AI-Powered Repair Cost Estimation for Computer Services

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***Abstract*—Repair cost estimation in computer services is of- ten inconsistent and lacks transparency. This paper presents a system that integrates 3D visualization with a rule-based pricing mechanism to improve accuracy and user experience. The proposed system allows technicians to interact with a 3D model, select faulty components, and automatically generate repair cost estimates along with detailed receipts. The implementation demonstrates improved efficiency and reduced estimation time compared to traditional methods. The system enhances transparency and builds customer trust through visual representation. Future enhancements include integration of machine learning and computer vision for automated and predictive cost estimation.**

***Index Terms*—Artificial Intelligence, Computer Services, Re- pair Cost Estimation, Rule-Based System, Three.js, 3D Visualization**

I. INTRODUCTION

The rapid growth of digital devices has increased the demand for efficient and reliable repair services. However, traditional repair cost estimation methods are often manual, inconsistent, and dependent on technician expertise. This leads to a lack of transparency and trust between customers and service providers.

To address these challenges, this paper proposes an AI- powered repair cost estimation system that integrates 3D visualization with rule-based cost calculation. The system enables technicians to visually select damaged components on a 3D model, improving clarity and reducing estimation time. Furthermore, the proposed system enhances customer trust by providing a clear breakdown of costs.

Although the current implementation uses a rule-based approach, the system is designed to incorporate artificial intelligence techniques in future, enabling automated damage detection and predictive cost estimation.

II. LITERATURE REVIEW

Several existing systems focus on repair cost estimation in different domains. Automotive repair platforms utilize computer vision and machine learning to detect damages and estimate costs. Tools such as AI-based damage detection systems use convolutional neural networks (CNNs) to identify defects from images.

In the domain of property and equipment repair, rule-based systems are widely used for estimating costs based on predefined pricing structures. However, these systems lack visual interaction and user-friendly interfaces.

Recent advancements in 3D visualization technologies, such as WebGL and Three.js, have enabled interactive user inter- faces that enhance understanding and engagement. Despite these advancements, limited research has been conducted on integrating 3D visualization with cost estimation in computer repair services.

III. PROPOSED SYSTEM

The proposed system combines 3D interactive visualization with a rule-based cost estimation mechanism. The key com- ponents of the system are:

- 3D Interactive Model: A 3D model of a computer device allows users to visually identify and select faulty components.
- Rule-Based Cost Engine: Predefined rules calculate repair costs based on selected components and labor charges.
- Receipt Generation: The system generates a detailed

repair estimate including part costs and labor charges.
- Future AI Integration: The system is designed to incorporate AI models for predictive cost estimation and damage detection.

IV. METHODOLOGY

The methodology of the proposed system consists of the following steps:

A.3D Model Integration

A 3D model of a computer system is created using Blender and exported in GLTF format. The model is rendered in the web interface using Three.js.

B.User Interaction

Users interact with the 3D model to select faulty components. Each component is mapped to a predefined cost structure.

C. Cost Calculation

The system calculates the total repair cost using:

$TotalCost = \Sigma (PartCost + LaborCost)$

D. Receipt Generation

A structured receipt is generated containing selected components, individual costs, and total repair cost.

V. IMPLEMENTATION

The system is implemented using the following technologies:
- Frontend: HTML, CSS, JavaScript
- 3D Visualization: Three.js
- Backend: Flask (Python)
- Database: JSON-based rule storage

The 3D model is integrated into the admin dashboard, allowing technicians to interact with components. Dummy data is used to demonstrate cost estimation functionality.

VI. RESULTS AND DISCUSSION

The developed system demonstrates the effectiveness of integrating 3D visualization with repair cost estimation. The interface allows users to interact with a 3D model and select faulty components easily.

The system successfully provides:
- Visual identification of damaged parts
- Instant cost estimation based on predefined rules
- Detailed and structured repair receipts

Compared to traditional manual estimation methods, the proposed system reduces estimation time and improves transparency. The use of 3D visualization enhances user under- standing and builds trust between customers and service providers.

However, the current system is limited to rule-based estimation and does not adapt dynamically to market price changes. Future integration of machine learning models can improve prediction accuracy and automation.

VII. CONCLUSION

This paper presents a novel approach to repair cost estimation for computer services using a 3D interactive model and rule-based system. The proposed solution improves efficiency, accuracy, and customer trust. The system provides a scalable foundation for future enhancements using artificial intelligence.

VIII. FUTURE SCOPE

Future work includes:
- Integration of machine learning models for predictive cost estimation
- Implementation of computer vision for automated damage detection
- Real-time price updates based on market trends
- Augmented reality-based visualization

As shown in Fig. 1, the proposed system begins with user interaction through a 3D model interface, where the technician selects the faulty component. The selected component is mapped to predefined repair rules stored in the database. The system then calculates the repair cost based on part and labor charges and generates a structured receipt for the customer.

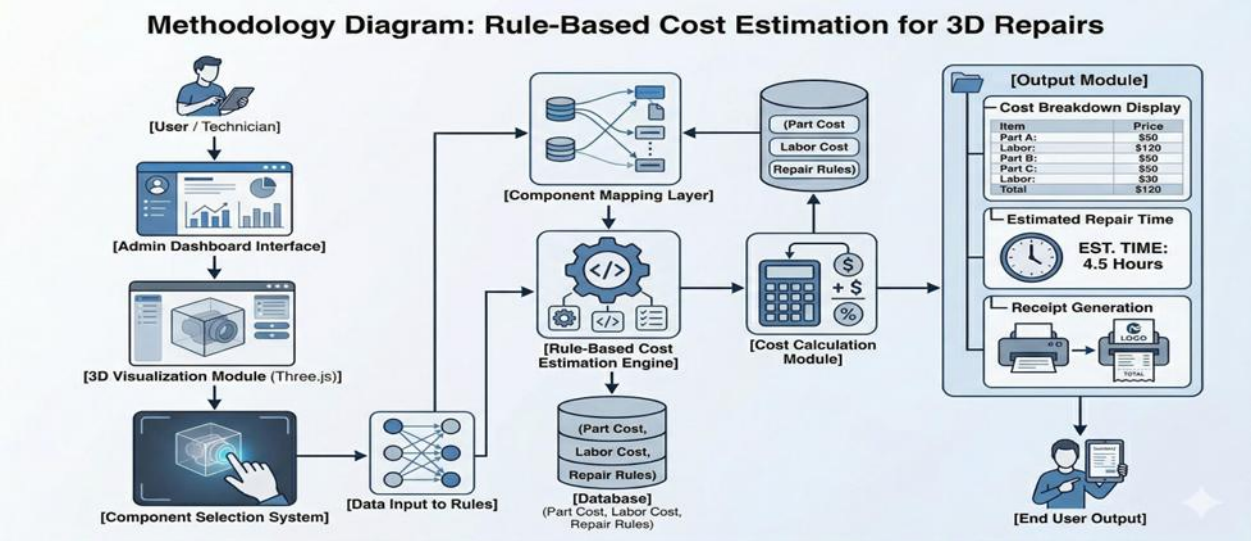
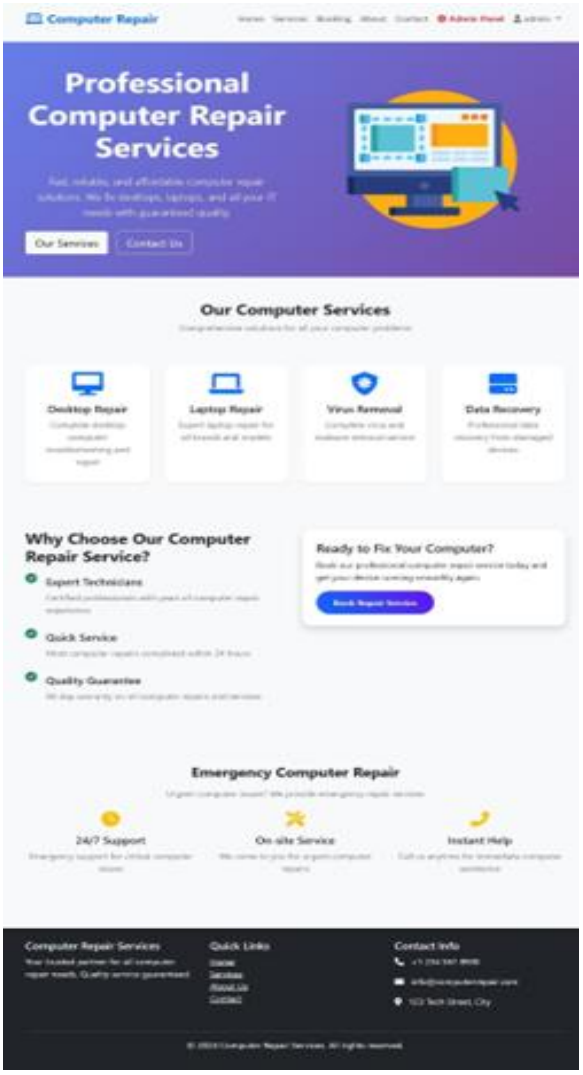
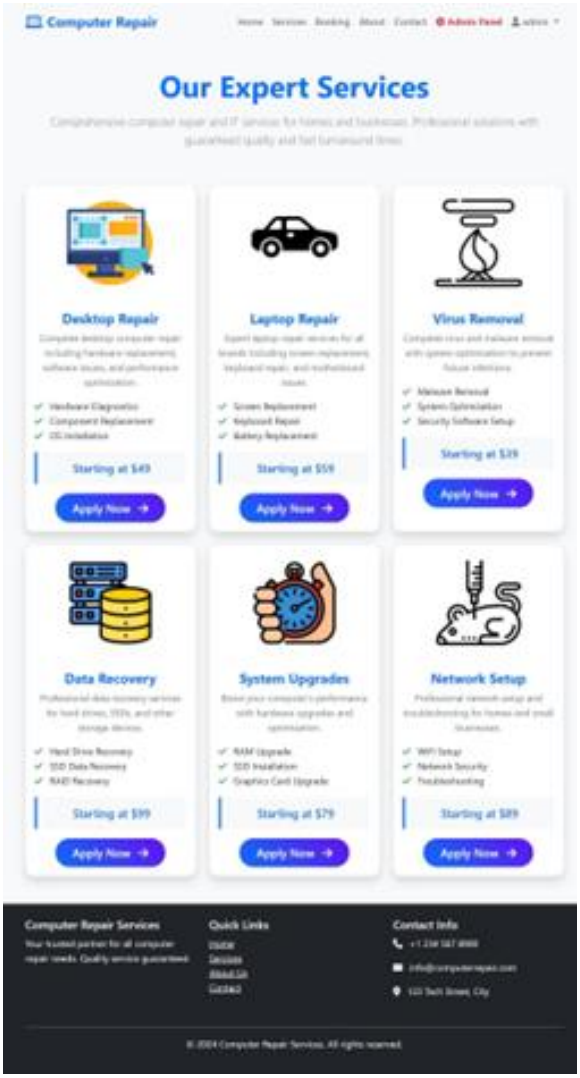


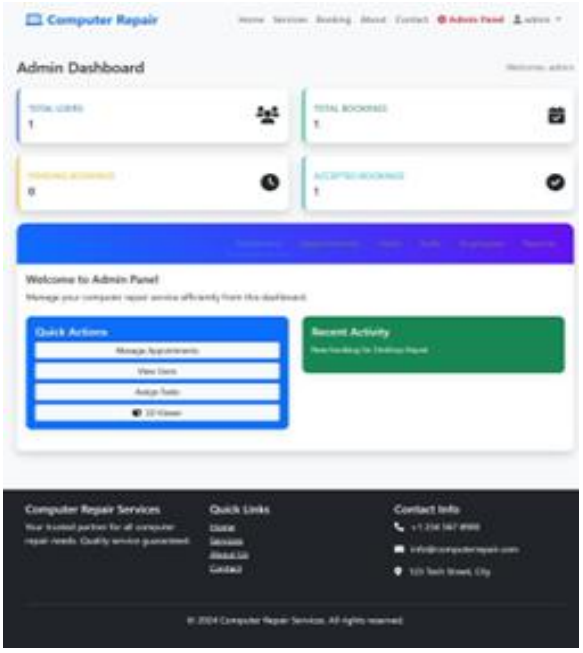
Fig. 1. Workflow of the Proposed 3D-Based Repair Cost Estimation System



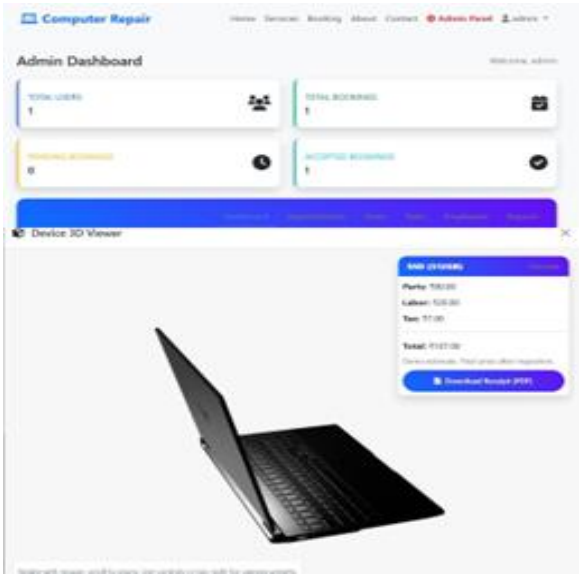
(a) Landing Page



(b) Services Page



(c) Admin Dashboard



(d) 3D Device View

Fig. 2. System Interface and Functional Modules

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