customer interaction platform project represents a significant step into digital transformation, showcasing how an established business can adapt to the digital era. Experiences during the project underscore the necessity of a user-centred approach in technology development, strategic planning, and iterative deployment to accomplish effective integration of technology in creating the user experience on a digital platform, while also providing valuable insights and methodologies for future projects in Genelec.

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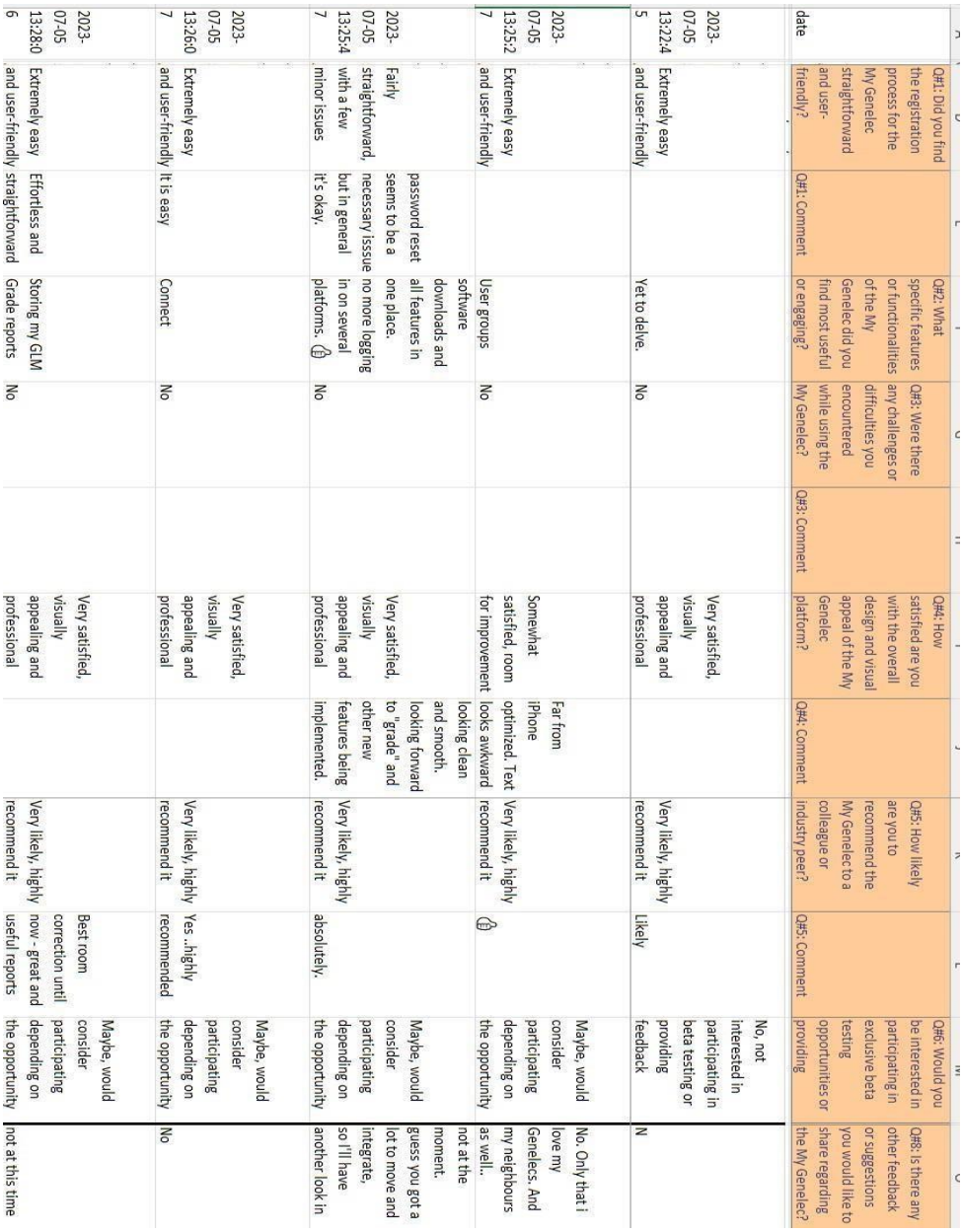
APPENDIX 1: USER FEEDBACK



date	Q#1: Did you find the registration process for the My Genelec straightforward and user-friendly?	Q#1: Comment	Q#2: What specific features or functionalities of the My Genelec did you find most useful or engaging?	Q#3: Were there any challenges or difficulties you encountered while using the My Genelec?	Q#3: Comment	Q#4: How satisfied are you with the overall design and visual appeal of the My Genelec platform?	Q#4: Comment	Q#5: How likely are you to recommend the My Genelec to a colleague or industry peer?	Q#5: Comment	Q#6: Would you be interested in participating in exclusive beta testing opportunities or providing feedback	Q#8: Is there any other feedback or suggestions you would like to share regarding the My Genelec?
2023-07-05 13:22:45	Extremely easy and user-friendly		Yet to delve.	No		Very satisfied, visually appealing and professional		Very likely, highly recommend it	Likely	No, not interested in participating in beta testing or providing feedback	N
2023-07-05 13:25:27	Extremely easy and user-friendly		User groups software downloads and all features in one place.	No		Somewhat satisfied, room for improvement	Far from iPhone optimized. Text looks awkward looking clean and smooth. looking forward to "grade" and other new features being implemented.	Very likely, highly recommend it		Maybe, would consider participating depending on the opportunity	No. Only that i love my Genelecs. And my neighbours as well.. not at the moment. guess you got a lot to move and integrate, so I'll have another look in
2023-07-05 13:25:47	Fairly straightforward, with a few minor issues	Extremely easy and user-friendly straightforward	password reset seems to be a necessary isssue but in general it's okay.	no more logging in on several platforms.	No	Very satisfied, visually appealing and professional		Very likely, highly recommend it	Very likely, highly recommend it	Maybe, would consider participating depending on the opportunity	
2023-07-05 13:26:07	Extremely easy and user-friendly	It is easy	Connect	No		Very satisfied, visually appealing and professional		Very likely, highly recommend it	Yes ..highly recommended	Maybe, would consider participating depending on the opportunity	No
2023-07-05 13:28:06	Extremely easy and user-friendly	Effortless and straightforward	Storing my GLM Grade reports	No		Very satisfied, visually appealing and professional		Very likely, highly recommend it	Best room correction until now - great and useful reports	Maybe, would consider participating depending on the opportunity	not at this time

Figure 43. Screenshot from the Excel showing users' feedback

APPENDIX 2: FEEDBACK FROM INTERNAL TESTERS

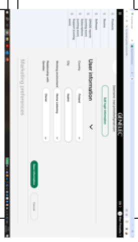
Do you already have a community membership or products registered with this email?	If you have signed up with an excisting email address you should receive and email to set up a new password.	Please enter the Profile page (up on the right) and provide the information.	You will need to test product registration with the test serial numbers below in excel. (In a rare chance your products might be visible if you had account before with the same email)	Test creating a location and a room with products linked to it.	Are you able to see the content as you filled in?	Please test forgotten password process	Please provide descriptions and screenshots of problems/issues	
	http://my-test.dev.genelec.com/		https://genelecov					
No I did not have anything set								
 a new on	Yes	OK	Nothing happens after adding the serial and submitting, tried two different serials.	Tried to add products but nothing happens after assigning the model. The serachbox does not offer anything, nothing happens when clicking the "Products in this room" box.	Yes, can see 1 room but nothing more, no possibility to add products	Works fine	GLM link button on the starting page does not work. Software links seem to work.	
No			Nothing happens when I add a serial number?	OK		I tried this and saw a message "You should receive an email shortly with further instructions." but never got that email.	Nothing happens when I try to save User information.	
I had an account that Mikko opened for me.		This was ok, strange that when I pressed "save information" that it then proceeded to close the tab. I would have expected a confirmation pop-up, like "your information has been saved" or something	This worked out fine, again i would have expected a confirmation pop-up that says something like "your product 8020D has been registered" also i tried the "assign to location" and "assign to room" and thought this would probs need an "add new room/location" in the dropdown menu, otherwise its a bit confusing.	works out fine, but when assigning products, I thought that simply selecting the monitor from the drop down menu would be enough to assign it, but you still have to seperately assign it? I think it's one step too much and by selecting the product with the green v mark would be enough to indicate that this product will be assigned to the room. After creating the room, I don't see the assigned products though.	Yes, but it is confusing that I land on a page I had been previously before logout and not on the homepage.	This works, except the message I receive is referring to "credentials" which is a bit confusing term	Visually, there is a lot to fix: the font sizes, the alignment of text, margins, icon sizes, button sizes. These are small fixes, but all together make a big difference to the user experience and premium feel. The top bar is too narrow and the hamburger icon on the left is not doing anything. There should be also a limit on how many words are seen per row, for example on the tab "Grade reports"	We need to also think about the presence of our name in external keycloak actions, for example the password reset process. In the automated email, it comes from cloudservice, and on top of that there is no mention of MyGenelec. Our logo should also be present in the email.

Figure 44. Screenshot from Excel showing internal testers' feedback