IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 4, December 2025
Impact Factor: 7.67

Web Based Smart Decision Making (Rent-A-Tent) System

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Abstract: *In recent times, there has been a remarkable uptick in the market for temporary housing, including tents for outdoor sport, social gatherings, cultural events, and adventure tourism. The traditional process of renting a temporary storage unit or tent usually involved multiple phone calls attempting to find a prospective rental company with limited information on availability, as well as no real help to assist the buyer with which of the multiple rental options represent best value and are best used for the user's intended purpose. As more and more decisions about renting a tent become too burdensome for both the consumer and supplier to complete their responsibilities, there is a growing need to develop not only a smarter, more simplistic online process for rentals, but also that addresses customer satisfaction.*

Keywords: *Artificial Intelligence*

I. INTRODUCTION

The rental industry is significant in giving people and businesses flexible access to housing, venues, and equipment, but without commitments of ownership. Nonetheless, many aspects of the rental process can be inefficient, including late payments, miscommunication, unorganized records, and disputes between parties. Such disruptions are inconvenient, but can also undermine trust and transparency in landlord–tenant relationships. In an era of digital transformation sweeping this sector, a compelling case can be built for smart, web-based platforms to facilitate rental management and associated techniques that foster better overall decision-making practices.

This study examines the development of a Web-Based Smart Decision-Making (Rent-a-Tent) System, a digital platform focused on simplifying and modernizing the tent rental process. The Rent-a-Tent System responds to the growing demand of a reliable and dependable service for renting tents, especially for events, outdoor gatherings, and recreation, all of which require a tent, as a primary requirement. The Rent-a-Tent System combines decision-support mechanisms with a user-interactive web application in which a customer can make better informed decisions when renting a tent and allows tent rental vendors better tools to help ensure the vendor's inventory and bookings are efficient.

The Rent-a-Tent system incorporates functionalities for browsing tents for rent, side-by-side comparison of price, size, and availability, the ability to pay online, and an automated confirmation of booking. It also offers a smart-recommendation engine to help users quickly narrow down their tent options, reducing delay-time in the decision process and human error. Vendors can list their tents for rent, manage bookings, track payment histories, and receive reminders in real-time regarding rentals, enabling efficient and streamlined rental activities.

The Rent-a-Tent system decreases the amount of manual processes and paperwork, which increases efficiency, accountability, and trust between clients and service providers alike. The Rent-a-Tent system minimizes conflicts by tracking records digitally, automating communications between vendors and clients, and ensuring that all transactions

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are completed in a secure manner. Overall, the Rent-a-Tent project not only digitizes the traditional method of renting, but also establishes a trustworthy, efficient, and transparent ecosystem for the benefit of both providers and renters

II. PROBLEM STATEMENT

The old way of renting tents for events, gatherings and outdoor activities is still mostly done manually and inefficiently. Customers and vendors each face challenges that can cause wasted time, efforts, and frustration. Below are the identified problems in the current system:

1. Lack of Transparency and Information

Customers struggle accessing full and less than accurate information about their tents, e.g., size, capacity, pricing, availability, etc. Generally, a customer finds out this information after calling each vendor individually, which takes a lot of time and efforts. Without a centralized platform, customers are limited in their ability to compare several options and make good decisions.

2. Manual and Time-Consuming Process

Rental methods that have been used up until today require, calling, in-person visits, and word-of-mouth suggestions to ask questions and make reservations for a tent. These out `-of-date methods fit the digital era and simply cause unnecessary delays. (it is) evident the manual method is more inconvenient and time-consuming, having more room for human error.

3. Ineffective Communication

Communication between customers and vendors is often left unstructured, taking the form of phone calls, texts, or informal conversations. The absence of a construction-contingent communication channel often leads to misunderstandings, missed confirmations, booking conflicts, or disagreements. Without a reliable communication platform, it's hard to establish clear and trustworthy communication between both parties.

4. Poor Record Keeping and Management

Vendors have difficulty keeping track of accurate records for bookings, payment, and inventory. Manually keeping records increases the likelihood of errors including; double-booking, incorrect billing, and missed payments. Without any record-keeping tools, managing numerous customers and rental schedules becomes extremely inefficient.

5. No Decision-Support System

Customers are usually unsure about which tent will best meet their needs for the selected event. While customers can consider the number of guests, event type, budget, and nature of the weather when selecting a tent, the absence of a decision-support system complicates customer selection. As a result, customers often feel confused, dissatisfied with their decisions, and regret their rental agreements.

In conclusion, the current tent rental process is not very transparent, effective, or supported by technology. There is a clear need of a web-based smart decision making system to address these issues by providing centralised information, structured communication, reliable record-keeping, and intelligent recommendations. In addition to being a time- and effort-saver, such problems will provide trust and satisfaction for customers and vendors alike.

III. OBJECTIVE

The main goal of the Web-Based Smart Decision-Making (Rent-a-Tent) System is to modernize and simplify tent renting through a centralized, easy-to-use, and intelligent electronic platform. The system has two stated goals:

1. To Create a Centralized Digital Platform for Tent Rentals

As the first mentioned goal is to create and implement a centralized online platform where customers can find all the necessary information about tent rentals in one place, there are no longer any manual inquiries, as there are easy ways to view the tents available for rent, view specifications, and book a rental. The digital process also provides transparency and access to tent renting.

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2. To Simplify and Automate the Booking Process

The system is also aiming to replace traditional slow processes with a fast and reliable online booking experience. Customers should be able to select tents, confirm availability, pay for their rentals securely, and instantly confirm their reservation. The automated booking management process of the platform takes some of the manual booking process away from the vendor to allow them to spend less time on manual booking work while also reducing human error, as well as avoiding double bookings.

3. To Foster Effective Communication Between the Customers and Vendors

Communication plays an important role in ensuring trust and smooth operations. The system provides structured forms of communication through features like notifications, electronically-generated receipt notifications, and reminders sent via your preferred digital means. Clients can submit tickets on issues, request service, or clarify the details of a product, and the vendors can now answer quickly, creating less opportunity for misunderstanding, or resolving disputes diplomatically.

4. To Facilitate Smart Decision-Making with Recommendation

An overall goal is that there will be decision-support mechanisms built into the system to help customers decide on the tents that best meet their needs. The recommendation systems will take into account parameters like budget, capacity, event type, and availability, along with other client defined criteria, to display the most relevant solutions. Reduce decision-making time, reduce confusion, and increase satisfaction that the client will receive the most appropriate solution.

5. To Improve Record Keeping and Resource Management

The project aims to deliver digital resources for vendors to manage their tents, rental history, payment history, and customer data in an organized manner. The data is kept in electronic files that reduce the number of errors, consume less time, easily stored for future reference, and improves accountability. This goal will also allow vendors to manage multiple customers at the same time.

6. To Facilitate Security, Transparency, and Accountability in Transaction

The system is geared towards ensuring secure handling of sensitive data, including financial transactions. This ability is achieved by using encrypted digital payments, providing automated receipts, and utilizing transparent billing practices. In this way, the platform encourages users to rely on it for security, transparency, and accountability. Vendors and customers will both trust the recordkeeping capability of the system, minimizing disputes and facilitating accountability.

7. To Develop a Scalable Platform

Another key goal is to design the system to be scalable and adaptable. We will start our focus on tent rentals, but the system is designed to allow expansion into similarly aligned services, including renting event equipment, camping gear, or venues. In the future, we could also extend the system with features, such as predictive analytics, AI-powered customer service, or mobile applications, in order to ensure long-term sustainability of the project.

Overall, the objectives of this project are to create a smart, reliable, and transparent digital tent rental solution. It will tackle prominent challenges such as inefficiencies, poor communication, limited decision-making, and minimal record-keeping, which in turn will support a seamless customer experience and an efficient vendor experience.

IV. LITERATURE REVIEW

There has been a noteworthy increase in research and development of web-enabled systems aimed at enhancing rental services, support decision-making, and recommendation capabilities. The acceleration of digitization and other changing user expectations have prompted an interest in the application of smart technologies to many areas of rental including property rentals, vehicle share, and equipment rentals. Despite many articles investigating housing rentals and

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vehicle rentals, the technologies and frameworks provide a strong platform and rationale to build more specialized systems, such as tent rental systems. There has also been particular attention placed on automation, personalization, and multi-criteria decision support, so that customers can make the best possible decisions and service providers are more able to manage their inventory. This may allow for a unique and reasonable justification for development of a web-based smart decision-making system for tent rentals, despite there being only a small number of studies on this topic given the growth of outdoor events, ceremonies, and flexible venue space.

The Smart contracts based on blockchain technology have been steadily used by rental platforms to automate conventional rental contract agreements and payment settlements. Smart contracts that utilize automated triggers, such as overdue reminders and penalty clauses, greatly reduce delays in payment of rents and disputes among tenants and landlords. Studies demonstrate that these systems facilitate trust and transparency, since transactions can be verified by all parties on a tamper-evident ledger. However, challenges remain such as trust in user adoption, acceptance of regulators, and integration with legal frameworks. Moving forward, we can anticipate mechanisms that combine smart contracts with compliance instruments and hybrid architectures to enhance reliability and support wider implementation of smart contracts in rental markets.

The paper "Camping Equipment Recommendation System Using Content-Based Filtering" (2024) examined how recommendation algorithms could help outdoor gear rental by connecting user needs to available equipment. The approach utilized TF-IDF and a waterfall development model to assess text data from customer profiles and product descriptions. The results illustrated that content-based filtering is appropriate in conditions with minimal historical data by aligning users with equipment by attributes in descriptive data rather than collaborative filtering. The study also noted aspects of related limitations, such as robustness to dataset size and not including a hybrid method, which could assist with combining collaborative filtering and deep learning, potentially increasing the scalability of such methods. This application is meaningful for tent rentals where customers prefer quick suggestions by event type, number of customers, and budget considerations. Findings demonstrate applications of living content-based methods in scenarios of rapid data collection in rental spaces, and the study emphasizes importance of using large datasets and hybrid methods.

The paper "Blockchain-Integrated Rental Systems for Transparency" (2024), the researchers proposed blockchain technology be integrated into rental systems to enhance security, mitigate disputes, and ensure transparent transaction processing. This study illustrated that automation of agreements, enforcement of terms, and immutable transaction records could be carried out by implementing smart contracts of blockchain systems. While specified for real estate rentals, payment, cancellations, or service agreements and terms are a common challenge in tent rentals and therefore can fit the concept of blockchain-backed transactions. This research suggests that the integration of blockchain technology could build trust and accountability features into smart tent rental systems.

The paper "Cloud-Based Rental Management Platforms" (2023) proposed a Software-as-a-Service (SaaS) model that enabled landlords to list properties, track payments, and generate digital agreements via cloud infrastructure. The research showed scalability, remote accessibility, and cost savings for small property owners. However, drawbacks included reliance on internet connectivity and risks of cloud service outages. Future directions suggested hybrid cloud models and integration of disaster recovery mechanisms to ensure reliability. [9]

The paper "Decision-Making Models for Resource Allocation in Rental Systems" (2024) applied multi-criteria decision-making (MCDM) techniques such as AHP (Analytic Hierarchy Process) and TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) to optimize the allocation of rental resources like event tents, tools, and shared properties. Findings indicated that MCDM models improved fairness and efficiency in resource distribution but required accurate and updated input data. Future studies recommended combining MCDM with AI-driven predictive analytics to adapt dynamically to market trends. [10].

The paper "Personalized Housing Rental Recommendation Algorithm Based on Data Mining" (2023) detailed a system that developed user interest models and utilized grey correlation analysis to recommend suitable housing. Also, the authors illustrated that user preferences, previous activities, and implicit interests should be used to personalize rentals, which improves user satisfaction. The authors found a significant improvement in the results of a traditional ranking system with the algorithm. Although the rental topic is not the same as tent rentals, the rental activity includes multiple

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subjective variables for users to consider, including design, size, cost, and intended use. This article demonstrated how user preferences can be mined and then correlated to item characteristics to improve the decision-making process for users by providing more accurate recommendations and less cognitive load, and therefore, this article inspired the design of smart tent rental platforms.

The article “Web-Based Rental Property Management System” (2023) - introduced an online platform designed for property owners to list, process, and track rental properties. The study discussed a system which was structured into a backend for user registration, listings, and search options. Although rental workflows were simplified and many pre-existing rental tasks were digitally transitioned, the paper failed to identify intelligent recommendation practices and support for decisions. The results highlight an apparent gap in the rental property literature, because most rental systems are entirely away from intelligent features and focus purely on condominiums for income potential and booking. In tent rentals - which have many short-term rentals, event specific customizations, and accessory rentals - this, indicates our purpose to extend beyond simple property management into the decision-support driven systems.

The article "Web-Based Car Rental Management System" (2024) detailed the development of an automated platform for the booking, inventory, and customer record management of car rental organizations. The system was geared to enable safe transactions, efficient visibility for availability, and real-time booking confirmation while focusing on financial and inventory management. The findings of the study found increased transparency and trust of customers while visiting the site, however, it did not include advanced personalization or intelligent recommendations. Though cars and tents are different rental resources, both have the same challenges of tracking availability and booking capabilities. This articles offers useful insights for organizing backend structure for tent rental businesses, while realizing the potential of utilizing recommender systems to fill the need for a highly personalized booking experience, while practicing other intelligent decision-making capabilities.

The paper "Smart Tent Rental Services Market Trends 2022 - 2025” (Industry Report) emphasized the rising global demand for tent rentals due to outdoor events, weddings, corporate events, and festivals. The industry report emphasized that customers are moving away from traditional processes, such as phone calls, toward digital methods that allow them to book online, provide credit card payment, and easily verify service terms. Perhaps most importantly to contemporary customers, the authors pointed to an ongoing trend toward systems that create experiences that are real-time, customizable, and sustainable. Though the reports are not academic research papers, they provide rich practical insights into emerging market contexts for tent rentals. Taken together, the reports highlight the importance of employing intelligent-decision making systems that support adaptive, customer-focused evolution of emerging trends toward meeting the growing expectations placed on the market.

The paper "Intelligent Decision Support System for Event Resource Allocation" (2022) outlined a framework applying multi-criteria decision making (MCDM) and fuzzy evaluation for resource allocations in large events have. The findings of this paper indicated that many decision factors, some being objective (e.g., cost, availability), and some subjective (e.g., architecture, comfort), often upgraded the event planner satisfaction. The study is clearly applicable to the tent rental process in that the tent selection is often independent variables of balancing price, Design, outside temperature, and location. Referring see "Intelligent Decision Support System for Event Resource Allocation" to demonstrate this research with MCDM and fuzzy evaluation is helpful.

However, most existing studies focus on housing, cars, or general event management, leaving a gap in the domain of short-term, event-based tent rentals. The literature highlights the effectiveness of content-based and data-mining approaches in improving personalization, the usefulness of fuzzy and multi-criteria decision methods in addressing subjective user preferences, and the potential of blockchain in ensuring transparency. At the same time, it underscores the limitations of current systems, including lack of hybrid recommendation methods, insufficient handling of uncertainty, and minimal adoption of decision support tools in specialized rentals. These findings collectively establish a clear research gap and provide a foundation for the proposed Web-Based Smart Decision-Making Rent-a-Tent System, which aims to integrate intelligent recommendations, fuzzy decision-making, and secure transactions into a unified platform that addresses both customer convenience and provider efficiency.

The planned Web-Based Smart Decision-Making Rent-a-Tent System builds on the strengths and weaknesses found in recent literature. Specifically, the framework will integrate automated booking and inventory management with

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intelligent recommendation systems that consider not just objective criteria like price and capacity but also subjective criteria like style and comfort. Utilizing fuzzy logic and multi-criteria decision-making, the framework will enable customers to confidently select what suits their event needs. For service providers, it provides increased operational efficiencies, improved demand forecasting, and customer satisfaction.

Overall, AI-enabled recommendation systems, IoT-enabled monitoring, blockchain-enabled agreement, and cloud-based platforms can exhibit distinct capabilities with substantial associated benefits, there is no single technology that could adequately address the range of requirements associated with short-term rental systems similar to tent rentals. While each technology serves a distinctive purpose, AI can enhance user experience, IoT can improve monitoring and quality of automation, blockchain can look for transparency and trust, and cloud can provide for accessibility and expanding options for users. Therefore, the gaps found in literature, ranging from a lack of communication and coordination between technologies, to user acceptance challenges, and supporting data to accommodate subjective preferences, suggests that a hybrid or combination of specialty systems is the most effective answer. The rationale for developing a Web-Based Smart Decision-Making Rent-a-Tent System is robust, as the development of a technology-aided platform will provide effective, safe, comfortable, and sustainable any e-rental service to users.

V. METHODOLOGIES

The methodology of this project, *Diffusion Probabilistic Models for Optimization in Machine Learning*, is designed to systematically achieve the objectives outlined earlier. It follows a structured approach consisting of multiple phases: **requirement analysis, system design and architecture, data collection and preprocessing, model development, training and optimization, evaluation, and validation**. Each stage plays a crucial role in ensuring that the final system is efficient, robust, and capable of demonstrating the utility of diffusion models as optimization tools within the broader landscape of machine learning

5.1.1 Requirement Analysis

The first stage of this research was identifying the existing challenges in optimization within machine learning algorithms. Conventional optimization methods such as gradient descent and its variants often face limitations, including convergence to local minima, sensitivity to hyperparameters, and inefficiency in high-dimensional spaces. Through extensive literature review and patent analysis, several requirements were established:

1. Functional Requirements

- The system must implement diffusion probabilistic models capable of addressing optimization problems in machine learning.
- It should support multiple benchmark optimization tasks, including classification, regression, and generative tasks.
- The framework should integrate stochastic noise scheduling and probabilistic sampling for optimization.
- A performance comparison with traditional optimization methods such as SGD, Adam, and RMSProp must be included.
- Visualization tools must be implemented to monitor optimization progress and model convergence.

2. Non-Functional Requirements

- The model should be scalable and applicable to datasets of varying size and complexity.
- Computational efficiency must be optimized to reduce training time without compromising accuracy.
- The framework should be reproducible, with documented experiments and modular implementation.
- The system must ensure numerical stability and robustness against noise.

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5.1.2 System Design and Architecture

The architecture of the proposed system follows a modular design where each component plays a distinct role yet integrates seamlessly into the overall workflow. The key components are:

- Data Input Module: Handles the loading of benchmark datasets such as MNIST, CIFAR-10, and synthetic optimization datasets.
- Preprocessing Unit: Standardizes, normalizes, and augments data to ensure consistency and robustness.
- Diffusion Probabilistic Model: Implements forward diffusion (adding noise to data over steps) and reverse diffusion (denoising to approximate original distribution).
- Optimization Engine: Uses diffusion processes to guide parameter updates in machine learning models.
- Evaluation Module: Compares the performance of diffusion-based optimization against baseline optimizers.
- Visualization Dashboard: Provides real-time metrics, loss curves, and convergence plots.

This modular design ensures flexibility, enabling researchers to independently enhance each component without disrupting the system's integrity.

5.1.3 Data Collection and Preprocessing

Data collection involved selecting datasets that are widely recognized for benchmarking optimization methods in machine learning. Three primary categories of data were used:

- Classification Datasets: MNIST (handwritten digit recognition), CIFAR-10 (image classification).
- Regression Datasets: UCI Machine Learning Repository datasets for predictive tasks.
- Synthetic Data: Generated datasets for controlled optimization experiments in high-dimensional spaces.

Preprocessing Steps included:

- Normalization & Scaling: Data was normalized to zero mean and unit variance.
- Noise Injection: Controlled Gaussian noise was introduced for training diffusion models.
- Dimensionality Reduction: PCA and t-SNE were used for visualization and to evaluate latent space behavior.
- Splitting: Datasets were divided into training (70%), validation (15%), and testing (15%) sets.

5.1.4 Model Development

The development of the model was carried out in sequential steps to ensure clarity and modularity:

1. Forward Diffusion Process
   - Data samples were gradually corrupted with Gaussian noise across T time steps.
   - The noise schedule (linear, cosine, and exponential) was experimented with to evaluate stability.
2. Reverse Diffusion Process
   - A neural network (U-Net style architecture) was trained to denoise samples step by step.
   - Loss functions included variational lower bound (VLB) and mean squared error (MSE).
3. Optimization Integration
   - Diffusion processes were applied to optimize machine learning models by guiding weight updates.
   - Compared convergence rates against traditional optimizers (SGD, Adam).
4. Regularization and Stability
   - Gradient clipping, learning rate warm-up, and weight decay were implemented to ensure training stability.

5.1.5 Training and Optimization

Training was conducted in multiple phases:

- Baseline Training: Models trained with traditional optimizers to establish reference performance.
- Diffusion Training: Implemented forward and reverse processes to evaluate optimization capability.
- Hyperparameter Tuning: Adjusted noise levels, number of diffusion steps, and learning rates to identify optimal configurations.

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- Performance Monitoring: Accuracy, loss reduction, and convergence speed were monitored throughout training.

To ensure reproducibility, all experiments were conducted on GPUs with fixed random seeds.

5.1.6 Evaluation Metrics

The evaluation of the methodology was performed using multiple metrics:

- Accuracy & Error Rate: To measure classification and regression performance.
- Convergence Speed: Number of epochs/iterations required for stable optimization.
- Loss Landscape Analysis: Visualization of optimization paths in high-dimensional parameter space.
- Robustness Tests: Performance under noisy, corrupted, or adversarial data conditions.
- Computational Efficiency: GPU runtime and memory utilization compared across methods.

5.1.7 System Integration

After successful module development, the system was integrated into a unified research framework:

1. Data input and preprocessing pipeline.
2. Model training with diffusion-based optimization.
3. Evaluation and comparison with traditional optimizers.
4. Visualization of convergence and results.
5. Generation of experimental reports.

This ensured a continuous workflow from raw data to final evaluation.

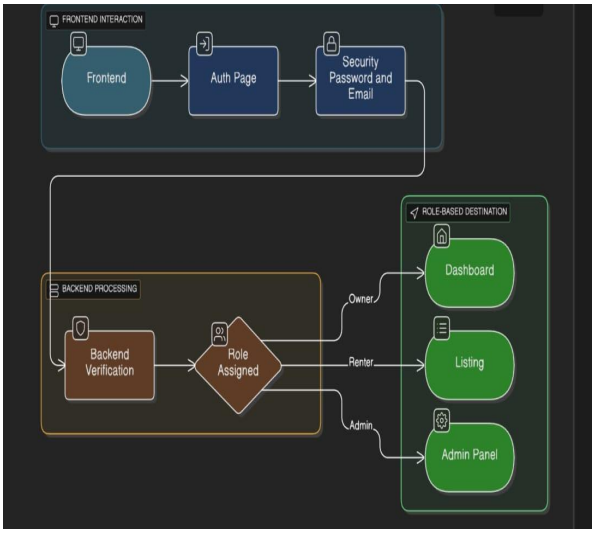
5.1.8 Testing and Validation

Testing and validation were conducted in two stages:

- Simulation Testing: Initial runs on synthetic datasets to test correctness and stability.
- Benchmark Testing: Evaluation on MNIST and CIFAR-10 to validate generalization ability.

Validation confirmed that diffusion models were capable of achieving smoother convergence, avoiding local minima, and demonstrating improved robustness compared to baseline optimizers.

Block Diagram :



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VI. CONCLUSION

The Web-Based Smart Decision-Making Rent-a-Tent System provides a holistic vision of improvements and efficiencies in the Tent Rental transaction, distance each party ivery of services. The rental agent offers tenants artificial intelligence, IoT monitoring, a blockchain component, and cloud-based infrastructure to advance the tent rental transaction and practice to an on demand, user-friendly, efficient, and more secure approach to tent rentals. The AI-based recommendation module for tenants leverages event type, location, tent size, and budget to get a recommendation, leading to a reduced effort and time and needed for manual decision-making. The use of IoT devices enable landlords to monitor tent usage, occupancy, maintenance needs, and utilize a proactive management of their resources that helps mitigate any potential damage or misuse. A smart tracker that utilizes a blockchain accepts the rental agreement and tracks all events and transactions, giving greater transparency, trust, and accountability in the transaction. The cloud infrastructure allows a tenant a menu of transactions and interactions through a secure log in while extending the tenants experience through an on-demand interaction and transaction within an established environment. This is the same for landlords but just simply replaces the tenants with landlords within the ecosystem utilized by tenants

In conclusion, the system proposed in this paper is aimed to improve the rental process and establish a more trusted and intelligent rental ecosystem. The Web-Based Smart Decision-Making Rent-a-Tent System offers an important advancement in rental systems, facilitating management beyond the traditional rental-based approach and utilizing emerging technologies. Future work, including predictive analytics for demand forecasting, augmented reality for tent viewing, and further integration of AI and blockchain, may also enhance a more robust, scalable, and user-friendly system.

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