**Innovative AI Solutions for Smart Construction**

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**Bachelors of Science in Computer Science**

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**Riphah International University, Islamabad**

Date: [date of final presentation]

**Final Approval**

This is to certify that we have read the report submitted by ***Mir Allahyar Khan Talpur (36527), Syed Touqeer Hussain Shah (32161), Haider Ali (32404)*** for the partial fulfillment of the requirements for the degree of the Bachelors of Science in Computer Science (BSCS). It is our judgment that this report is of sufficient standard to warrant its acceptance by Riphah International University, Islamabad for the degree of Bachelors of Science in Computer Science (BSCS).

**Committee:**

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| **1** | [Name Supervisor]  (Supervisor) |
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**Declaration**

We hereby declare that this document “**Innovative AI Solutions for Smart Construction**” neither as a whole nor as a part has been copied out from any source. It is further declared that we have done this project with the accompanied report entirely on the basis of our personal efforts, under the proficient guidance of our teachers, especially our supervisor **Mubariz Rehman**. If any part of the system is proved to be copied out from any source or found to be reproduction of any project from anywhere else, we shall stand by the consequences.

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**Dedication**

Our project is dedicated to our parents, seniors, friends and our supervisor “Mubariz Rehman” whose unwavering support, guidance and inspiration have been instrumental to its success. We are deeply grateful for their love and encouragement throughout this journey. Their belief in us has fueled our determination to overcome challenges and achieve our goals. This achievement stands as a testament to their continuous care and mentorship and we dedicate every millstone to them.

**Acknowledgement**

First of all, we are obliged to Allah Almighty the Merciful, the Beneficent and the source of all Knowledge, for granting us the courage and knowledge to complete this Project.

We would like to express our sincere gratitude to our project supervisor “Mubariz Rehman” whose invaluable guidance, advice, and constant support have played a key role in the successful completion of this project. Without his expertise and encouragement this work would not have been possible.

We are also deeply thankful to our parents and family whose unwavering support and belief in us have been a constant source of strength. They have instilled in us the values of honesty, hard work and perseverance which have been instrumental in the completion of this project.

Our heartfelt thanks go to our teachers, classmates and friends for their encouragement and assistance throughout this journey. Their collective support has helped us stay motivated and focused making this achievement even more meaningful.

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

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**Abstract**

As technology continues to reshape industries, AI is opening up exciting possibilities in construction, making complex tasks easier and more accessible for everyone involved. Our project “**Innovative AI Solutions for Smart Construction**” introduces a user-friendly platform designed to simplify the construction process, especially for homeowners, service providers and contractors. With this platform users can generate front elevation designs for their house by simply entering plot front size, making professional design accessible at their fingertips.

Beyond design the platform also provides detailed cost estimation factoring in current market rates with material and without material, so users have a clear understanding of their budget right from the start. Additionally, the platform support community chat where users, contractors and service providers can interact, ask questions and share insights. To simplify the process, a bidding system allow users to submit their project proposal, which are then displayed to all contractors. This ensures contractor can review various projects, understand the requirements and make informed decisions based on their expertise, vision and budget alignment. This blend of AI-driven design, cost transparency, real-time interaction and competitive bidding aims to transform residential construction into a more seamless, efficient and personalized experience for everyone involved.

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# Abstract

**Innovative AI Solutions for Smart Construction** is a web-based platform designed to streamline the residential construction planning process, focusing on standard size. Built using the **MERN** *(MongoDB, Express, React, Nodejs)* **Stack**, this platform leverages **generative AI** to automatically produce front elevation designs, enabling users to visualize and customize their home exteriors with ease.

The platform also includes a **cost estimation** tool that calculates projected construction expenses based on current market rates for materials and labor, providing users with clear financial insights for their projects. For seamless communication, a **community chatbot** facilitates real-time interaction, allowing users, contractors and service providers to connect and collaborate effortlessly. Additionally, a **bidding featu**re enables user to submit competitive proposals, giving users the flexibility to choose the best fit for their project. With its unique combination of AI-driven design, budget clarity, interactive community support and a streamlined bidding process, this platform offers a complete solution that simplifies construction planning for house.

# Introduction

The real estate construction industry has always faced challenges with using modern technology. This has led to inefficiencies, poor coordination and major delays in projects. Even though platforms like Houzz and Thumbtack help with specific tasks such as design and managing vendors, they don’t cover the entire construction process. This makes things harder for homeowners, contractors and others involved in building houses. As a result, there are problems like inaccurate cost estimates, project delays and communication issues among teams.

To solve these problems, this project proposes a web-based platform that uses artificial intelligence (AI) to make the construction process smoother. The idea is to use AI for house design, estimating costs and improving communication between everyone involved. This platform will make the whole process more efficient, reduce the need for in-person meetings and speed up decision-making. The goal is to create a seamless, integrated solution that improves coordination, cuts down on delays and ensures more accurate cost estimates. This will lead to construction projects being completed in a more efficient and cost-effective way.

The proposed platform will use Deep learning, specifically a DCGAN (Deep Convolutional Generative Adversarial Network) model, to generate house designs based on user preferences. Users can input their plot dimension and the AI will create realistic front elevation designs for houses. It will also provide accurate cost estimates based on current market prices. In addition, the platform will include a community chat feature to allow homeowners, contractors and service providers to communicate easily and work together throughout the construction process. With a dataset of 500-600 images of house designs, the AI model will be able to create detailed and realistic house plans for standard plot sizes.

This chapter introduces the key issues in the real estate construction industry, explains why using AI is important for improving the construction process, and outlines the goals of the project. The next sections will go into more detail about the specific objectives and the scope of the project, offering a clear plan for developing and implementing the platform.

## Goals and Objectives

**Goals:**

* To provide an AI-powered platform that integrates design, cost estimation and vendor communication in the real estate construction industry.
* To streamline the house construction process by automating design generation and providing accurate cost estimates.
* To improve communication and collaboration between stakeholders, reducing the need for in-person meetings and accelerating project decision-making.

**Objectives:**

* To develop a system that uses Deep learning algorithms (DCGAN) to generate front elevation designs.
* To implement a cost estimation tool that calculates construction costs using current market rates and material costs.
* To facilitate collaboration between contractors, service provider and homeowners through an integrated community chat feature.
* To address the issues of poor coordination, inaccurate cost estimates and delays commonly experienced in the traditional construction process.

## Scope of the Project

The scope of this project includes the development of a web-based platform built on AI technologies, with the following key features:

* **AI-Based Design Generation**: The platform will allow users to generate customized front elevation designs of houses using Deep Learning algorithm (DCGAN).
* **Cost Estimation**: The system will provide accurate cost estimates for house construction based on current market rates, material costs and user-specific preferences.
* **Community Chat**: A feature that enables communication and collaboration among different stakeholders, including homeowners, contractors, service provider and other parties involved in the construction process.
* **Bidding System**: It allows users to submit their project proposal, which are then displayed to all contractors. This ensures contractor can review various projects, understand the requirements and make informed decisions based on their expertise, vision and budget alignment.
* **Contractor and service provider**: It allow user to find contractor and service provider.
* **Data Set**: The platform will use a dataset of 500-600 images of front house elevations, collected from various architectural sources, to train the AI model.

The project will focus on integrating the main elements Design, cost estimation, Bidding system, find contractor, find service provider and communication—into a single platform, with the goal of improving overall efficiency, reducing delays and minimizing errors in cost Calculation. The platform will be accessible online, providing an easy-to-use interface for homeowners and contractors to interact and collaborate efficiently. Future versions of the platform may expand to include additional features or support a wider range of architectural designs.

# Literature Review

**For each related work provide a paragraph of introduction and in the end a paragraph of conclusions.** Give a page break after the chapter ends. **This chapter is mandatory.**

For development projects describe related or similar work done by other teams and details of their methods/algorithms. For a research project a detailed literature survey is expected.

## Introduction

## Background and Problem Elaboration

## Detailed Literature Review

### Definitions

### Related Research Work 1

### Related Research Work 2

## Literature Review Summary Table

The columns in the table depend upon your problem and should be specific to your project.

Table 1: History of Computing Devices

The summary of various computing devices invented in the past from 1833-1901 is presented here.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| No. | Name, reference | Inventor | Year | Input | Output | Description |
| 1. | Analytical Engine, [1] | Charles Babbage | 1833 | Punch cards | Printer, curve plotter, bell | First general purpose computer that had an arithmetical logic unit and could compute using conditional branching and loops. Also incorporated integrated memory. |

## Research Gap

## Problem Statement

# Requirements and Design

Describe all modules of requirements and design in clear English text along with the necessary diagram and figures. Anyone reading your report should be able to reproduce your system/results after reading it.

**For each chapter provide a paragraph of introduction and in the end a paragraph of conclusions.** Make sure no heading/subheading is blank. Write text to introduce each section as well.

Introduce sub-heading as:

## Requirements

### Functional Requirements

### Non-Functional Requirements

### Hardware and Software Requirements

## Proposed Methodology

## System Architecture

## Use Cases

### Sample Use Case Name Here

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | | Sample Use Case Name Here | | |
| Actors | | Admin, Business Owner, Store Manager | | |
| Summary | | The user shall provide their email and password on the login form and after successful verification, redirect the user to the home page. | | |
| Pre-Conditions | | The user must be in the database records either added by any of the authorized users or added manually by a developer.  The user must not already be logged in. | | |
| Post-Conditions | | The user’s session is successfully established and shall be redirected to the home page. | | |
| Special Requirements | | None | | |
| Basic Flow | | | | |
| Actor Action | | | **System Response** | |
| 1 | The user opens the login page. | | 2 | The login page is displayed asking for email and password. |
| 3 | The user enters valid email and password. | | 4 | The system verifies the email and password, establishes a session for the user and redirects the user to the home page. |
| **Alternative Flow** | | | | |
| 3 | The user enters invalid email or password. | | 4-A | The system responds with an error message: *Incorrect email or password entered.* |

## Database Design *(Optional)*

## Class Diagram (*Optional)*

## Sequence diagram *(Optional)*

## Any Other Artifact…

## GUI Graphical User Interfaces (*Optional)*

This section should give the GUI dumps of each screen, with reference to the user. The navigation flow of each user is also required, and each GUI should mark the functionality/use case that it covers.

# Implementation and Test Cases

**For each chapter provide a paragraph of introduction and in the end a paragraph of conclusions.**

## Implementation

Whatever implementation that you have done so far, please elaborate here.

Give clear details of the algorithms that were implemented along with the platform and the APIs which were used. **For FYP-1, this chapter can be changed to description of prototype developed.**

### Implementation of First Component/Algorithm

Write implementation of first component of your system here.

## **Test case Design and description**

**This section will be added in FYP-II.** Summarize the common attributes of test cases. This may include input constraints that must be true for every input in the set of associated test cases, any shared environmental needs, any shared special procedural requirements, and any shared case dependencies. The following scheme is recommended for describing test cases in detail.

### Sample Test case No.1

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **<Software component Name>** | | | | | |
| **<Reference>** | | | | | |
| Test Case ID: | | *Reference Number* | Test Date: | | *Date* |
| Test case Version: | | *Version number* | Use Case Reference(s): | | *Relation to use cases* |
| Revision History: | | *Refer to previous test case identity (if any)* | | | |
| Objective | | *Need and scope of the testing* | | | |
| Product/Ver/Module: | | *Refer to overall system being built and the place of this test case in it.* | | | |
| Environment: | | *Necessary and desired properties of the test environment. (hardware/software)* | | | |
| Assumptions: | | *Assumptions that might affect the testing process.* | | | |
| Pre-Requisite: | | *Necessary condition that needs to be fulfilled prior to the test case.* | | | |
| Step No. | Execution description | | | Procedure result | |
|  | *Events being tested.* | | | *Mention software response.* | |
| Comments: | | | | | |
| *Passed* *Failed* *Not Executed* | | | | | |

### Sample Test case No.2

.

.

.

## Test Metrics

Summarize here the common ground of attributes of test case metrics.

### Sample Test case Matric.No.1

|  |  |
| --- | --- |
| Metric: | Purpose |
| Number of Test Cases: | Total number of test cases that you have developed for your system. |
| Number of Test Cases Passed: | The number of test cases that successfully passed |
| Number of Test Cases Failed: | The number of test cases that failed |
| Test Case Defect Density: | (No of test cases failed \* 100)  No of test cases executed |
| Test Case Effectiveness: | No of defects detected using test cases \*100  Total number of defects detected |
| Traceability Matrix: | Traceability is the ability to determine that each feature has a source in requirements and each requirement has a corresponding implemented feature. |

### Sample Test case Metric.No.2

### Sample Test case Metric.No.3

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# Experimental Results and Analysis

**This chapter will be added in FYP-II.** Give proper analysis and discussion of experimental results (in plain English text) along with tables of results. **For each chapter provide a paragraph of introduction and in the end a paragraph of conclusions.**

# Conclusion and Future Directions

**This chapter is mandatory.** Give conclusions and summary of the work done. What were your findings and what were the results? Discuss in detail whether the scope of your project was entirely covered or not and whether the objectives of the project were met or not. What challenges did you face and what has been left out and why?

Sum up all the conclusions of all the chapters here to make a conclusion chapter. Do not repeat any text, just summarize it in different words.

Give recommendations for future work also. How your project can be further enhanced or improved? Future recommendations if someone wants to work on it. **For FYP-1 it is mandatory to list down a plan of the work to be done for FYP-2.**

# References

List all important sources of information which have been consulted for this project

# Appendix

## Appendix A: Guidelines

This section should include all supporting information from the project that was not included in the body of the report.  You should include surveys, complex statistical calculations, certain detailed tables and other such information in an appendix.  The information presented in this section is important to support the work presented in the body of the report but would make it more difficult to read and understand if presented within the body of the report.

Cite the appendix items in the report narrative (write "see Appendix A") and organize appendices (e.g., Appendix A, Appendix B,

Any tables, figures, forms, or other materials that are not totally central to the analysis but that need to be included are placed in the Appendix.

## Appendix B: Heading of Sample Appendix B

Following is a sample code with “code” style format.

Void SampleFunction(){

Print “Hello World.”;

}

# Formatting Guidelines

This document also serves as style guide for final year project reports. In order to give a similar high-quality appearance to all final year software project reports this template uses a collection of predefined Microsoft Word formatting styles. **These styles should be used without modification or replacement.** Font in the document is ***“Time New Roman”.*** This template provides following styles:

* **Title** – the main title style
* **Title2** – the subtitle style
* **Body Text** – style for paragraphs
* **Caption** – the style for a figure or table caption
* **Table Description** – the style for description of table, it must be added after caption.
* **Figure Description** - the style for description of figure, it must be added after caption.
* **Code** – the style for program source code

**int x** = 10; // Writing important code

* **Table Header Row** – Style for the header row of table
* **Table Grid** – the style for the data rows in the tables
* **Reference** – The style for references
* **Bullets** – The style for the bullet lists
* **Numbered** **List**– Style for numbered lists

All Heading styles with different level numbers are listed below.

# Heading 1

## Heading 2

### Heading 3

#### Heading 4

##### Heading 5

###### Heading 6

Heading 7

Heading 8

Heading 9

## Tables and Figures

Tables and figures should be centered horizontally. The caption button should be used to insert caption for both the figures and tables. All figures and tables must be numbered properly. Always refer to tables and figures according to their numbers. A table or figure can be cited as follows: ‘see Table1’ or ‘as shown in Table1’. The caption of table should be centered above the table and figure caption should be centered below the figure. Place the tables/figures close to their reference. Use “Table Header Row” and ‘Table Grid’ style for table’s header and data rows respectively. It is compulsory to provide brief description of table/figure after its caption. Styles for table and figure descriptions are “Table Description” and “Figure Description” respectively.

Press Ctrl+Shift+S to see list of styles mentioned above. Figure 1 shows the Apply Style window displaying the list of styles. Select any text then press Ctrl+Shift+S, the Apply Style window will show you the current style applied on that text and if required, you can change the style by selecting any other style from the “Style Name” dropdown.

This is brief description of above figure.

Figure 1: List of Styles

Table 1: This is Sample table caption

This is brief description of following Table.

|  |  |  |  |
| --- | --- | --- | --- |
| Header row | Header row | Header row | Header row |
| Row1 col1 | Row1 col2 | Row1 col3 | Row1 col4 |
| Row2 col1 | Row2 col2 | Row2 col3 | Row2 col4 |

Table 2: This is Sample table caption

This is brief description of following Table.

|  |  |  |  |
| --- | --- | --- | --- |
| Header row | Header row | Header row | Header row |
| Row1 col1 | Row1 col2 | Row1 col3 | Row1 col4 |
| Row2 col1 | Row2 col2 | Row2 col3 | Row2 col4 |

## Equations

Use equation editor to write equations in this report. Use last button of the custom tool bar to invoke equation editor. Similar to tables and figures, equations should also be aligned centered horizontally. Number all equations and insert them in parenthesis. Below is a sample equation and its reference number. An equation can be referenced like this: ‘it is clear from (1)’.

 (1)

## Header/Footer

Notice the headers in this document, before Introduction (i.e. the main content of this document) page numbers are in roman numerals. The page numbers of the actual content start with Arabic numerals i.e. 1, 2, 3 and so on. All of the **odd numbered pages** contain title of your project while the **even numbered pages** contain the section heading (i.e. chapter’s name) in the headers.

## Other Formatting Guidelines

* Keep 2-4 GUIs in one page. Consume as much space as possible. Do not leave most of page blank unnecessarily.
* Do not break tables (or use cases) in multiple pages unless the table is too large to fit in one page.
* Re-arrange the content i.e., text, images, and tables properly to meet above two guidelines.

## References

Always refer to the source of information by inserting the reference number in square brackets like this [5]. The reference numbers can either be added at the end of the sentence or within the sentence without changing the punctuation of sentence. A reference can also be cited as follows: ‘as Ruskey [2] mentioned’. List each source only once on your reference page.



Figure 2: IEEE Reference style

This figure represents the styling information for adding references in IEEE format

**Following is a list of sample reference for various typed of sources in IEEE format.**

1. P.M. Morse and H. Feshback, *Methods* of *Theoretical Physics*. New York: McGraw Hill, 1953. **//Format for Book**
2. S.K. Kenue and J.F. Greenleaf, “Limited angle multifrequency diffiaction tomography,” *IEEE Trans. Sonics Ultrason*., vol. SU-29, no. 6, pp. 213-2 17, July 1982. **//Format for Journal Article**
3. B. Tsikos, “Segmentation of 3-D scenes using multi-modal interaction between machine vision and programmable mechanical scene manipulation,” Ph.D. dissertation, Univ. of Pennsylvania, BCE Dept., Philadelphia, 1987. [Add if applicable: University Microfilms, Inc., University of Michigan, Ann Arbor, Michigan.] **//Format for Dissertation or thesis**
4. R. Finkel, R. Taylor, R. Bolles, R. Paul, and J. Feldman, “An overview of AL, programming system for automation,” in *Proc. Fourth Int. Joint Conf Artif. Intell*., pp. 758-765, Sept. 3-7, 1975. **//Format for Proceedings paper**
5. “Technology threatens to shatter the world of college textbooks, *The Wall Street Journal*, vol 91, pp. Al, A8, June 1, 1993. **//Format for Newspaper article**
6. R. Cox and J. S. Turner, “Project Zeus: design of a broadband network and its application on a university campus,” Washington Univ., Dept. of Comp. Sci., Technical Report WUCS-91-45, July 30, 1991. **//Format for Technical Report**
7. M. Janzen, *Instant Access Accounting*. Computer software. Nexus Software, Inc IBM-PC, 1993. **//Format for** **Software**
8. Fuminao Okumura and Hajime Takagi, “Maglev Guideway On the Yamanashi Test Line,” *http://www.rtri.or.jp/rd/maglev2/okumura.html*, October 24, 1998. **//Format for** **World Wide Web** (give author and title if named)
9. “AT&T Supplies First CDMA Cellular System in Indonesia,” http://www.att.com/press/1095/951011.nsa.html, Feb 5, 1996. **//Format for World Wide Web**