CS 25-348 RenovationTracker
[Project Proposal]

Prepared for

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10/11/24

Executive Summary

In today's competitive real estate landscape, accurately showcasing property renovations is critical to enhancing buyer and seller engagement. Current methods of renovation presentation often rely on static, uninspiring descriptions and lack compelling visual representation, which limits users' ability to fully grasp the impact of updates on property value. This project, RenovationTracker: Intelligent Renovation Detection and Visualization, aims to address these limitations by introducing an AI-powered system that automatically detects, classifies, and visualizes property renovations, offering a more comprehensive and dynamic approach to property listings.

The RenovationTracker system will integrate several advanced technologies to meet the primary objectives of the project. These include the development of a Natural Language Processing (NLP) engine designed to extract renovation-related information from property descriptions, and a computer vision-based image classification model capable of automatically identifying and categorizing rooms from property images. By linking these detected renovations with the corresponding images, the system will offer a contextual and visually rich experience for users, allowing them to fully appreciate the improvements made to a property.

In addition to its core functionalities, the project also focuses on enhancing user interaction and engagement. A side-by-side renovation visualization tool will allow users to compare images of rooms before and after renovations, with interactive features such as sliders and overlays that highlight the changes. This tool will significantly improve user understanding and decision-making by providing clear and interactive visual evidence of property updates.

To ensure the system meets both functional and user needs, the project will follow a phased approach with key milestones that include model development, system integration, and rigorous testing. A feedback mechanism is also planned as a stretch goal, enabling users to verify or correct detected renovations and room classifications, which will contribute to the continuous improvement of the system's accuracy and performance.

The proposed solution aligns with the strategic goals of CoStar Group, the project sponsor, by leveraging cutting-edge AI technologies to improve the way property data is presented. The project deliverables include a fully functional AI-powered renovation detection and visualization platform, capable of operating in a production environment. The solution is designed to be scalable, allowing it to evolve with the growing demands of the real estate industry.

Currently, the project is in the proposal phase, with the initial system architecture and design requirements being defined. As we move forward, the team will continue to refine the project and integrate feedback to ensure that the final product meets both the technical specifications and the broader business objectives. This summary will be updated in future reports to reflect progress, including any additional insights gained during the system's development and testing phases.

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Section A. Problem Statement

In the competitive real estate market, effectively highlighting property renovations remains a persistent challenge for buyers, sellers, and real estate professionals. The existing methods of presenting renovations primarily rely on static textual descriptions and a limited number of before-and-after images, which often fail to provide the clarity and context needed to fully appreciate the scope and quality of renovations. This problem affects a broad range of stakeholders in the real estate sector, including homeowners, prospective buyers, property managers, and real estate agencies. The inability to accurately and dynamically represent renovations can result in diminished engagement from potential buyers, missed opportunities to showcase value-adding property features, and inefficient decision-making processes for both sellers and buyers.

RenovationTracker aims to address these gaps by introducing an intelligent system that automates the detection and visualization of property renovations, significantly enhancing the clarity, interactivity, and overall user experience in property listings. Current methods, which rely on manual classification of room types and static presentations of renovation data, are both time-consuming and prone to human error. The inefficiency of manually annotating rooms and renovations in property images creates delays and increases the potential for inaccuracies, which can negatively impact buyer trust and hinder successful property transactions.

The prevalence of this issue in real estate is considerable. As more properties undergo renovations, the need for a solution that can seamlessly integrate renovation data with visual evidence is increasingly urgent. The economic implications of failing to adequately showcase renovations are also significant, with poorly presented listings often leading to lower property values, extended time on the market, and a loss of competitive edge for sellers. Furthermore, the absence of clear and dynamic renovation data hampers user engagement, reducing the likelihood of successful property transactions and limiting the ability of real estate professionals to differentiate properties in a crowded marketplace.

RenovationTracker builds upon recent advances in natural language processing (NLP) and computer vision, two fields that have already seen success in automating similar tasks in other industries. However, while some existing solutions may offer basic image recognition or textual analysis, none have fully integrated these technologies into a cohesive platform specifically tailored to the needs of the real estate market. By combining automated renovation detection with visual image classification, RenovationTracker aims to provide a more complete, accurate, and engaging solution for property listings.

The system's ability to classify rooms based on images and to extract renovation details from listing descriptions will streamline the property listing process, reduce the time required for manual updates, and improve the accuracy of the information presented to potential buyers. Furthermore, the incorporation of interactive visual comparison tools will offer users a more engaging and informative experience, allowing them to clearly visualize the before-and-after state of renovations with side-by-side image comparisons and overlays.

The development of this system also involves tackling several engineering challenges, including the need for high-accuracy machine learning models capable of processing diverse property images and textual descriptions. Additionally, ensuring that the system integrates smoothly with existing real estate platforms will be crucial for its widespread adoption. The success of RenovationTracker will represent a significant step forward in how real estate listings are created and consumed, transforming static, uninspiring descriptions into dynamic, visually rich experiences that better reflect the true value of a property.

In conclusion, RenovationTracker will not only advance the current technology used in real estate listings but also create new standards for how renovations are detected and showcased. The proposed solution will lead to improved decision-making, increased user engagement, and higher property values, addressing an unmet need that spans the entire real estate industry.

Section B. Engineering Design Requirements

B.1 Project Goals (i.e. Client Needs)

The primary objective of Renovation Tracker project, is to improve the way individuals identify and display property renovations in the Real Estate industry, through an end-to-end machine learning system. It is intended to enhance user experience, through this AI powered solution, combining the use of Natural Language Processing (NLP) and computer vision for the automated renovation detection and room classification.

Key goals should include:

- Precise Recognition: Create an AI system that can automatically recognize and classify renovations from descriptions and images of properties.
- Enhanced Visualization: Side-by-side visualization control for users to compare property images before and after renovations.
- User Interface: Enhance your ability to make good decisions by showing you in a clear and intuitive fashion what's really happening to your property.
- Scalability: Ensure the platform is scalable to meet future industry demands and evolving technologies.

B.2 Design Objectives

- The design will identify and categorize property renovations from text descriptions and images correctly with at least 90% accuracy
- The design will enable users to compare property images side-by-side to view renovations, seamlessly and interactively.
- It will seamlessly work with existing real estate listing sites while being compatible with APIs of listing sites such as CoStar.
- The design will accommodate scale by handling very large property databases and huge volumes of image data.
- The design will be delivered by the deadline, respecting the budget and making optimal use of a cloud environment such as AWS.

B.3 Design Specifications and Constraints

- Integration with existing APIs: The system needs to be integrated with CoStar's APIs to retrieve property descriptions and images, so that the flow of data between platforms can go as planned.
- Scalability constraint: Support for up to 10,000 properties and related renovation data can be incorporated into the system without affecting performance drastically.
- Paraphrased AI accuracy requirement: The Natural Language Processing and image classification models must have at least 90% accuracy in recognizing and categorizing renovations.
- Cost constraint: The solution must be created within the budget of less than $10,000 in cloud resources, development and deployment.
- Security and Privacy requirements: The platform must be compliant with GDPR requirements, meaning that the storage and handling of delicate property-related data should be secure.
- Usability: the user interface should be intuitive, so that a non-IT user can operate a simple tool for exploring renovation data.

B.4 Codes and Standards

- ISO/IEC 27001 – Information Security Management: assures that sensitive property data is managed safely from end to end.
- ISO/IEC 25010 – Software Quality Requirements and Evaluation (SQuaRE): to ensure that the system is constructed so as to meet quality requirements for functionality and reliability.
- GDPR (General Data Protection Regulation): Tells the system to make sure it's safeguarding your users' and clients' information and complying with privacy laws.
- REST API Standards (RFC 2616)**: Ensures interoperability with web-based messaging protocols for integration with CoStar's APIs.
- ISO 9241-210 – Ergonomics of Human-System Interaction: Concerned with the usability of the user interface (eg, is it easy to access and navigate?).

Section C. Scope of Work

The scope of the RenovationTracker project is to design, develop, and deploy an AI-powered system that automatically detects, classifies, and visualizes property renovations in real estate listings. This project aims to integrate Natural Language Processing (NLP) and computer vision technologies into a unified platform to enhance property insights, automate room classification, and provide dynamic renovation visualization tools. The project will focus on delivering the following key objectives:

- AI-Powered Renovation Detection: Develop an NLP engine to extract renovation-related information from property descriptions.
- Automated Room Type Detection: Create a computer vision model to classify room types based on images provided in property listings.
- Interactive Renovation Visualization: Implement side-by-side comparison tools with sliders and overlays to visually compare rooms before and after renovations.
- System Integration and Testing: Ensure all components are integrated into a seamless platform, thoroughly tested for accuracy and usability.

Project Boundaries and Responsibilities:

The RenovationTracker team is responsible for the design, development, and testing of the core system functionalities, including text analysis, room classification, and renovation visualization. The team will also deliver academic materials, such as the project proposal, reports, and presentations, to meet academic deliverables.

Out-of-Scope Tasks: The following tasks fall outside the scope of the team's responsibilities:

- Development of any external tools or integrations beyond the RenovationTracker system.
- Handling server deployment logistics or costs, as this will be managed by CoStar.
- Collecting or generating new property images or data, as the project will rely on data provided by CoStar or publicly available datasets.
- Any physical hardware development or interaction with real estate platforms beyond the software deliverables outlined.

Project Timeline and Milestones:

The project follows a structured timeline with defined milestones to ensure timely delivery of all objectives. The key milestones include:

- Phase 1: Requirements Gathering & System Design (Proposal phase, 4-6 weeks)
  - Completion of the project proposal, defining system architecture, and selecting relevant datasets.
- Phase 2: Model Development & Initial Prototypes (6-8 weeks)
  - Development of the NLP engine and image classification model, followed by internal testing.
- Phase 3: System Integration & Mid-term Testing (4-6 weeks)

    - Integration of NLP and image classification components into a functional prototype.
    - Initial system testing to ensure that components work together seamlessly.
- Phase 4: Final System Testing, Feedback Integration & Refinement (4-6 weeks)
    - Conduct thorough testing, obtain user feedback, and refine the system for deployment.
- Phase 5: Final Presentation & Deliverables (2-4 weeks)
    - Complete the final design report, prepare presentations, and deliver the Capstone EXPO poster and presentation.

Development Methodology:
The RenovationTracker project will follow an Agile methodology to ensure flexibility and adaptability throughout the development process. This approach will involve iterative development cycles, with regular sprint planning, code reviews, and progress meetings with both the project sponsor (CoStar) and faculty advisors. Feedback from CoStar and internal testing will be incorporated continuously to refine the system.

Timeline Boundaries and Risk Management:
The project is expected to be completed by the end of the academic year, with all deliverables submitted according to the academic calendar deadlines. Given the Agile approach, the project will be flexible in managing unforeseen challenges or risks. To avoid scope creep, any changes in project scope will be discussed with CoStar and faculty advisors before implementation, ensuring alignment with the project's key objectives and timeline.

CoStar will provide server resources for hosting the final system, and no additional funding will be required. By proactively securing necessary tools and licenses, the team aims to avoid delays due to resource shortages or third-party dependencies. Regular communication between the team, sponsor, and advisors will be maintained to ensure the project stays within scope and on schedule.

C.1 Deliverables

The RenovationTracker project will deliver an AI-powered system that enhances property listings by automatically detecting, classifying, and visualizing renovations. The primary deliverables include a Natural Language Processing (NLP) model that extracts and analyzes renovation-related information from property descriptions, coupled with algorithms to detect renovation-specific keywords and contexts. This system will also integrate with a computer vision-based image classification model that can automatically identify and categorize room types (e.g., kitchen, bathroom) from property images. Additionally, a side-by-side renovation visualization tool will allow users to compare room images before and after renovations, featuring interactive elements such as sliders and overlays to highlight changes. The entire system, consisting of text analysis, image classification, and visualization tools, will be integrated into a unified platform, thoroughly tested for accuracy, performance, and usability. If time permits, the team will also implement a user feedback system, allowing users to verify or correct detected renovations and room classifications, contributing to the continuous improvement of the system.

Regarding academic deliverables, the team will provide a team contract, project proposal, preliminary design report, fall poster and presentation, final design report, and Capstone EXPO poster and presentation.

Most of the project work can be completed remotely. This includes coding, model development, system testing, and writing deliverables, which can be done using shared drives like Google Drive or OneDrive, and version control platforms like GitHub. The team will also leverage CoStar's cloud-hosted servers for deploying and running the RenovationTracker system, minimizing dependency on on-campus resources. However, certain tasks such as integration testing, poster printing for presentations, or final presentations may require occasional access to campus facilities. The team members who regularly access campus will coordinate these tasks to ensure they are completed on schedule.

To ensure remote work proceeds smoothly, all necessary software licenses and machine learning tools will be secured early. This includes access to Python libraries and cloud computing resources such as AWS for model training and deployment. The team will need collaborative tools like Slack or Zoom for regular meetings and progress tracking, ensuring effective remote coordination.

The project does not heavily rely on third-party vendors or components with extended lead times, as it is primarily software-based. However, to mitigate any unforeseen risks, the team will proactively manage resources such as cloud computing credits and any necessary machine learning frameworks. By planning ahead and securing these resources in advance, potential delays related to supply chain disruptions will be avoided. Additionally, the team will work closely with CoStar to ensure server access is consistently available and properly maintained for the deployment and testing phases.

C.2 Milestones

The first milestone for the RenovationTracker project is the Project Proposal & Requirements Gathering, where the team will finalize the project proposal, define the system architecture, and gather data for both the NLP and image classification models. This phase is expected to take 4 weeks, with a completion date set for October 15, 2024.

Following that, the team will focus on NLP Model Development, which involves building and training the NLP engine to extract renovation-related information from property descriptions. This milestone will require 3 weeks and is anticipated to be completed by November 5, 2024.

Next, the team will work on the Image Classification Model Development, where the computer vision model to classify room types from property images will be developed. This phase will take 3 weeks, with a target completion date of November 26, 2024.

The Initial System Integration will follow, where the NLP engine and image classification model will be integrated into a unified system. This task will take 2 weeks and is expected to be finished by December 10, 2024.

After integration, the team will move to Preliminary System Testing, testing all system components for functionality, accuracy, and performance. Internal debugging and improvements will be made during this 2-week phase, with a completion date of January 10, 2025.

The Mid-term Report & Presentation will involve preparing and submitting the mid-term report, as well as presenting the current project status to sponsors and faculty advisors. This milestone will take 2 weeks, with a deadline of January 24, 2025.

The team will then focus on the Side-by-Side Renovation Visualization Tool, where an interactive tool for comparing before-and-after renovation images, including sliders and overlays, will be developed and tested. This will take 3 weeks and should be completed by February 14, 2025.

If time allows, the team will work on the User Feedback Mechanism Development (a stretch goal), implementing a feedback system for users to confirm or correct renovation detections and room classifications. This task is estimated to take 2 weeks and would be completed by February 28, 2025.

Next is Final System Integration & Refinement, where the team will fully integrate all components, refine the system based on user feedback, and finalize the platform for deployment. This phase will take 3 weeks, with a completion date of March 20, 2025.

The Final Testing & Quality Assurance phase will follow, where the team will conduct thorough testing to ensure the system's accuracy, usability, and performance under various scenarios. This will take 2 weeks and is expected to be completed by April 3, 2025.

Finally, the team will work on the Final Report & Capstone EXPO Preparation, where they will prepare the final design report, as well as the poster and presentation materials for the Capstone EXPO. This phase will take 3 weeks, with a deadline of April 24, 2025.

The last milestone is the Capstone EXPO Presentation, where the team will present the project at the Capstone EXPO. This will take 1 week and is scheduled for completion by April 30, 2025.

C.3 Resources

The RenovationTracker project requires several key resources for successful completion, which will either be provided by the project sponsor, CoStar, or made available through existing tools and platforms. These resources are categorized into software, hardware, and data resources as outlined below.

Software Resources:

- Natural Language Processing Libraries: The project will require access to NLP libraries such as spaCy, NLTK, or Transformers (Hugging Face) for extracting and analyzing renovation-related data from property descriptions. These are open-source libraries that can be used free of charge.
- Computer Vision Frameworks: The development of the room type classification model will utilize computer vision libraries such as TensorFlow, Keras, or PyTorch. These frameworks will be necessary for training and deploying machine learning models for image classification.
- Integrated Development Environment (IDE): The team will require access to coding environments such as PyCharm, Visual Studio Code, or Jupyter Notebooks for writing, testing, and debugging code.
- Version Control System: To facilitate collaboration among team members, the project will use GitHub for version control and code management. This will allow multiple developers to work on different components of the project simultaneously.
- Cloud Services: CoStar will provide access to cloud servers for hosting and deploying the RenovationTracker system. This is essential for scaling the system to handle larger datasets and for testing the platform in a production-like environment.
- Machine Learning Platforms: If additional computing power is needed for model training, cloud-based services such as Google Cloud AI, AWS SageMaker, or Azure Machine Learning may be utilized to speed up the development process.

Hardware Resources:

- Cloud Servers (Provided by CoStar): The system will be hosted on cloud servers provided by CoStar, which will support both development and testing environments. These servers will be used to run the AI models, integrate components, and deploy the platform for testing and user feedback.
- Personal Laptops/PCs: The team will primarily use personal laptops and PCs for code development, local testing, and prototype iterations before deploying to the cloud environment.

Data Resources:

- Property Listing Descriptions (Provided by CoStar): A dataset containing property listing descriptions will be required to train and test the NLP model. This data will be provided by CoStar, ensuring relevance to the real estate industry.
- Property Images (Provided by CoStar): Images of various rooms (e.g., kitchens, bathrooms, living rooms) in different properties will be needed to train the computer vision model. These will also be provided by CoStar as part of the project sponsorship.
- Pretrained Models: The team may leverage pretrained models for NLP and computer vision tasks from open-source platforms like Hugging Face or ImageNet. These pretrained models will significantly reduce the time required to build models from scratch.

Additional Resources:

- Collaboration Tools: Remote collaboration tools such as Slack and Zoom will be used for team communication, regular meetings, and discussions with project sponsors and faculty advisors.
- Documentation and Reporting Tools: Tools such as Google Docs or Microsoft Word will be used for creating project documentation, including reports and presentations for mid-term and final evaluations.

Section D. Concept Generation

A number of methods can be used to help generate design concepts from simple reflection and brainstorming, to working the problem backwards, using reverse thinking techniques, and looking to nature for inspiration (i.e. biomimicry). Existing solutions, or components of existing solutions, can be substituted, combined, adapted, modified, put to other uses, eliminated, or rearranged to meet new design objectives and specifications. A minimum of 3 overall design concepts is required for this section although more are welcome. Provide a brief description of how each design concept addresses the design problem. Discuss the potential pros and cons, including and potential risks of failure, of each of these concepts.

It is likely that each design concept may consist of several components. In this case, one or more of these components may offer a sub-problem that can be further explored, modified, or otherwise improved upon. These sub-problems may lead to the addition of several additional design concepts and may require the inclusion of a design concept chart or matrix to organize all ideas and potential solutions.

Provide any initial design sketches, drawings, 3D renderings, or conceptual models such as dataflow diagrams, process flows, etc. developed during the concept ideation phase. All hand drawings should be drawn to scale using basic engineering drafting tools (i.e. ruler, protractor, and compass). Geometric stencils can also be used to help produce quality hand drawings. Drawings should be presented in a profession manner, preferably done on engineering graph paper and using a high-quality scan. All sketches should be labeled to identify major components and different drawing views or projections if applicable. Basic dimensions should be provided to give a general sense of scale. Label each sketch or drawing with the name of the team member responsible for the sketch, the date it was drawn, and the drawing scale.

Section E. Concept Evaluation and Selection

Using a systematic decision-making process, evaluate each of the design concepts and choose the one that is most likely to succeed in meeting the design objectives and constraints. A Decision Matrix, or Pugh Matrix, helps to analyze alternatives, eliminate biases, and make rational decisions through thought and structure. First, work to develop a set of selection criteria for which to evaluate the previously generated design concepts. Selection criteria often include concepts of performance, cost, safety, reliability, risk, etc. Note that the selection criteria developed here will likely be more general than the project design objectives. As with the design objectives, conversations with the client help define appropriate selection criteria.

In many cases, the client may value the selection criteria differently, preferring that more emphasis be placed on some than others. In this case, weighting factors may be used to place more or less importance on the various criteria in the decision making process. Again, conversations with the client can be used to define criteria weighting factors. Often times, these conversations must be analyzed and interpreted by the team to determine which criteria are more important to the client and by how much. Feel free to discuss the assigned weighting factors with the client to see if they seem accurate.

Next, define an associated metric to represent each criteria. Metrics should be specific and quantifiable, providing numerical values that quantify the often vague concepts of the selection criteria. Metrics can be obtained, generated, or estimated through a number of methods including simple background research, preliminary design calculations, or basic analyses. Note that these metrics do not need to specifically align with the design specifications although there may be some commonality between the two. Provide a brief discussion of the rationale for selecting each of the assigned metrics.

Using the defined metrics, evaluated each design concept against all selection criteria by filling out a Decision Matrix. Design concepts can be compared by using simple rank scoring, raw scoring, or weighted scoring techniques and design concept with which to move forward can be selected. This type of process provides a meaningful, unbiased means for choosing a preliminary design concept prior to moving forward with more comprehensive, detailed analyses as provided in the design methodology section below. The results of this process should be discussed with the project client prior to moving forward with the selected design. Table 1 provides an example of a simple decision matrix.

Table 1. Example of a Decision Matrix.

	Design Concept A	Design Concept B	Design Concept C	Design Concept D
Criteria 1				
Criteria 2				
Criteria 3				
Criteria 4				
Criteria 5				
Total Score				

Note: Weights can be assigned to each criterion if desired.

Section F. Design Methodology

Provide a detailed explanation of the methods that will be used to help evaluate, improve, and evolve the design through the iterative engineering design process. Consider that ultimately, the final design must be verified and validated to ensure that it meets all of the previously developed and listed design objectives and specifications. Verification ensures that the design meets all specification, while validation confirms that the design functions as intended such to meet the client's needs. While it is common for initial design concepts to first be evaluated using simplified design criteria and metrics, the chosen design should be advanced, and later verified, using engineering calculations, computational models, experimental data, and/or testing procedures.

Use this section to describe any underlying physical principles and mathematical equations that govern the design. Provide details of any computer-aided modeling techniques used to evaluate the design including the software used, prescribed boundary conditions, and assumptions. Include a detailed description of any experimental testing methods including required testing equipment, test set-up layout, data acquisition and instrumentation, and testing procedures. If one or more prototypes is to be produced and tested, provide a detailed description of how each will be evaluated.

Note: The contents of this section are expected to vary from project to project. Subsections may be appropriate for providing details of analytical, computational, experimental, and/or testing methods. Some potential subsections that may be included in this section are provided. While critical design equations may be provided here, lengthy mathematical derivations may be included in an appendix. Validation procedures are critical and all projects should address such topic.

F.1 Computational Methods (e.g. FEA or CFD Modeling, example sub-section)

F.2 Experimental Methods (example subsection)

F.3 Architecture/High-level Design (example subsection)

F.5 Validation Procedure

Describe how the design team will validate that the final design meets the client's needs. This section should include a plan to meet with the client towards the end of the project to discuss final design details and demonstrate a prototype, experimental test, and/or simulation results. Provide a relative time frame for this validation to occur (e.g. "mid-March" or "early-April"). Include a brief discussion on how client feedback will be captured, such as a formal survey, interview, or observation notes of the client using the prototype. It may also include plans to solicit feedback from other stakeholders and/or potential users.

Section G. Results and Design Details

Use this section to highlight the major results of the design methodology described above including important analytical, computational, experimental, modeling, assembly, and testing results. This section should be one of the most substantial sections of the report showcasing all of the hard work and effort that went into the completion of the final design and delivery of the project deliverables. Show how the identified problem was solved.

Highlight the prominent features of the final design through analysis results, modeling, drawings, renderings, circuit schematics, instrumentation diagrams, flow and piping diagrams, etc. to show that the design functions as intended and meets all design objectives and constraints. Overview designs such as dataflow diagrams, process flow, swim lane diagrams, as well as presentation-layer designs (e.g. storyboards for front-ends) should be included here. Detailed designs such as database designs, software designs, procedure flowcharts, or pseudocode should be included here. Support computational and experimental results with key plots and figures. All supporting figures should be clearly labeled and annotated to highlight the most important points of the figure (i.e. explicitly point out what the reader should focus on or understand about the image).

Note that while all results should be used to help inform design decisions, not all results may be necessary to include in the main body of the report. Extraneous supporting results (e.g. graphs, data, design renderings, drawings, etc.) that are not necessary for presenting the fundamental findings can be placed in one or more appendices. Detailed documentation of each program module can be provided as appendix.

G.1 Modeling Results (example subsection)

G.2 Experimental Results (example subsection)

G.3 Prototyping and Testing Results (example subsection)

G.4. Final Design Details/Specifications (example subsection)

Note that while the design constraints and specifications may have provided minimum or maximum values, or ranges or values, that the design needed to meet, the final design specifications should be listed here showing that the required design values were met. A list of final design details can also be included demonstrate fulfillment of the design objectives.

Note: Preliminary results should be included in the Preliminary Design Report to show the progress made of the selected design concept to-date. This section should be updated for the Final Design Report to include documentation of all of the work that was completed on the project throughout the entirety of the academic year.

Section H. Societal Impacts of Design

In addition to technical design considerations, contemporary engineers must consider the broader impacts that their design choices have on the world around them. These impacts include the consideration of public health, safety, and welfare as well as the potential societal, political/regulatory, economic, environmental, global, and ethical impacts of the design. As appropriate for the project design, discuss how each of these considerations influenced design choices in separate subsections. How will the design change the way people interact with each other? What are the political implications of the design? Does the technology have the potential to impact or shift markets? Does the design have any positive or negative effects on the environment? Don't forget to consider unintended consequences such as process or manufacturing byproducts. What impacts might the design have on global markets and trade? Are there any ethical questions related to the design?

While it is hard to forecast the various impacts of a technology, it is important to consider these potential impacts throughout the engineering design process. When considered during the early stages of the design phase, consideration of these impacts can help determine design objectives, constraints, and specifications and help drive design choices that may mitigate any potential negative impacts or unintended consequences.

Note: A minimum of 4 of these design considerations, including the consideration of public health, safety, and welfare, are required for the Preliminary Design Report while a section for all considerations must be included in the final design report.

H.1 Public Health, Safety, and Welfare

Provide a list of all design safety features and provide a brief description of each. Discuss the potential effects the design may have on public health, safety, and welfare. References to the codes and standards previous provided and the organizations that produced them may be summarized or referenced here.

H.2 Societal Impacts

H.3 Political/Regulatory Impacts

H.4. Economic Impacts

H.5 Environmental Impacts

H.6 Global Impacts

H.7. Ethical Considerations

Section I. Cost Analysis

Provide a simple cost analysis of the project that includes a list of all expenditures related to the project. If an experimental test set-up or prototype was developed, provide a Bill of Materials that includes part numbers, vendor names, unit costs, quantity, total costs, delivery times, dates received, etc. Do not forget to include all manufacturing costs incurred throughout the completion of the project. If the design is expected to become a commercial product, provide a production cost estimate including fixed capital, raw materials, manufacturing (including tooling and/or casting), and labor costs to produce and package the device. Note that this type of detailed cost analysis may be listed as a project deliverable.

Note: The Preliminary Design Report should include all costs incurred to date. It is expected that this section will be expanded and updated between the preliminary and final design reports.

Section J. Conclusions and Recommendations

Use this section to summarize the story of how the design team arrived at the final design. Focus on the evolution of the design through the use of the engineering design process including lessons learned, obstacles overcome, and triumphs of the final design. Revisit the primary project goals and objectives. Provide a brief summary of the final design details and features paramount to the function of the design in meeting these goals and objectives.

A discussion may be included to discuss how the design could be further advanced or improved in the future. If applicable, summarize any questions or curiosities that the final results/design of this effort bring to mind or leave unanswered. If this project might continue on as a future (continuation) senior design project, detail the major milestones that have been completed to date and include any suggested testing plans, relevant machine drawings, electrical schematics, developed computer code, etc. All relevant information should be included in this section such that future researchers could pick up the project and advance the work in as seamless a manner as possible. Documents such as drawings, schematics, and codes could be referenced here and included in one or more appendix. If digital files are critical for future work, they should be saved on a thumb drive, external hard drive, cloud, etc. and left in the hands of the project advisor and/or client.

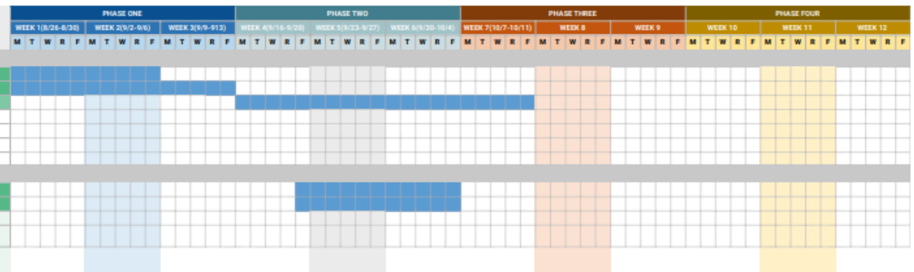
Appendix 1: Project Timeline

Gantt chart - Gantt Chart.pdf

CS 25-348 Gannt Chart

PROJECT TITLE	RenovationTracker	COMPANY NAME	CoStar
PROJECT MANAGER	Khajamoinuddin Syed	DATE	10/10/24

Number	TASK	TASK OWNER	START DATE	DUE DATE	DURATION	PCT OF TASK COMPLETE
Semester 1	**Class Assignments**					
1.1	Team Contract	Team	8/26/24	9/6/24	10	100%
1.2	GitHub Repo	Team	8/26/24	9/13/24	17	100%
1.3	Project Proposal	Team	9/16/24	10/11/24	25	75%
1.4	Fall Design Poster	Team	10/11/24	11/15/24	34	0%
1.5	Preliminary Design Report	Team	11/15/24	12/9/24	24	0%
1.6					0	0%
1.6					0	0%
Semester 1	**Project Work**					
2.1	Create AWS Account	Team	9/20/24	10/5/24	15	100%
2.2	Download JS and run previous repo	Team	9/20/24	10/5/24	15	100%
2.3	Explore Image Classification	Jaidon	10/3/24	10/18/24	15	10%
2.4	Set Up - ChatGPT run the python script	Sterling	10/3/24	10/28/24		10%
2.5	Webscrapping the images	Jonathan	10/3/24	10/19/2024		10%
2.6	UI Design	Courtney	10/3/24	10/19/24		10%



Appendix 2: Team Contract (i.e. Team Organization)

Copy and paste the content from the completed Team Contract here starting with Step 1 of the Team Contract and including all content following the 'Contents' list.

Step 1: Get to Know One Another. Gather Basic Information.

Task: This initial time together is important to form a strong team dynamic and get to know each other more as people outside of class time. Consider ways to develop positive working relationships with others, while remaining open and personal. Learn each other's strengths and discuss good/bad team experiences. This is also a good opportunity to start to better understand each other's communication and working styles.

Team Member Name	***Strengths each member bring to the group***	***Other Info***	***Contact Info***
Sterling Glasheen	Communication, problem solving, open-minded, adjustable,	Open to working to lead the team to achieving a great working product.	glasheensm@vcu.edu (804) 971-2901
Jaidon Lightfoot	Communication, adaptability, problem solving, open-minded	Works as a receiving assistant in the ERB.	lightfootjb@vcu.edu (757)663-1692 lightfxxt on discord
Courtney Van	Communication, organization, problem-solving	Currently works in Open Cyber City Lab as a Research Assistant, working with machine learning in Python	vanct2@vcu.edu 572-383-6353 cornbreads on discord
Jonathan Netala	Communication, attention-to-detail, problem-solving, resourcefulness	Experience working with machine learning models and automating data processes for real-world applications; in the past, e.g. a financial market analysis tool	netalajd@vcu.edu (804)-385-9408 pakalutupaki on discord

Other Stakeholders	*Notes*	*Contact Info*
Preetam Ghosh	*No notes*	pghosh@vcu.edu
Syed Khajamoinuddin	*No notes*	ksyed@costar.com

Step 2: Team Culture. Clarify the Group's Purpose and Culture Goals.

Task: Discuss how each team member wants to be treated to encourage them to make valuable contributions to the group and how each team member would like to feel recognized for their efforts. Discuss how the team will foster an environment where each team member feels they are accountable for their actions and the way they contribute to the project. These are your Culture Goals (left column). How do the students demonstrate these culture goals? These are your Actions (middle column). Finally, how do students deviate from the team's culture goals? What are ways that other team members can notice when that culture goal is no longer being honored in team dynamics? These are your Warning Signs (right column).

Resources: More information and an example Team Culture can be found in the Biodesign Student Guide "Intentional Teamwork" page (webpage | PDF)

Culture Goals	***Actions***	***Warning Signs***
Clearly defined goals	- track progress - setting realistic goals - roles are clear	- Student missed deadlines - student overwhelmed - task is not complete
Open communication	- promote accountability - responding in a timely manner - open to criticism	- misunderstanding/confusion - not speaking up
Have fun	- Celebrate wins - encourage each other - recognize achievements	- overly stressed - unenthusiastic meetings - low energy

Step 3: Time Commitments, Meeting Structure, and Communication

Task: Discuss the anticipated time commitments for the group project. Consider the following questions (don't answer these questions in the box below):

- What are reasonable time commitments for everyone to invest in this project?
- What other activities and commitments do group members have in their lives?
- How will we communicate with each other?
- When will we meet as a team? Where will we meet? How Often?
- Who will run the meetings? Will there be an assigned team leader or scribe? Does that position rotate or will same person take on that role for the duration of the project?

Required: How often you will meet with your faculty advisor advisor, where you will meet, and how the meetings will be conducted. Who arranges these meetings?
See examples below.

Meeting Participants	***Frequency*** ***Dates and Times / Locations***	***Meeting Goals*** ***Responsible Party***
Students Only	As Needed, On Discord Voice Channel or in text channels	Update group on day-to-day challenges and accomplishments and relay what needs to be done
Students Only	Every Thursday during class time, on discord	Actively work on the project. Discuss ideas and plan for the future. Assign tasks.
Students + Faculty advisor	3:30 Every Friday on Microsoft Teams	Updates on tasks and assigning of tasks
Project Sponsor	3:30 Every Friday on Microsoft Teams	Updates on tasks and assigning of tasks

Step 4: Determine Individual Roles and Responsibilities

Task: As part of the Capstone Team experience, each member will take on a leadership role, ***in addition to*** contributing to the overall weekly action items for the project. Some common leadership roles for Capstone projects are listed below. Other roles may be assigned with approval of your faculty advisor as deemed fit for the project. For the entirety of the project, you should communicate progress to your advisor specifically with regard to your role.

- **Before meeting with your team**, take some time to ask yourself: what is my "natural" role in this group (strengths)? How can I use this experience to help me grow and develop more?
- **As a group,** discuss the various tasks needed for the project and role preferences. Then assign roles in the table on the next page. Try to create a team dynamic that is fair and equitable, while promoting the strengths of each member.

Communication Leaders

Suggested: Assign a team member to be the primary contact <u>for the client/sponsor</u>. This person will schedule meetings, send updates, and ensure deliverables are met.

Suggested: Assign a team member to be the primary contact <u>for faculty advisor</u>. This person will schedule meetings, send updates, and ensure deliverables are met.

Common Leadership Roles for Capstone

1. **Project Manager:** Manages all tasks; develops overall schedule for project; writes agendas and runs meetings; reviews and monitors individual action items; creates an environment where team members are respected, take risks and feel safe expressing their ideas.
   Required: On Edusourced, under the Team tab, make sure that this student is assigned the Project Manager role. This is required so that Capstone program staff can easily identify a single contact person, especially for items like Purchasing and Receiving project supplies.
2. **Logistics Manager:** coordinates all internal and external interactions; lead in establishing contact within and outside of organization, following up on communication of commitments, obtaining information for the team; documents meeting minutes; manages facility and resource usage.
3. **Financial Manager:** researches/benchmarks technical purchases and acquisitions; conducts pricing analysis and budget justifications on proposed purchases; carries out team purchase requests; monitors team budget.
4. **Systems Engineer:** analyzes Client initial design specification and leads establishment of product specifications; monitors, coordinates and manages integration of sub-systems in the prototype; develops and recommends system architecture and manages product interfaces.
5. **Test Engineer:** oversees experimental design, test plan, procedures and data analysis; acquires data acquisition equipment and any necessary software; establishes test protocols and schedules; oversees statistical analysis of results; leads presentation of experimental finding and resulting recommendations.

6. **Manufacturing Engineer:** coordinates all fabrication required to meet final prototype requirements; oversees that all engineering drawings meet the requirements of machine shop or vendor; reviews designs to ensure design for manufacturing; determines realistic timing for fabrication and quality; develops schedule for all manufacturing.

Team Member	***Role(s)***	***Responsibilities***
Jonathan Netala	Financial Manager	-Research pricing for tools and software required for renovation detection. -Manage the project's budget and ensure financial resources are allocated efficiently.
Sterling Glasheen	Project Manager	- Develop and assign tasks to members. - Oversee meetings. - Make sure deadlines are met and communication is occurring.
Jaidon Lightfoot	Logistics Manager	- lead communication efforts - information gathering - document meeting minutes
Courtney Van	Test Engineer	- Create experimental design plan - Lead debug and analysis of results - Lead presentations of experimental finding and further recommendations

Step 5: Agree to the above team contract

Team Member: *Signature: _Jaidon Lightfoot_________________________*

Team Member: *Signature: _Courtney Van_______________________*

Team Member: *Signature: _Sterling Glasheen_______________*

Team Member: *Signature: _Jonathan Netala__________*

Appendix 3: [Insert Appendix Title]

Note that additional appendices may be added as needed. Appendices are used for supplementary material considered or used in the design process but not necessary for understanding the fundamental design or results. Lengthy mathematical derivations, ancillary results (e.g. data sets, plots), and detailed mechanical drawings are examples of items that might be placed in an appendix. Multiple appendices may be used to delineate topics and can be labeled using letters or numbers. Each appendix should start on a new page. Reference each appendix and the information it contains in the main text of the report where appropriate.

Note: Delete this page if no additional appendices are included.

References

Provide a numbered list of all references in order of appearance using APA citation format. The reference page should begin on a new page as shown here.

[1] VCU Writing Center. (2021, September 8). *APA Citation: A guide to formatting in APA style.* Retrieved September 2, 2024. https://writing.vcu.edu/student-resources/apa-citations/

[2] Teach Engineering. *Engineering Design Process*. TeachEngineering.org. Retreived September 2, 2024. https://www.teachengineering.org/populartopics/designprocess