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REVOLUTIONING HOME DESIGN:AI-POWERED HOUSE PLANNING AND VISUALIZATION

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ABSTRACT

- The proposed system is an innovative app that helps users design their dream homes effortlessly, tailored to their budget, family needs, and style preferences.
- By entering inputs such as plot size, dimensions, and requirements, users can instantly generate functional and aesthetic floor plans as the foundation of their home design.
- The app provides cost-effective material suggestions, energy-efficient design ideas, and estimated construction costs to assist users in making practical decisions.
- Users can access clear information about relevant housing schemes and subsidies (e.g., PMAY), making home construction more affordable.
- The app is especially beneficial for first-time homeowners, low/middle-income families, as well as architects and contractors seeking AI-assisted design tools.

INTRODUCTION

- Artificial Intelligence is transforming traditional house planning by enabling smart, automated, and highly personalized design solutions with the help of professional architects.
- The system tailors floor plans and visualizations based on user-specific inputs such as budget, family size, location, and style preferences, making home design more accessible.
- By suggesting suitable building materials, estimating construction costs, and recommending energy-efficient designs, the AI assistant helps optimize resources and reduce expenses.
- The tool also supports homeowners with insights on government housing schemes and subsidies, ensuring affordable, practical, and well-informed decisions for building a dream home.

PROBLEM DEFINITION

- To develop an AI-based platform that provides affordable and accessible house design solutions by generating personalized floor plans and visualizations tailored to user needs, budgets, and lifestyle preferences. The system aims to assist users in construction planning through intelligent suggestions on suitable building materials and cost estimation. It also seeks to support informed decision-making by offering guidance on government housing schemes and subsidies. Furthermore, it aims to enable collaboration and professional validation by connecting users with verified architects ,workers and material suppliers for enhanced reliability and quality.

SCOPE OF THE SYSTEM

- The system will generate customized floor plans and visualizations based on user inputs like budget, plot size, and family requirements.
- It will provide material suggestions, cost estimates, and energy-efficient design recommendations to optimize construction.
- The app will inform users about relevant government housing schemes and subsidies to make construction more affordable.
- The platform will connect users with verified architects and contractors, enabling design validation and access to expert services.
- The system aims to make professional-quality house planning accessible to first-time homeowners, low/middle-income families, and small-scale contractors without high costs.

OBJECTIVES

- To provide affordable and accessible house design solutions by generating personalized floor plans and visualizations tailored to user needs, budget, and lifestyle preferences.
- To assist users in construction planning through AI-generated suggestions on suitable building materials, cost estimation, and energy-efficient design ideas.
- To support informed decision-making by offering guidance on government housing schemes and subsidies, making home ownership more affordable.
- To enable collaboration and professional validation by connecting users with verified architects and contractors for enhanced reliability and quality.

- Semi-Automatic Building Layout Generation for Virtual Environments.
- Transparent and reliable construction cost prediction using advanced machine learning and explainable AI.
- AI-driven design optimization for sustainable buildings: A systematic review.
- Generative artificial intelligence in construction: A Delphi approach, framework, and case study.
- AI in Civil Engineering.
- Generative AI in the Construction Industry: Opportunities and Challenges.
- Transforming the civil engineering sector with generative artificial intelligence, such as ChatGPT or Bard.
- AI in automated sustainable construction engineering management.
- Cost Estimation Model Based on Building Information Modeling and Virtual Reality for Customizing Presold Homes.
- Comprehensive and Dedicated Metrics for Evaluating AI-Generated Residential Floor Plans.

TECHNICAL CONTENT

- Uses a weighted fitness function (adjacency, room area, empty space, connectivity) with hill-climbing to automatically optimize floor plan layouts.
- Converts abstract room graphs into practical 2D layouts through iterative neighbor generation and best-fit selection.[1]
- Implements steepest ascent and stochastic hill-climbing in C, achieving optimized layouts in under 30 seconds for real-time design.

RELEVANCE

- Direct floor plan generation from user preference inputs.
- Real-time optimization suitable for mobile/web platforms.

Base Paper: Semi-Automatic Building Layout Generation for Virtual Environment

ALGORITHM

- Steepest Ascent Hill-climbing (deterministic).[1]
- Stochastic Hill-climbing (random neighbor selection).[1]

METHODOLOGY

- Graph representation (nodes=rooms, edges=connections).
- Tile-based layout optimization.

PAPER 2: Transparent and reliable construction cost prediction using advanced machine learning and explainable AI

TECHINICAL CONTENT

- Ten machine learning models evaluated (Ridge, Lasso, Elastic Net, KNN, Extra Trees, Gradient Boosting, AdaBoost, XGBoost, CatBoost, HistGradient Boosting). [2]
- SHAP-based explainable AI for model interpretability.

RELEVANCE

- Direct application to cost estimation feature in AI home design app.
- The app can quickly estimate construction costs in real time on mobile or web .
- Confidence intervals support budget planning and risk assessment.

PAPER 2: Transparent and reliable construction cost prediction using advanced machine learning and explainable AI

ALGORITHM

- HistGradient Boosting Regression.[2]
- XGBoost and CatBoost ensemble methods.
- SHAP (SHapley Additive exPlanations).

METHODOLOGY

- Dataset preprocessing with MinMaxScaler normalization.
- GridSearchCV hyperparameter optimization.
- Multi-metric evaluation.

PAPER 3: AI-driven design optimization for sustainable buildings: A systematic review

TECHNICAL CONTENT

- Tree-based models, CNNs, and Support Vector Regression (SVR) for building performance prediction.
- Surrogate models enable rapid design exploration suitable for mobile/web platforms.
- EnergyPlus simulation tool used for energy performance evaluation.[3]

RELEVANCE

- Framework for AI-driven sustainable design optimization directly applicable to home design app.
- Multi-objective optimization (energy, cost, comfort) aligns with budget and family needs constraints.

PAPER 3: AI-driven design optimization for sustainable buildings: A systematic review

ALGORITHM

- Surrogate models. [3]
- Optimization algorithms.

METHODOLOGY

- Five-step surrogate modeling process.
- Multi-objective optimization with sustainability metrics.

PAPER 4: Generative artificial intelligence in construction: A Delphi approach, framework, and case study

TECHNICAL CONTENT

- Systematic review and Delphi study with 11 experts on GenAI applications in construction. [4]
- GenAI opportunities across text, image, and video generation.
- Implementation with GPT-4.

RELEVANCE

- Framework for implementing GenAI solutions directly applicable to AI home design app development.
- Text-to-image generation capabilities support automated floor plan visualization from user descriptions.

PAPER 4: Generative artificial intelligence in construction: A Delphi approach, framework, and case study

ALGORITHM

- GPT-4 based model.
- Text-to-image models.[4]

METHODOLOGY

- Large Language Models (LLMs).
- GenAI.

TECHNICAL CONTENT

- Intelligent Design Construction and Maintenance (IDCM) framework with four modules.[5]
- Integration of AI algorithms, computer vision, robotics, and IoT in construction.
- Life-cycle AI applications from planning to maintenance.

RELEVANCE

- Intelligent planning and design module directly supports automated floor plan generation.
- AI helps in budget constraints, family needs, and design optimization.

ALGORITHM

- Mathematical optimization algorithms.
- Natural language processing for user interfaces.[5]

METHODOLOGY

- Interdisciplinary integration.
- Modular system design.
- Life-cycle management.

PAPER 6: Opportunities and Challenges of Generative AI in Construction Industry: Focusing on Adoption of Text-Based Models

TECHNICAL CONTENT

- Discusses how Generative AI (GenAI) can transform construction.[6]
- Provides a conceptual implementation framework for GenAI in construction.

RELEVANCE

- Paper addresses AI-driven design and automation in construction.
- Discusses GenAI for floorplans, cost estimation, and material selection.

PAPER 6: Opportunities and Challenges of Generative AI in Construction Industry: Focusing on Adoption of Text-Based Models

ALGORITHM

- Autoregressive Models.
- Diffusion Models.

METHODOLOGY

- Fine-tuning
- Prompting

PAPER 7: Transforming the civil engineering sector with generative artificial intelligence, such as ChatGPT or Bard

TECHNICAL CONTENT

- The paper explores the application of Large Language Models (LLMs) like ChatGPT and Bard across various civil engineering disciplines.
- It details how these models assist in tasks such as design optimization, structural analysis, risk assessment, and predictive analytics.[7]

RELEVANCE

- The study focuses on the transformative influence of Generative AI in civil engineering.
- It provides examples of how GenAI can generate and refine structural designs and optimize resource utilization.

PAPER 7: Transforming the civil engineering sector with generative artificial intelligence, such as ChatGPT or Bard

ALGORITHM

- Large Language Models (LLMs).
- Natural Language Processing (NLP).

METHODOLOGY

- Natural Language Processing (NLP).
- Data Analysis and Interpretation.
- Modeling and Simulation.

PAPER 8: AI in automated sustainable construction engineering management

TECHNICAL CONTENT

- Artificial Intelligence (AI) in Automated Sustainable Construction Engineering Management (ASCEM).[8]
- It explores how AI, including machine learning and deep learning, enhances construction automation, sustainability, and operational efficiency.
- AI is applied for cost and duration prediction, scenario simulation, and contract management.

RELEVANCE

- A central theme of the paper is the use of AI to promote sustainability in construction by improving energy efficiency, reducing carbon emissions, and managing waste.
- Project Management Automation (PMA), such as cost and duration prediction, directly aligns with our app's feature.

PAPER 8: AI in automated sustainable construction engineering management

ALGORITHM

- Artificial Neural Networks (ANNs).[8]
- Deep Reinforcement Learning (DRL).
- Generative Neural Networks (GNNs).

METHODOLOGY

- Artificial Neural Networks (ANNs).
- Deep Reinforcement Learning (DRL).
- Generative Neural Networks (GNNs).

PAPER 9: Cost Estimation Model Based on Building Information Modeling and Virtual Reality for Customizing Presold Homes.

TECHNICAL CONTENT

- The paper presents a system that integrates Building Information Modeling (BIM) and Virtual Reality (VR) for customizing and estimating costs for presold homes.[9]
- It automatically calculates the cost of changes by linking the BIM model to a unit price database.
- This approach addresses common industry problems like poor communication and time-consuming manual recalculations for design changes.

RELEVANCE

- The system is designed to improve communication between clients and designers by providing an immersive, intuitive interface for design changes.
- A major feature of the paper's system is its ability to instantly calculate and display the cost of design changes.

PAPER 9: Cost Estimation Model Based on Building Information Modeling and Virtual Reality for Customizing Presold Homes.

ALGORITHM

- BIM (Building Model Construction)
- Virtual Reality

METHODOLOGY

- BIM Model Construction.
- Construction of VR environments.

PAPER 10: Comprehensive and Dedicated Metrics for Evaluating AI-Generated Residential Floor Plans

TECHNICAL CONTENT

- This paper proposes a new evaluation framework called Residential Floor Plan Assessment (RFP-A) to assess the quality of AI-generated floor plans. [10]
- The framework is designed to be comprehensive, interpretable, and computationally efficient, addressing the limitations of existing metrics borrowed from computer vision.
- RFP-A evaluates designs across four key aspects: room numbers, spatial connectivity (graph structure), room locations/orientations, and room geometries.

RELEVANCE

- RFP-A framework checks room count, connectivity, locations, and geometry to ensure designs are accurate, compliant, and reliable.
- High interpretability lets the app explain why a design works (e.g., light, flow), improving decision-making and trust.

PAPER 10: Comprehensive and Dedicated Metrics for Evaluating AI-Generated Residential Floor Plans

ALGORITHM

- RFP-GED (Graph Edit Distance). [10]
- RFP-IoU (Intersection over Union).

METHODOLOGY

- Room Number Compliance.
- Graph Structure Analysis.
- Geometric Feature Quantification.

PAPER 11:Quantity Surveying and its Association with Building Information Modeling (BIM) and Digital Twin (DT).

TECHNICAL CONTENT

- This project develops an AI-powered assistant to generate and evaluate house plans automatically. [11]
- The system integrates NLP, BIM, and Digital Twin (DT) for interactive floor plan design, cost estimation, and sustainability simulation.
- AI models (GANs/Diffusion + Constraint Solvers) generate layouts that adapt to user inputs like area, style, and budget.
- The assistant ensures compliance with building codes, material optimization, and lifecycle efficiency through digital simulations.

RELEVANCE

- Provides faster, cost-efficient, and sustainable design solutions, reducing manual drafting efforts. Enhances accuracy and compliance by integrating BIM standards and quantity take-off automation.
- Improves decision-making by simulating real-world performance (energy, ventilation, daylight).Bridges the gap between architects, engineers, and clients, making home design more interactive and accessible.

PAPER 11:Quantity Surveying and its Association with Building Information Modeling (BIM) and Digital Twin (DT).

ALGORITHM

- Generative Layout Algorithm. [11]
- Constraint Satisfaction Algorithm.
- Evolutionary Optimization.
- BIM-5D Cost Estimation and Digital Twin Simulation.

METHEDOLOGY

- Requirement Analysis.
- AI-driven Floor Plan Generation.
- BIM and Cost Integration.
- Digital Twin Simulation.
- Output Visualization.

CONSOLIDATED TABLE

SI No	Paper Selected	Technical Content	Relevance	Algorithms	Methodology
1	Semi-Automatic Building Layout Generation for Virtual Environments	It uses a weighted fitness function (adjacency, room area, empty space, connectivity) with hill-climbing to iteratively convert abstract room graphs into optimized 2D floor plan layouts through neighbor generation and best-fit selection.	1.Direct floor plan generation from user preference inputs. 2.Real-time optimization suitable for mobile/web platforms	1.Steepest Ascent Hill-climbing. 2.Stochastic Hill-climbing	1. Graph representation(nodes=rooms, edges=connections). 2.Tile-based layout optimization.
2	Transparent and reliable construction cost prediction using advanced machine learning and explainable AI	1.Ten machine learning models evaluated (Ridge, Lasso, Elastic Net, KNN, Extra Trees, Gradient Boosting, AdaBoost, XGBoost, CatBoost, HistGradient Boosting). 2. SHAP-based explainable AI	1. Direct application to cost estimation feature in AI home design app. 2.The app can quickly estimate construction costs in real time on mobile or web .	1.HistGradient Boosting Regression. 2. XGBoost and CatBoost ensemble methods.	1.GridSearchCV hyperparameter optimization. 2. Multi-metric evaluation.
3	AI-driven design optimization for sustainable buildings: A systematic review	1.Tree-based models, CNNs, and Support Vector Regression (SVR) for building performance prediction. 2. Surrogate models enable rapid design exploration suitable for mobile/web platforms.	1. Framework for AI-driven sustainable design optimization directly applicable to home design app. 2.Multi-objective optimization aligns with budget and family needs constraints	1. Surrogate models. 2.Optimization algorithms.	1. surrogate modeling process. 2.Multi-objective optimization with sustainability metrics.

CONSOLIDATED TABLE

4	Generative artificial intelligence in construction: A Delphi approach, framework, and case study	1.GenAI applications in construction. 2. Implementation with GPT-4.	1.Framework for implementing GenAI solutions directly applicable to AI home design app development. 2.Text-to-image generation capabilities support automated floor plan visualization from user descriptions.	1. GPT-4 based model 2.Text-to-image models.	1.Large Language Models (LLMs). 2. GenAI.
5	AI in Civil Engineering	1.Intelligent Design Construction and Maintenance (IDCM) framework. 2.Integration of AI algorithms, computer vision, robotics, and IoT in construction.	1. Floor plan generation based on user inputs. 2.NLP	1.Mathematical optimization algorithms. 2.Natural language processing(NLP)	1.Interdisciplinary integration. 2. Modular system design.
6	Opportunities and Challenges of Generative AI in Construction Industry: Focusing on Adoption of Text-Based Models	1.Discusses how Generative AI (GenAI) can transform construction. 2.Provides a conceptual implementation framework for GenAI in construction.	1.Prompting. 2.Natural Language Processing(NLP)	1.Autoregressive Models 2.Diffusion Models.	1. Fine-tuning 2.Prompting

CONSOLIDATED TABLE

7	Transforming the civil engineering sector with generative artificial intelligence, such as ChatGPT or Bard	1.The paper explores the application of Large Language Models (LLMs) like ChatGPT and Bard across various civil engineering disciplines.	1. Natural Language Processing (NLP).	1.Large Language Models (LLMs). 2. Natural Language Processing (NLP)	1. Natural Language Processing (NLP). 2.Data Analysis and Interpretation.
8	AI in automated sustainable construction engineering management	1.It explores how AI, including machine learning and deep learning, enhances construction automation, sustainability, and operational efficiency. 2. AI is applied for cost and duration prediction.	1. AI to promote sustainability in construction. 2. Project Management Automation (PMA), such as cost and duration prediction.	1. Artificial Neural Networks (ANNs) 2. Generative Neural Networks (GNNs).	1.Artificial Neural Networks (ANNs) 2. Generative Neural Networks (GNNs).
9	Cost Estimation Model Based on Building Information Modeling and Virtual Reality for Customizing Presold Homes.	1.Integrates Building Information Modeling (BIM) and Virtual Reality (VR) for customizing and estimating costs for presold homes.	1. calculate and display the cost of design changes	1. BIM (Building Model Construction) 2.Virtual Reality	1.BIM Model Construction. 2.Construction of VR environments.

CONSOLIDATED TABLE

10	Comprehensive and Dedicated Metrics for Evaluating AI-Generated Residential Floor Plans	1.proposes a new evaluation framework called Residential Floor Plan Assessment (RFP-A)	1.RFP-A framework checks room count, connectivity, locations, and geometry to ensure designs are accurate, compliant, and reliable.	1. RFP-GED (Graph Edit Distance). 2.RFP-IoU (Intersection over Union)	1. Room Number Compliance. 2.Graph Structure Analysis.
11	Quantity Surveying and its Association with Building Information Modeling (BIM) and Digital Twin (DT).	1.AI-powered assistant to generate and evaluate house plans automatically.	1.Generative Layout Algorithm. 2.Evolutionary Optimization.	1.Generative Layout Algorithm 2. Constraint Satisfaction Algorithm.	1.Requirement Analysis. 2.Digital Twin Simulation.

Functional requirements

- Accept user inputs (budget, plot size, family needs, style).
- Generate floor plans .
- Provide material suggestions and cost estimation.
- Offer information on government housing subsidies.

Non functional requirements

- Easy-to-use and intuitive interface.
- Fast and reliable performance.
- Secure handling of user data.
- Compatibility across web and mobile platforms.

Software requirements

- Programming: Python ,Dart
- Frameworks: NLTK,NLP
- Feature Extraction: Pandas,Numpy,NLTK
- Frontend(UI): HTML,CSS,Bootstrap,Javascript,Flutter.
- Backend :Python,MySQL,Dart

Functional requirements

- Accept user inputs (budget, plot size, family needs, style).
- Generate floor plans .
- Provide material suggestions and cost estimation.
- Offer information on government housing subsidies.

MODULE DIVISION AND DESCRIPTION

- **PLAN GENERATION** :An AI based plan generator.
- **PROFILE REGISTRATION** :User profile creation with basic details.
- **GUIDELINES** :Guidelines to be followed when building a house.
- **CHAT-BOT** :To communicate with user(basically to clear doubts).
- **WORKER BOOKING** :To assign/request skilled workers for the construction of the house.
- **VIEW/REQUEST ARCHITECT** :To view basic details of approved architect their experience and works and to request their assistance.
- **RAW MATERIALS**:To view nearest raw material provider,their stock details and order the raw materials.
- **QUANTITATIVE SURVEY** :To analyze the cost and materials required for building the house.

The proposed system employs artificial intelligence techniques to generate personalized house floor plans based on user inputs such as budget, plot size, and family requirements.

Technical Feasibility:

- The system can be built using commonly available programming tools and databases, which are easy to use, maintain, and upgrade in the future.

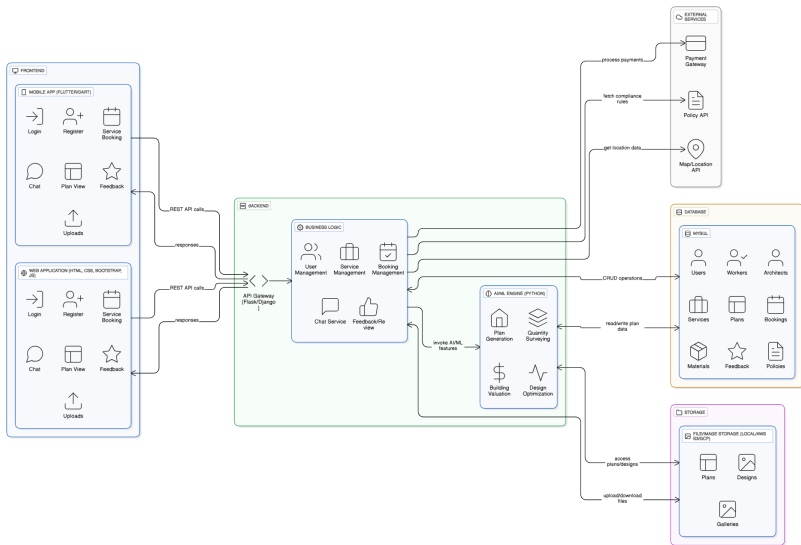
Operational Feasibility:

- The system is operationally feasible since users can easily interact with it through a simple interface, making home design accessible without requiring technical or architectural expertise.

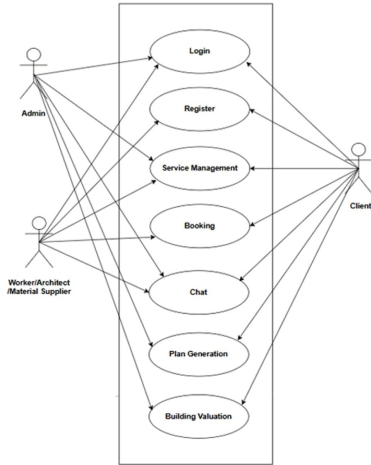
Economic Feasibility:

- The project is economically feasible as it reduces the cost of hiring professional architects, offers affordable design solutions, and helps users save money through cost estimation and subsidy guidance.

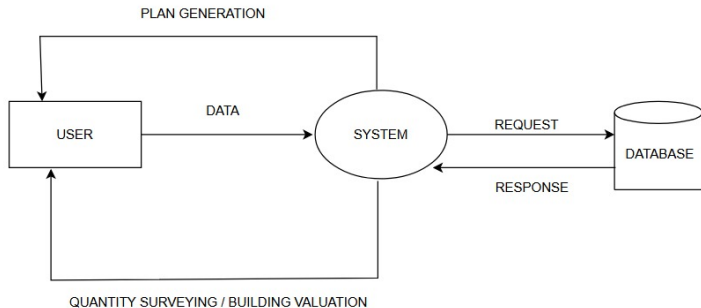
ARCHITECTURE DIAGRAM



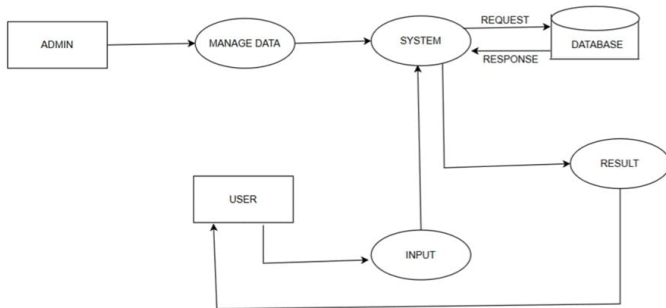
USE CASE DIAGRAM



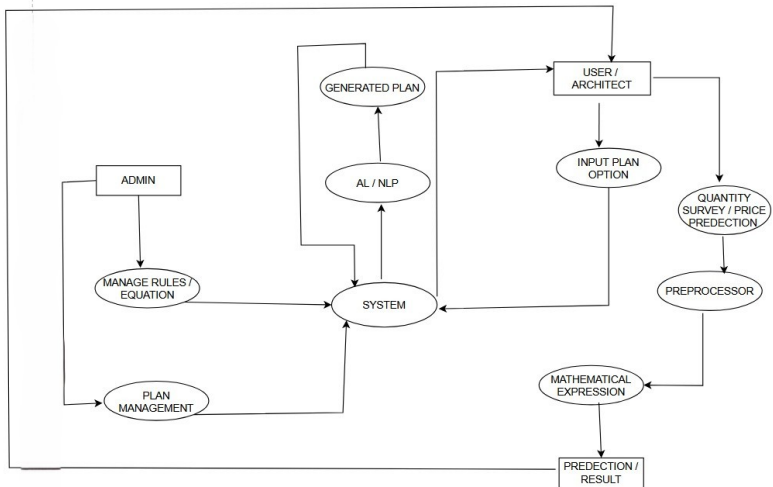
DATA FLOW DIAGRAM (LEVEL 0)



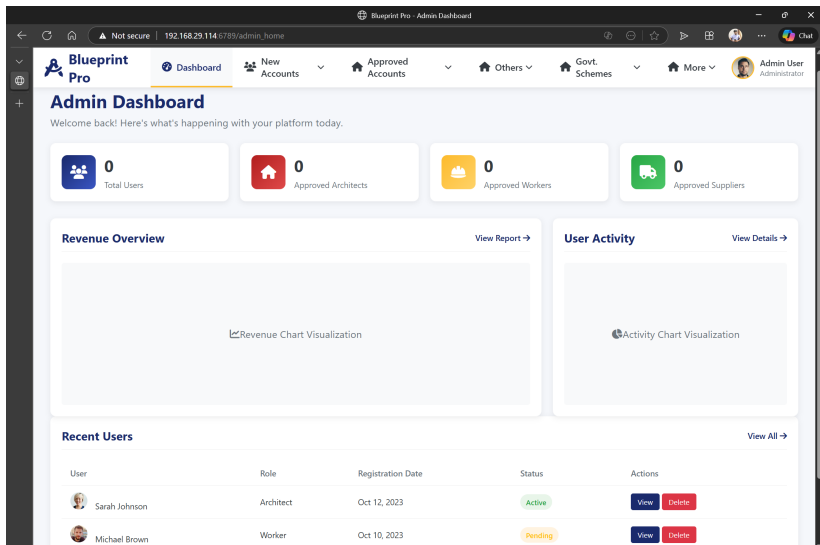
DATA FLOW DIAGRAM (LEVEL 1)



DATA FLOW DIAGRAM (LEVEL 2)



ADMIN



Blueprint Pro - Admin Dashboard

Not secure | 192.168.29.114:6789/admin_home

Blueprint Pro

Dashboard | New Accounts | Approved Accounts | Others | Govt. Schemes | More | Admin User Administrator

Admin Dashboard

Welcome back! Here's what's happening with your platform today.

0 Total Users

0 Approved Architects

0 Approved Workers

0 Approved Suppliers

Revenue Overview

View Report →

Revenue Chart Visualization



User Activity

View Details →

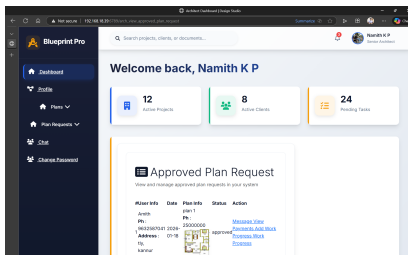
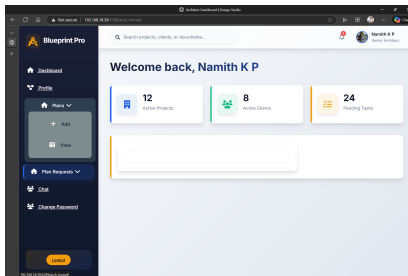
Activity Chart Visualization

Recent Users

View All →

User	Role	Registration Date	Status	Actions
 Sarah Johnson	Architect	Oct 12, 2023	Active	View Delete
 Michael Brown	Worker	Oct 10, 2023	Pending	View Delete

ARCHITECT



RESULTS

WORKER

Blueprint Pro

Search projects, clients, or documents...

Welcome back, Akashy

- 12 Active Projects
- 8 Active Clients
- 24 Pending Tasks

Logout

Blueprint Pro

Search projects, clients, or documents...

Welcome back, Akashy

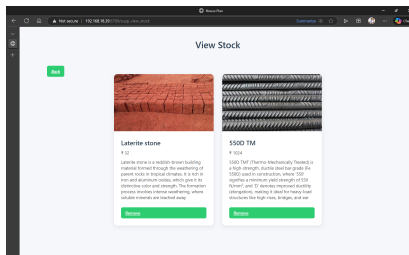
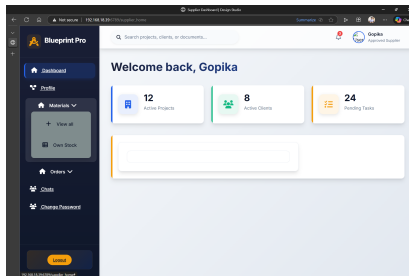
- 12 Active Projects
- 8 Active Clients
- 24 Pending Tasks

Service Request

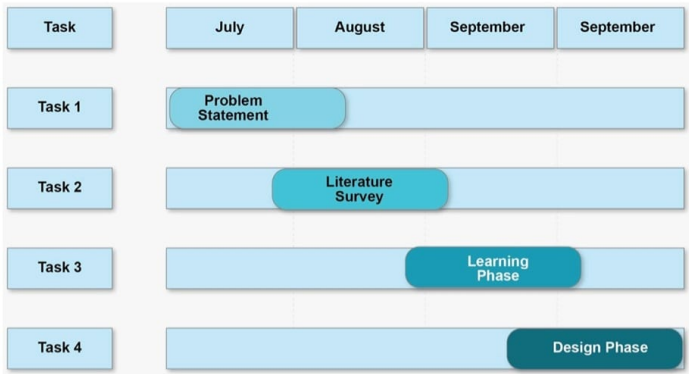
View and manage service requests in your system

Request Info	Date	Service Info	Action
Avatar		File Worker	
PR: 9622587641			
Address:	2020-01-18	Amount: 125	Account Detail
IP:			
Avatar			

SUPPLIER



GANTT CHART



CONCLUSION

- The system successfully provides customized house designs based on user needs, budget, and preferences, making home planning more accessible.
- By offering material suggestions, cost estimation, and energy-efficient design ideas, the system helps reduce overall construction expenses.
- Guidance on government subsidies and access to verified architects ensures that users make smart and affordable housing choices.
- The project benefits first-time homeowners, low/middle-income families, and professionals, making it a practical and innovative solution for modern housing challenges.

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