Supplementary Questions

2023-FALL-COSC-4375.001

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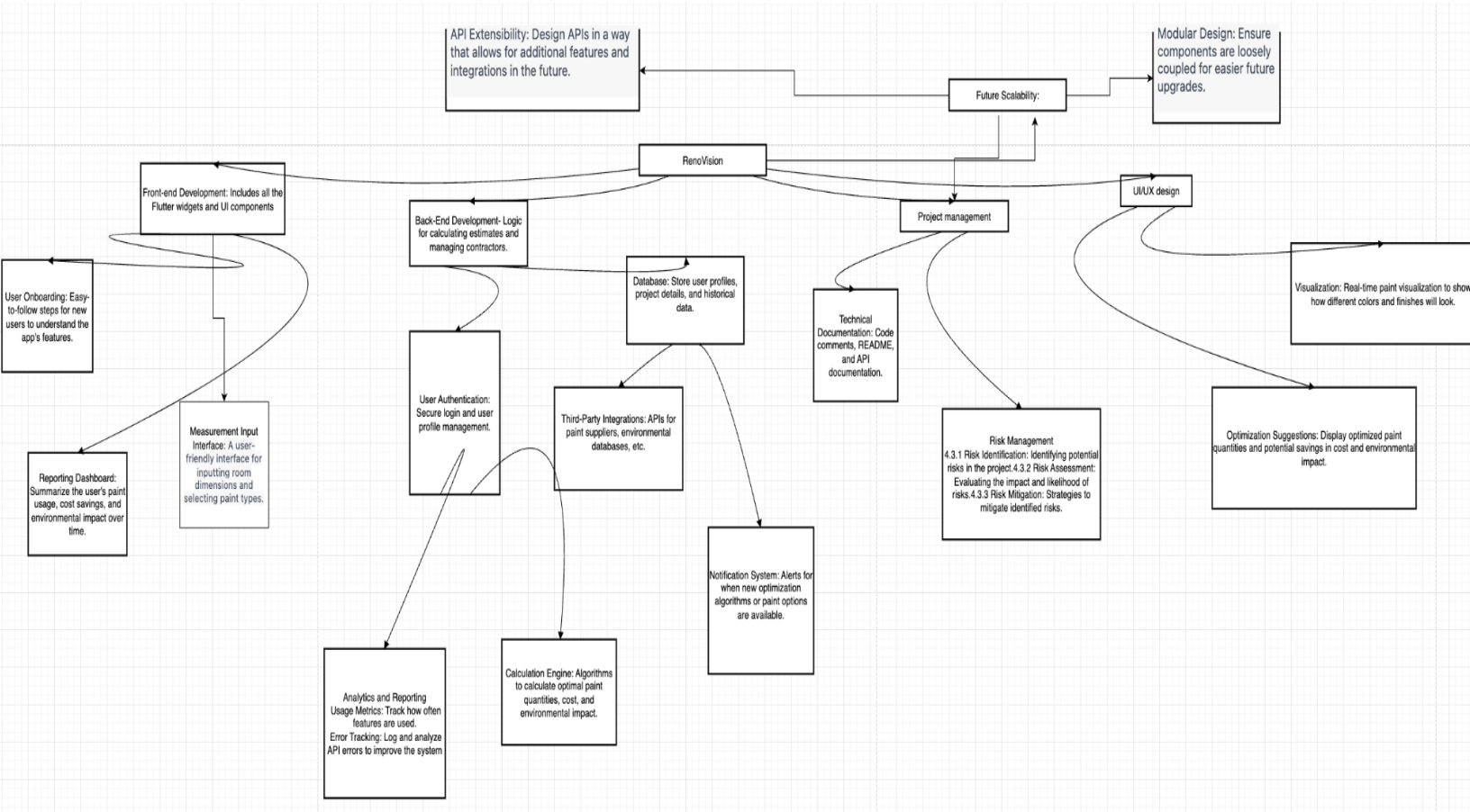
1. (IT) Produce a Systems Design Sketch



2. (CIS) Discuss the Business Plan

I. Executive Summary

A. RenoVision

RenoVision

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B. Type of Business

RenoVision is an innovative mobile application designed to simplify the process of painting and renovating homes. This app utilizes a smartphone's camera and advanced computer vision technology to accurately measure wall areas and provide users with precise paint resource estimates. With its user-friendly interface and time-saving features, RenoVision aims to revolutionize the way people plan and execute their painting projects.

C. Mission

At RenoVision, our unwavering commitment is to empower homeowners, contractors, and DIY enthusiasts with the tools and knowledge they need to transform their living spaces with confidence and efficiency. We understand that painting projects are not just about aesthetics; they are about creating homes that reflect individuality, creativity, and comfort. Our mission is to

simplify the complex, streamline the process, and enhance the experience of bringing those dreams to life.

Our mission can be distilled into several core principles:

1. Empowering Accuracy: We believe that accuracy is the cornerstone of any successful painting project. Our app harnesses cutting-edge computer vision technology to provide precise wall area measurements, ensuring that every drop of paint is used efficiently, reducing waste, and saving valuable resources.

2. User-Centric Design: We are dedicated to creating an app that is approachable and accessible to all, from seasoned contractors to first-time DIYers. Our user-centric design ensures that RenoVision is intuitive, informative, and a joy to use, making it an indispensable companion on every project.

3. Saving Time and Money: We understand that time and budget constraints often loom large in-home improvement endeavors. Our mission is to help users save both. By accurately estimating paint resources, suggesting cost-effective paint solutions, and providing project cost estimations, we enable our users to make informed decisions that lead to cost savings.

4. Fostering Creativity: We are passionate about nurturing the creative spirit within our users. Beyond just measurements and resource estimates, we offer paint color recommendations and captivating visualizations, enabling users to explore their ideas and make inspired choices.

5. Simplifying Complexity: Painting projects can be complex, with numerous variables and choices to consider. Our mission is to simplify this complexity, offering users a one-stop solution that aids in project planning, resource management, and even virtual room visualization to bring their vision to life.

6. Sustainability and Environmental Responsibility: We are dedicated to promoting sustainability in the home improvement industry. By reducing paint waste through precise measurements and encouraging responsible product choices, we contribute to a more environmentally friendly approach to painting.

In pursuit of our mission, we are committed to continuous improvement and innovation. We aim to exceed the expectations of our users by constantly enhancing our app, expanding our partnerships, and staying at the forefront of technological advancements in the field of home improvement.

Ultimately, our mission is to transform the way people approach painting projects, from the initial spark of inspiration to the final brushstroke. We aspire to be more than just an app; we aim to be a trusted companion on the journey of turning houses into homes, one project at a time.

D. Competitive Advantage

RenoVision possesses several distinct competitive advantages that position it as a market leader in the field of home improvement and painting project planning:

1. Advanced Computer Vision Technology: RenoVision leverages cutting-edge computer vision technology to provide unparalleled accuracy in wall area measurements. Unlike competitors that rely on manual measurements or less precise methods, our app ensures that users receive the most precise measurements possible. This accuracy translates into reduced paint wastage and cost savings for users.

2. User-Friendly Interface: Our app is designed with both professionals and beginners in mind. Its intuitive and user-friendly interface makes it accessible to a wide audience. Users can quickly navigate the app, input data, and receive accurate measurements and estimates, regardless of their level of expertise.

3. Integration with Paint Brands: RenoVision stands out by integrating seamlessly with popular paint brands. Users can access a wide range of paint options, including color palettes, types, and coverage rates, directly within the app. This integration simplifies the purchasing process, saving users time and ensuring they select the right paint for their project.

4. Cost Savings Through Accurate Estimation: Our app doesn't just measure wall areas; it also estimates paint resources and project costs. This feature empowers users to make informed decisions about their painting projects, helping them avoid overbuying or underestimating paint

quantities. By reducing resource wastage, RenoVision saves users money and contributes to a more sustainable approach to home improvement.

5. Paint Color Recommendations and Visualizations: We go beyond measurement and estimation by offering paint color recommendations and visualizations. Users can experiment with different color schemes and see how their chosen colors will look in their space before making a commitment. This feature fosters creativity and confidence in paint choices.

6. Project Cost Estimation: RenoVision provides users with detailed project cost estimates, including paint costs, labor, and other associated expenses. This transparency helps users plan their budgets more effectively and prevents unexpected financial surprises during the project.

7. Virtual Room Visualization: Our app offers virtual room visualization, allowing users to preview their paint choices in a digital representation of their space. This visualization aids in decision-making and ensures that users are satisfied with their choices before beginning the painting process.

8. Continuous Innovation and Improvement: We are committed to ongoing development and improvement of the RenoVision app. Regular updates and enhancements, including new features and improved accuracy, ensure that our users always have access to the latest technology and tools for their painting projects.

9. Environmental Responsibility: RenoVision promotes environmentally responsible practices by reducing paint wastage. By helping users choose the right paint quantities and types, our app

contributes to a more sustainable approach to home improvement, aligning with the growing environmental consciousness of consumers.

In summary, RenoVision competitive advantages lie in its precision, user-friendliness, integration capabilities, cost-saving features, creativity-enhancing tools, and commitment to continuous improvement and environmental responsibility. These factors make RenoVision the ideal choice for homeowners, contractors, and DIY enthusiasts looking to streamline and enhance their painting projects.

E. Backup/Alternative

In an ever-evolving tech landscape, versatility is paramount. While our core focus is the development of a mobile app for wall area measurement and paint resource estimation, we understand the importance of contingency planning. We present alternative approaches that complement our primary strategy, aiming to enhance user experiences, cater to diverse needs, and position RenoVision as a dynamic solution. These approaches expand our reach, bolster partnerships, and offer affordability. In this evolving market, our commitment remains unwavering—to simplify and enrich home improvement.

Web Based Version: Instead of solely focusing on a mobile app, an alternative approach is to develop a web-based version of RenoVision that complements the mobile app. This web application would offer similar features, such as wall area measurement, paint resource

estimation, color visualization, and project cost estimation, but with the convenience of web access. Users can access the tool from their desktop or mobile browser.

Partnerships with Home Improvement Stores: Instead of solely relying on app downloads and in-app purchases, establish partnerships with major home improvement stores. RenoVision could provide a customized version of the app or an API (Application Programming Interface) to these stores, allowing them to offer the measurement and estimation features to their customers as part of their online or in-store experience. In return, RenoVision could receive a percentage of sales made through these partnerships.

RenoVision API for Integration: To extend our reach and adapt to various user needs, consider developing a RenoVision API (Application Programming Interface). This API would allow other home improvement and design applications, both mobile and web-based, to integrate our wall area measurement and paint resource estimation features seamlessly. By offering this integration option, we can tap into a broader ecosystem of users and provide them with our accurate measurement and estimation capabilities within the platforms they already use.

F. Feasibility Systems Matrix

Approach/Features	Technical Feasibility	Economic Feasibility	Operational Feasibility	Schedule Feasibility
Accurate Estimations	*High*	*Moderate*	*High*	*High*
Integration with Paint Suppliers	*Moderate*	*High*	*Moderate*	*Moderate*
Virtual Visualization	*Low*	*Moderate*	*Moderate*	*Low*
Eco-friendly Recommendations	*High*	*High*	*High*	*High*
Web Platform	*High*	*Moderate*	*High*	*Moderate*
Integration with DIY Platforms	*Moderate*	*High*	*High*	*Moderate*
Offline Estimation Tool	*High*	*Low*	*High*	*High*

Legend:

- *High:* Easily feasible or very beneficial.
- *Moderate:* Feasible with some challenges or moderately beneficial.
- *Low:* Difficult to implement or of limited benefit.

The feasibility systems matrix provides a snapshot of the potential benefits and challenges of each feature or approach. The app development should prioritize features with high feasibility scores across the board.

3. (CS) Discuss the Technical Requirements and Data, Process Pipeline

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3a. Technical Feasibility

Our product is an estimation app called RenoVision that seeks to help people in the estimation of materials in home building/remodeling.

Technology Stack: For the front end development we are using Flutter, which uses the language 'dart.' What Flutter is widely known for is being cross platform. It allows us to create code one time that can be used on both iOS and Android without the need for any tinkering to tailor it for each OS (camera feature will require us to change the 'Info.plist' file inside of the iOS folder, but other than that everything remains untouched as far as making the code work on both platforms). For our database and user authentication we will be using Firebase which will allow us to link databases like paint colors, price, and contractors. Also within Firebase is the ability to authenticate user sign-up/login info so that the accounts are stored and all relevant data is stored within that user instance.

Development Environment: Our development environment that will be used is Visual Studio Code which is flexible and easy to use, perfect for the development of our app. Within VSC there are many helpful plugins that will make the experience better for us as developers and the end user.

Hardware Requirements: A working camera (user can enter data manually, but the camera is recommended for ease). iOS or Android phone.

Data Management: The primary data that we plan to have will be paint colors, contractor info, and authentication info databases. To manage these we can use Firebase to store all of them.

Features and Functionality:

+User Authentication	+Home Screen (Estimation button, Contractors button)	
+Camera Integration	+User Data Management	+User-Friendly Interface
+Data Security	+Help and Support	+Feedback and Reviews

The functionality of our app is to make the life of home renovators easier when calculating their material needs for their project and also potentially saving money in overbought materials. After selecting either the paint, flooring, or roofing estimation button the user will import/take an image that is processed and then returns the value that the user is looking for. Furthermore, users will be able to find contractors local to them along with their info so that they can plan almost every step of the renovation process simply by using the RenoVision app on their smartphone.

Scalability: Our RenoVision app's scalability is crucial, especially since we expect an increase in user numbers. We've taken many proactive efforts to guarantee that our app can manage increased traffic while keeping a consistent user experience. Our backend architecture has been intentionally built for horizontal scaling, employing cloud technologies such as Firebase to modify resources as needed. Our code is extremely efficient, and asynchronous processing saves resources. We've also incorporated powerful monitoring tools and used a microservices architecture for complicated features, all while emphasizing security. Our efforts are rounded off by rigorous scalability testing and extensive documentation. To summarize, we've already built the groundwork for a scalable app infrastructure, effective resource management, and a proactive approach to performance optimization, all of which are critical for easily accommodating future expansion.

Offline Functionality: It is pretty early to say whether all of our features will work when the user has no internet connection. The login authentication will not be able to work, and the camera function will likely not be able to work as well. However, the user could still use the measure app pre-installed on their phone, or use a ruler to enter their measurements and the app should be able to return the appropriate estimate value without internet connection. As the app develops and we are able to test it this offline functionality will become more clear.

Testing and Debugging: We have 5 group members, all of which are familiar with the app and able to test for common bugs within the app itself. The group members working directly with the code of the app have a better understanding of bugs that root from code, and also can be shown bugs through running our app in the Visual Code Studio IDE which makes it very helpful to catch things that might have been missed. Testing and debugging is a constant process, and we will also open up reviews/suggestions to users to be able to spot even more bugs.

Cost Considerations: As stated previously, we are early in the implementation of our full fledged material estimations app. Everything we have done to this point required no money out of pocket, but when we get to the stage of launching the app I'm sure there will be licenses and fees to consider in regards to hosts, and running the app on iOS/Android's app store. On average apps cost $250-500 a month to keep on the app store and running which is more than feasible considering we have 5 group members with jobs. Of course we are subject to unknown costs, but it shouldn't be anything to where we can't afford to keep the app available to the public.

Overall Technical Feasibility:

RenoVision has great technical feasibility, thanks to a well-established technological stack, scalability measures, and a devoted workforce. As we continue to develop and test, we are confident in our ability to provide our users with a dependable and efficient app.

3b. Data Management Plan

1. **Data Collection:** We plan to primarily collect data through the user's smartphone camera and user login credentials. The app will use image processing algorithms to accurately measure walls and floors, providing essential measurements for estimating paint and flooring costs. The data will include images, dimensions, and any other relevant data regarding measurement tasks.
2. **Data Storage:** Since our main development of RenoVision will be done through Flutter using the Dart programming language, we intend to use the Firebase database for our implementation of this app. Firebase runs under a NoSQL database which ensures efficient data storage and retrieval for real-time updates across multiple devices. This database does a great job at organizing user data into structured collections and documents, ensuring scalability and ease of management.
3. **Data Security:** With security being one of our top priorities, Firebase's built-in authentication is the perfect fit for this task. Firebase implements security rules that will be configured to grant access only to authorized users. As a last line of defense, data encryption will be enforced to and from the Firebase servers to ensure security.

3c. Describe briefly the Processes involved

1. **Conceptualization and Planning:** This initial phase includes defining the app's purpose, target audience, and core features. Once we have decided on what is needed, we focus on feasibility which includes operational feasibility, technical feasibility, economic feasibility, and the scheduling feasibility.
2. **Design and User Interface:** As mentioned before, we plan to use Flutter to be able to implement our app across most platforms. With that, create a baseline for the login template and the features we plan to implement. Once that baseline is created, further design to create an intuitive and visually appealing interface will be added.
3. **Database Management:** Once our model is created, we then need a place to store user credentials and other data such as images. Firebase offers a great and seamless implementation of what we require for data storage.

4. **Computer Vision:** Stated before, we plan on using the user's phone camera to accurately measure the dimensions of walls and floors. Our goal is to have the user take a picture/video of any wall or floor and have our program perform image processing to be able to send back accurate measurement details. A short summary of the image processing would be the input of an image. The image turned to grayscale to enable better edge detection. Then global otsu thresholding which simply intensifies the grayscale by creating a darker background and more white foreground. Lastly the use of adaptive thresholding which separates desirable foreground image objects from background based on difference in pixel intensity.
5. **Testing and Debugging:** Our last step will be extensive testing to identify and solve any bugs, performance issues, and usability concerns present in the project. For us to find these issues, we must identify edge cases for us to start debugging.
