

Blockchain-Assisted Decentralized Roommate Matching with Verifiable Consent and Tamper-Proof Trust Mechanisms

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Abstract—This paper presents a blockchain-assisted decentralized roommate matching platform designed to provide intelligent compatibility analysis, secure consent management, and trustworthy roommate interactions. The proposed system combines a React-based web interface, a Spring Boot backend, a MySQL database, a Python-based machine learning module, and Ethereum smart contracts to provide an integrated roommate matching workflow. Users can create profiles and specify lifestyle preferences such as sleep schedule, food habits, cleanliness level, smoking and drinking preferences, work type, budget, and personality characteristics. These preference attributes are processed and converted into suitable numerical representations for compatibility analysis using the K-Nearest Neighbors (KNN) algorithm. The KNN model identifies users with similar lifestyle characteristics and generates a compatibility score to recommend suitable roommate matches. In addition to intelligent matching, the platform incorporates blockchain technology to provide verifiable consent between matched users. Once a user sends a roommate request and the other user accepts it, the consent transaction is recorded through a Solidity-based smart contract on the Ethereum blockchain, with the transaction hash and timestamp providing a verifiable record of the agreement. Conventional user information, preferences, matching results, and feedback are maintained through the application database, while blockchain is utilized for consent-related records requiring tamper-resistant verification. The system also provides user authentication, profile management, roommate recommendations, consent management, and feedback mechanisms through a unified web interface. By integrating machine learning-based compatibility prediction with blockchain-based consent verification, the proposed platform aims to improve the transparency, reliability, and trustworthiness of

roommate matching compared with conventional preference-based matching approaches.

Index Terms—Blockchain, K-Nearest Neighbors, roommate matching, machine learning, smart contracts, Ethereum, compatibility prediction, verifiable consent, trust management, decentralized application.

I. INTRODUCTION

Roommate matching has become an important requirement for students, working professionals, and individuals relocating to unfamiliar cities. Traditional approaches to finding roommates commonly depend on personal references, social platforms, classified advertisements, or centralized accommodation applications. These approaches generally provide basic information such as location, rent, occupation, and contact details, but may provide limited consideration of lifestyle compatibility between individuals.

Differences in sleeping schedules, food preferences, cleanliness, work patterns, smoking and drinking habits, and personality can influence the suitability of a shared living arrangement. Previous studies on roommate matching have explored the use of compatibility-related preferences and behavioral characteristics in roommate selection [1], [2], [8]. This creates a need for a systematic platform that can consider multiple user characteristics and assist individuals in identifying potentially compatible roommates.

Recommendation and machine learning techniques have demonstrated the potential to improve personalized matching by analyzing user attributes

and identifying similarities among individuals [4]. Similarity-based approaches are particularly relevant to roommate matching because compatibility depends on the degree of similarity between the preferences and lifestyle characteristics of two users [1],[2]. The proposed system applies the K-Nearest Neighbors (KNN) algorithm to perform compatibility-based matching. User preferences including sleep schedule, food habits, cleanliness level, work type, smoking and drinking preferences, budget, and personality are represented as input features for the model. KNN analyzes the distance between user feature representations and identifies the nearest users with similar characteristics [3]. Based on these similarities, the system generates a compatibility score and recommends potential roommates.

While machine learning can assist in identifying suitable matches, the establishment of trust between users remains an important challenge. A conventional centralized application stores user profiles, preferences, requests, and interaction records within a database managed by the application. Although centralized databases are effective for regular application operations, records related to agreements and user consent can benefit from an independently verifiable and tamper-resistant mechanism. Blockchain technology has been investigated for improving privacy, security, transparency, and trust in recommendation and data- management systems [4], [7], [9], [10]. Smart contracts further enable predefined operations to be executed and recorded through programmable Blockchain transactions [11]. Blockchain-based systems have been explored in areas requiring transparency, data integrity, identity management, and verifiable transactions [5], [6], [9], [11]. Ethereum smart contracts provide programmable mechanisms for recording predefined transactions and maintaining their associated blockchain records [11]. In the proposed system, blockchain technology is applied specifically to roommate consent management. After a potential roommate is identified through the matching process, a consent request can be sent to the selected user. When the request is accepted, the consent transaction is recorded through a Solidity-based smart contract on the Ethereum blockchain. The corresponding transaction hash and timestamp provide a verifiable reference to the consent record, while conventional application data continues to be maintained in the MySQL database. The use of

blockchain and smart contracts for consent management is supported by previous research on blockchain-based consent systems [5], [6].

The proposed system integrates machine learning and blockchain within a web-based roommate matching platform. The application uses a React-based frontend to provide interactive user functionality and a Spring Boot backend to manage authentication, application logic, database operations, and communication with the machine learning module. MySQL is used to maintain user profiles, preferences, matching information, and feedback. A Python- based KNN module performs compatibility analysis and returns matching results to the application. The blockchain layer uses Ethereum, Solidity smart contracts, and a compatible wallet interface to manage and record consent transactions. This architecture connects the complete workflow from user registration and preference collection to intelligent matching, consent management, and feedback.

The overall workflow begins with user registration and authentication, followed by the creation of a profile and submission of roommate preferences. The collected preferences are processed by the machine learning module, where KNN identifies users with similar characteristics and produces compatibility scores [3]. The resulting recommendations are presented to the user, who can view potential roommate profiles and initiate a consent request. The selected user can accept or reject the request, and an accepted consent transaction is recorded through the blockchain smart contract. Feedback and reviews can subsequently be maintained as part of the application workflow, supporting a more transparent interaction between users [5], [9].

The proposed work is primarily system-oriented and focuses on integrating established technologies into a single roommate matching workflow. The system does not propose a new machine learning algorithm or a new blockchain protocol; instead, it combines KNN-based similarity matching with blockchain-assisted consent verification to address two complementary aspects of roommate selection: compatibility and trust. By integrating intelligent preference analysis, conventional database management, and verifiable blockchain-based consent, the proposed platform provides a structured approach for developing a more transparent and trustworthy digital roommate matching environment [3], [5], [9], [11].

II. RESEARCH METHODOLOGY

A. Compatibility-Based Roommate Matching

The proposed system adopts a structured compatibility-based approach for identifying suitable roommates from user lifestyle and behavioral preferences. Existing roommate matching approaches demonstrate the importance of considering compatibility-related characteristics rather than relying only on basic user information [1], [2], [8]. Recommender-system research also establishes the use of preference and similarity information for generating personalized recommendations [4].

In the proposed system, users provide relevant roommate preferences through structured forms. These preferences are converted into a consistent representation so that potential roommate pairs can be evaluated according to their degree of similarity. The matching process is designed to support practical co-living requirements by considering the characteristics provided by the users before generating roommate recommendations.

B. KNN-Based Compatibility Prediction

The machine-learning component uses the K-Nearest Neighbors (KNN) algorithm to perform compatibility classification. KNN is a similarity-based method in which an input instance is compared with existing training samples and classified according to its nearest neighbouring instances. Similarity-based recommendation and classification approaches provide a suitable foundation for matching problems where relationships between preference attributes are important [3], [4].

The selected roommate preference attributes are converted into numerical feature representations and supplied to the KNN model. The distance between two candidate feature vectors x and y is computed using the standard Euclidean distance metric:

$$d(x, y) = \sqrt{\sum_{i=1}^n (x_i - y_i)^2} \quad (1)$$

where $x = (x_1, x_2, \dots, x_n)$ and $y = (y_1, y_2, \dots, y_n)$ represent the normalized numerical feature vectors corresponding to the lifestyle and behavioral preference attributes of two candidate users, and n denotes the total number of evaluated preference dimensions. The implemented model uses $K = 15$ and evaluates the nearest training instances to determine whether a potential roommate pair belongs to the compatible or non-compatible class.

The dataset contains 4000 roommate-pair instances, with 3000 instances used for training and 1000 instances used for testing. The model achieves approximately 84.5% test accuracy, while five-fold cross-validation produces an average accuracy of approximately 85.5%. The resulting compatibility prediction is passed to the recommendation component to support the identification of suitable roommate matches.

C. Blockchain-Assisted Privacy and Consent Management

The proposed system incorporates blockchain technology to provide a verifiable mechanism for recording important user-authorized actions.

Existing research has explored the combination of blockchain with recommender systems to improve privacy, trust and resistance to unauthorized modification [4], [7], [9], [10]. Security-oriented recommender-system research also highlights the importance of protecting recommendation-related interactions against malicious or unauthorized manipulation [7].

In the proposed architecture, conventional user and application information is maintained in a MySQL database, while selected trust-related operations are recorded through an Ethereum smart contract. When a user explicitly accepts a recommended roommate connection, the consent operation is submitted through the Solidity smart contract using Meta Mask. The resulting blockchain transaction provides a transaction hash and timestamp that can be used to verify the recorded consent action.

Blockchain-based consent-management studies support the use of blockchain and smart contracts for maintaining verifiable authorization records [5], [6], [11].

This separation ensures that the blockchain is not used to store the complete application database. Instead, it functions as a trust layer for selected user-authorized operations, while MySQL continues to support regular application data management.

D. Integrated Matching, Recommendation, and Consent Workflow

The proposed system integrates compatibility prediction and blockchain-assisted consent within a single web-based workflow. Previous roommate matching and recommender-system studies

demonstrate the value of structured preference-based matching [1], [2], [4], [8] while blockchain-based recommender research highlights the potential of decentralized mechanisms for improving trust and privacy [9], [10]. However, the proposed system combines these concepts specifically for roommate matching by integrating KNN-based compatibility prediction with verifiable consent management.

The system is implemented using a React frontend, Spring Boot backend, MySQL database, Python-based KNN compatibility module and Ethereum smart-contract layer. The overall workflow consists of user registration, preference submission, compatibility prediction, roommate recommendation, user consent, blockchain recording and feedback.

The contribution of the proposed system is therefore primarily integration-oriented. Rather than introducing a new KNN algorithm or a new blockchain protocol, the system combines established machine-learning and blockchain technologies to provide a roommate matching platform in which recommendations are supported by compatibility prediction and important consent actions are recorded through a tamper-resistant mechanism [3], [5], [9], [11].

III. PROPOSED SYSTEM

A. Design Objectives

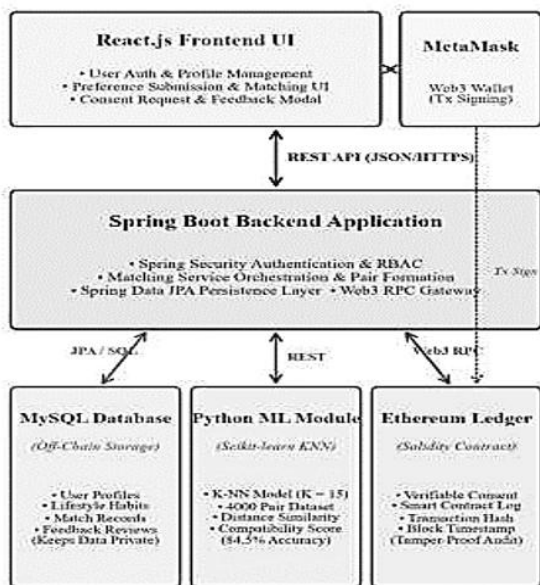


Fig. 1. High-level architecture of the proposed blockchain-assisted roommate matching system.

The proposed system was designed around five primary objectives: (1) to provide structured collection of roommate preferences related to lifestyle and personal behavior; (2) to estimate compatibility between potential roommates using a machine-learning-based matching mechanism; (3) to provide users with suitable roommate recommendations based on their compatibility characteristics; (4) to introduce a verifiable consent mechanism for controlling whether a recommended connection is accepted; and (5) to maintain

important trust-related records in a tamper-resistant manner using blockchain technology [1], [2], [5], [9]. The system is designed to separate conventional application data management from compatibility prediction and blockchain-based trust management, allowing each component to perform a specific function within the overall matching process.

B. System Architecture

The proposed system is implemented as a web-based application consisting of a React frontend, Spring Boot backend, MySQL database, Python-based machine learning module and Ethereum smart-contract layer. The frontend provides interfaces for user registration, authentication, preference submission, compatibility results, roommate recommendations, consent management and feedback. The Spring Boot backend manages authentication, user profiles, preference data, application logic and communication between the frontend, database, machine learning module and blockchain layer.

The machine learning component is implemented in Python using the K-Nearest Neighbors (KNN) algorithm. User preference attributes are converted into feature representations and supplied to the compatibility model.

The KNN model identifies neighboring training samples based on feature similarity and uses them to determine the compatibility class of a potential roommate pair.

The resulting compatibility information is returned to the application and used to support the recommendation process.

The blockchain layer is implemented using Ethereum and Solidity smart contracts, with Meta Mask providing wallet-based interaction for blockchain transactions.

Regular user and application information is maintained in the MySQL database, while selected trust-related operations, particularly consent records, are submitted to the blockchain.

This separation avoids storing complete application data on-chain while providing a verifiable and tamper-resistant record for important user-authorized actions [5], [6].

C. Preference Representation and Compatibility Prediction

The system represents roommate requirements through structured lifestyle and behavioral preferences. The preference collection process considers characteristics such as sleeping schedule, cleanliness preference, food habits, work type, smoking and drinking preferences, and personality-related characteristics.

These attributes are collected through the web interface and transformed into suitable feature representations for compatibility analysis [1], [2], [8]. The compatibility prediction component uses the K-Nearest Neighbors algorithm to determine the similarity between users.

During prediction, the input feature representation is compared with the available training samples and the nearest neighboring instances are identified. The implemented model uses $K=15$ to determine the neighborhood considered during classification. The resulting prediction provides a compatibility indication that can be used by the recommendation component to identify potentially suitable roommate pairs.

The matching process therefore considers behavioral and lifestyle similarity rather than relying only on basic profile information. This enables the system to identify compatibility based on factors that can influence the practical co-living experience [1], [2], [8].

D. Consent and Blockchain-Based Trust Mechanism

A major component of the proposed system is the integration of explicit consent with blockchain-based record management. A compatibility prediction does not automatically establish a roommate relationship. Instead, the recommended match is presented to the user, who can review the available information and decide whether to provide consent.

When consent is given, the system invokes the deployed Ethereum smart contract through the user's connected MetaMask wallet. The consent transaction is recorded on the blockchain along with relevant transaction information and timestamp details. The resulting transaction hash provides a verifiable reference to the recorded action and makes subsequent unauthorized modification of the blockchain record impractical [5], [6], [11].

The blockchain component is therefore used as a trust layer rather than as a replacement for the application database. MySQL manages conventional user and application information, whereas the blockchain is used for selected consent-related records requiring stronger verifiability and tamper resistance. This separation also reduces unnecessary blockchain storage and transaction overhead [4], [5], [9], [11].

E. Integrated Matching and Consent Workflow

The complete system integrates preference collection, compatibility prediction, recommendation and consent management into a single workflow. A user first registers and authenticates through the web application and provides the required profile and lifestyle preferences. The backend validates and stores the application information, after which the selected preference features are processed by the Python-based KNN compatibility module [3].

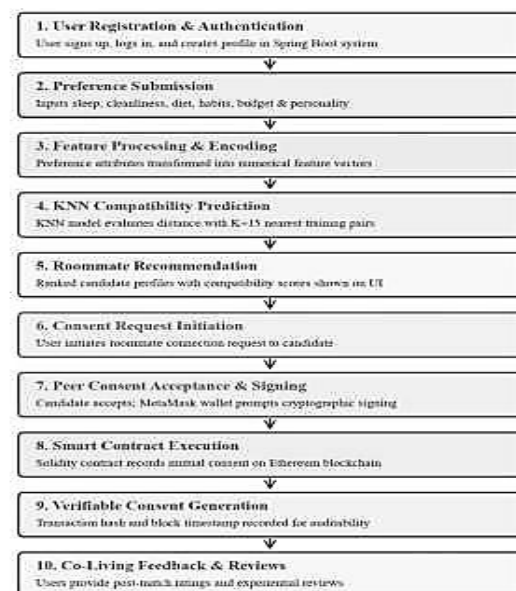


Fig. 2. Overall roommate matching and consent workflow.

The compatibility module evaluates the user's feature representation against the prepared training data and generates a compatibility prediction. The recommendation component uses this result to present suitable roommate suggestions through the frontend. The user can then examine the suggested match before deciding whether to proceed.

When the user accepts a recommended connection, the consent operation is submitted through the Ethereum smart contract and the corresponding blockchain transaction is generated. The transaction hash and timestamp provide a verifiable record of the consent event [5], [6], [11]. Feedback and reviews can subsequently be managed through the application to support continued interaction between users.

IV. MATCHING AND FAILURE MODEL

A. Preference Processing and Pair Formation

The system processes the lifestyle and behavioral preferences submitted by registered users through the web interface. The collected information is validated and converted into a structured representation before being passed to the compatibility prediction module. The matching process considers relevant roommate characteristics such as sleeping schedule, cleanliness preference, food habits, work type, smoking and drinking preferences, and personality-related characteristics.

For compatibility evaluation, the selected preference attributes are transformed into numerical feature values suitable for machine-learning processing. A pair of users is then represented as a compatibility instance based on the relationship between their corresponding preference features. The prepared dataset contains 4000 roommate-pair instances, which are divided into training and testing subsets. The training data is used to establish the neighborhood relationships required by the KNN model, while the testing data is used to evaluate its prediction behavior.

B. Compatibility Prediction and Recommendation

The compatibility engine uses the K-Nearest Neighbors (KNN) algorithm to determine whether a potential roommate pair is compatible. For a given input pair, the feature representation is compared with the training instances using a distance-based similarity calculation. The nearest 15 neighbors ($K = 15$) are considered during classification, and the neighboring

class information is used to determine the compatibility result.

The implemented dataset is divided into 3000 training instances and 1000 testing instances. The model achieves approximately 84.5% test accuracy, while five-fold cross-validation produces an average accuracy of approximately 85.5%. The prediction output is passed to the recommendation component, which uses the compatibility information to present suitable roommate suggestions to the user.

The matching process is designed to distinguish between compatible and non-compatible pairs rather than treating every registered user as a possible match. This allows the system to reduce unsuitable recommendations and provide users with compatibility information before they decide whether to establish a connection.

C. Failure and Recovery Handling

The system incorporates validation and failure-handling mechanisms to manage incorrect, incomplete or unavailable information during the matching process. User inputs are validated before they are stored or processed, preventing incomplete preference records from being directly supplied to the compatibility module. Authentication and authorization mechanisms also restrict access to protected profile, matching and consent operations. If the machine-learning module is unavailable or a prediction cannot be generated, the backend prevents an invalid compatibility result from being presented as a valid recommendation. Similarly, database failures or unavailable

records are handled through backend error responses rather than producing incomplete matching results. The separation between the application database, prediction module and blockchain layer allows failures in one component to be detected without treating the entire system as a successful transaction.

Blockchain operations introduce an additional validation stage during consent recording. A recommended match is not considered consented merely because a compatibility result exists. The user must explicitly authorize the consent transaction, and the blockchain transaction must be successfully submitted before the consent record is treated as verifiable. If a transaction fails or is rejected, the application can retain the recommendation state without falsely recording the consent as completed.

The system therefore distinguishes between matching failure, application failure and blockchain transaction failure. A failed compatibility prediction does not create a recommendation, an invalid application request does not modify protected data, and an unsuccessful blockchain transaction does not produce a confirmed consent record.

V. INTELLIGENT COMPATIBILITY LAYER

A. Preference-Aware Compatibility Layer

The proposed system incorporates an intelligent compatibility layer which uses the K-Nearest Neighbors (KNN) algorithm to identify potential roommate compatibility from user-provided lifestyle and behavioral preferences. The compatibility module operates on structured preference representations rather than relying only on basic profile information. Relevant characteristics such as sleeping schedule, cleanliness preference, food habits, work type, smoking and drinking preferences, and personality-related information are converted into feature representations for compatibility analysis.

For a new roommate pair, the KNN model compares the corresponding feature representation with previously prepared training instances and identifies the nearest neighboring samples. The implemented model uses $K = 15$, and the neighboring class information is used to determine the compatibility outcome. The system was trained using 3000 instances and evaluated using 1000 test instances from a dataset containing 4000 roommate-pair samples. The resulting prediction is passed to the recommendation component, which uses the compatibility information to identify suitable roommate suggestions.

B. Compatibility Explanation and Recommendation

The intelligent component also provides contextual information associated with the generated compatibility result. Instead of presenting a recommendation without any basis, the system associates the result with the preference characteristics supplied by the users. Similarity in relevant lifestyle attributes contributes to the compatibility assessment, while differences in those attributes can affect the resulting classification.

The recommendation stage uses the output of the KNN model to support the presentation of suitable

roommate pairs. The generated compatibility information allows users

to understand that the recommendation is based on their submitted preferences rather than being selected arbitrarily. The explanation is derived from the structured input features and model output and does not claim to infer hidden psychological states or unsupported personal characteristics.

The implemented model achieved approximately 84.5% accuracy on the test set, with five-fold cross-validation producing an average accuracy of approximately 85.5%. These results indicate the behavior of the implemented compatibility classifier on the prepared dataset and are used to demonstrate the effectiveness of the matching component within the proposed system.

C. Integrated Intelligent and Trust Layer

The intelligent compatibility layer is integrated with the blockchain-assisted trust mechanism so that compatibility prediction and user authorization remain separate stages of the matching process. The KNN model determines the compatibility outcome, while the blockchain layer records selected user-authorized actions such as consent. A compatibility prediction therefore does not automatically establish a roommate connection.

After a compatible roommate is recommended, the user can review the suggested match and decide whether to proceed. When explicit consent is provided, the Ethereum smart contract records the corresponding consent transaction through the user's connected wallet. The transaction hash and timestamp provide a verifiable reference to the recorded action.

This layered design allows the intelligent component to support personalized roommate recommendations while retaining user control over the final interaction. The KNN module performs compatibility prediction, the recommendation component presents the resulting match, and the blockchain layer provides a tamper-resistant record of consent. Consequently, the system combines intelligent compatibility prediction, contextual recommendation and blockchain-assisted trust management without making the machine-learning prediction itself a substitute for user authorization.

VI. IMPLEMENTATION

A. Frontend Implementation

The frontend of the proposed system is implemented using React.js to provide an interactive web interface for user registration, authentication, profile management, preference submission, roommate recommendations, consent management and feedback. The interface is organized into reusable components so that the different stages of the matching process can be accessed independently. Structured forms are used to collect lifestyle and behavioral preferences, while dedicated views present the compatibility result and recommended roommate information.

The frontend communicates with the backend through REST APIs for user authentication, profile operations, preference management and compatibility-related requests. The interface also provides the interaction required for blockchain-based consent. When a user decides to provide consent for a recommended roommate connection,

Meta Mask is used to connect the user's blockchain wallet and authorize the corresponding transaction. This architecture keeps user interaction separate from the underlying matching, database and blockchain operations.

B. Backend and Machine Learning Implementation

The backend is implemented using Spring Boot and provides the application services required for authentication, user management, profile and preference processing, roommate matching and consent management. Spring Security is used for secure authentication and authorization, while Spring Data JPA provides the persistence layer for communication with the MySQL database. The backend acts as the central coordination layer between the React frontend, database, Python-based machine learning module and blockchain components.

The compatibility prediction module is implemented using Python and Scikit-learn. The K-Nearest Neighbors (KNN) algorithm is used to classify potential roommate pairs according to their preference similarity. The selected preference features are converted into numerical representations and supplied to the trained model. The implemented model uses $K = 15$ and evaluates the nearest training instances to determine the compatibility class. The resulting prediction is returned to the backend and used to generate suitable roommate recommendations.

C. Database and Blockchain Implementation

MySQL is used as the primary relational database for storing conventional application information. User accounts, profiles, preferences and other application-level records are managed through the Spring Boot backend and persisted using JPA. MySQL Workbench is used during development and database management to inspect and maintain the relational data.

The blockchain component is implemented using Ethereum and Solidity smart contracts. Remix IDE is used for developing, testing and deploying the smart contract, while Meta Mask provides wallet-based authorization for blockchain transactions. The blockchain layer is primarily used for trust-related operations such as recording user consent rather than storing the complete user profile.

When a user explicitly accepts a recommended roommate connection, the corresponding consent operation is submitted to the Solidity smart contract. The blockchain transaction generates a transaction hash and timestamp that can be used to verify the recorded action. This approach separates frequently accessed application data from trust-sensitive records and avoids unnecessary storage of complete user information on the blockchain.

D. Development and Testing Environment

The system was developed using a combination of development and testing tools selected according to the requirements of each software component. Visual Studio Code is used for React frontend development and Python-based machine-learning development, while IntelliJ IDEA or Eclipse can be used for Spring Boot backend development.

Postman is used to test and verify the REST APIs exposed by the Spring Boot backend. Remix IDE is used to compile, test and deploy Solidity smart contracts, while Meta Mask is used to interact with the deployed blockchain functionality. GitHub is used for version control and project source-code management. The overall implementation therefore combines React.js for the user interface, Spring Boot for backend services, Python and Scikit-learn for KNN-based compatibility prediction, MySQL for relational persistence, and Ethereum/Solidity for blockchain-assisted consent management.

VII. FUNCTIONAL EVALUATION AND DISCUSSION

Since the proposed system is a web-based roommate matching prototype integrating machine learning and blockchain, the evaluation focuses on functional correctness, compatibility prediction performance, recommendation behavior and verification of consent-related operations rather than claiming a new machine-learning algorithm or blockchain protocol. The implementation was evaluated according to the major functional components of the system and the performance of the implemented KNN compatibility model.

TABLE I. FUNCTIONAL VERIFICATION TARGETS

Functional Area	Implemented Behavior
User Authentication	Registration, login and authenticated access to protected application functions
Preference Management	Collection and storage of structured roommate lifestyle preferences
Compatibility Prediction	KNN-based classification of potential roommate pairs
KNN Configuration	K = 15 with 3000 training and 1000 testing instances
Recommendation	Generation of roommate suggestions based on compatibility prediction
Database Persistence	MySQL storage of user, profile, preference and application records
Consent Management	Explicit user acceptance before establishing a recommended connection
Blockchain	Ethereum/Solidity-based recording of consent-related transactions
Wallet Interaction	Meta Mask used for authorization of blockchain transactions
Verification	Transaction hash and timestamp available for recorded consent operations
Feedback	User feedback and review functionality associated with roommate interactions

A. Compatibility and Functional Evaluation

The compatibility module was evaluated using a dataset containing 4000 roommate-pair instances. The dataset was divided into 3000 training instances and

1000 testing instances for evaluating the implemented KNN classifier. The model uses $K = 15$, with the nearest training instances contributing to the classification of a new roommate pair.

The model achieved a test accuracy of approximately 84.5%. The confusion matrix contained 437 correctly classified non-compatible pairs and 408 correctly classified compatible pairs, while 77 non-compatible pairs were classified as compatible and 78 compatible pairs were classified as non-compatible. The corresponding precision, recall and F1-score were approximately 0.85 for the non-compatible class and 0.84 for the compatible class. Five-fold cross-validation produced an average accuracy of approximately 85.5% with a variation of ± 1.4 percentage points. These results provide an indication of how consistently the implemented KNN model classifies the prepared roommate-pair dataset. The evaluation is intended to measure the behavior of the implemented compatibility component rather than to claim universal prediction accuracy for all roommate populations.

B. Discussion of Research Positioning

The primary contribution of the proposed system lies in the integration of compatibility-based roommate recommendation and blockchain-assisted consent management within a single application. Existing roommate matching approaches focus primarily on assigning or recommending roommates according to compatibility-related preferences [1], [2]. Broader recommender-system research establishes the importance of similarity, preference modelling and contextual information in personalized recommendation [4], [9], [10]. The proposed system extends this application context by incorporating a KNN-based compatibility classifier and a separate blockchain-based trust layer. The KNN component provides data-driven compatibility classification, while the Ethereum smart contract is used for recording explicit user consent. MySQL remains responsible for conventional application data, allowing blockchain storage to be limited to selected trust-related operations.

The system therefore occupies an application-oriented position at the intersection of roommate recommendation, machine-learning-based compatibility prediction and blockchain-assisted trust management. The evaluation demonstrates the

functional operation of these components and their integration within the proposed workflow.

VIII. LIMITATIONS

Several limitations should be stated explicitly. First, the proposed system uses a KNN-based compatibility model trained on a prepared dataset of 4000 roommate pairs; therefore, its prediction performance may vary when applied to larger or more diverse real-world populations. Second, the compatibility model considers selected structured lifestyle and behavioral preferences, so it does not capture every factor that may influence long-term roommate relationships, such as changing personal circumstances, communication patterns, or interpersonal experiences. Third, the value of $K=15$ and the prepared compatibility labels are implementation-specific choices; they have not been calibrated using a large-scale real-world roommate dataset. Fourth, the blockchain layer is used primarily for recording user-authorized consent and verification information, while conventional application data remains stored in MySQL; therefore, the system should not be interpreted as a fully decentralized storage architecture. Fifth, blockchain operations depend on wallet interaction and successful transaction processing, so network delays, transaction failures, or wallet unavailability may affect consent- recording operations. Finally, the current study evaluates the system through functional testing and model-performance measurements, but does not include a large-scale user study, long-term deployment, or controlled comparison with existing roommate-matching platforms and recommendation systems.

IX. FUTURE WORK

The future work can extend the compatibility layer by training the KNN model on larger and more diverse real-world roommate datasets and incorporating additional behavioral and lifestyle attributes to improve the representation of roommate preferences. The matching mechanism can be further enhanced with adaptive weighting or alternative machine learning approaches and evaluated against KNN under comparable datasets and conditions. The blockchain layer can be extended to support additional verifiable records such as agreements, reviews, and match-

related activities while exploring more efficient transaction and storage mechanisms [9]. The system can also be extended with improved recommendation explanations, allowing users to understand the major preference factors contributing to a compatibility result. Finally, the evaluation can be expanded through long-term deployment and controlled user studies to examine recommendation usefulness, user satisfaction, consent transparency, and the practical effectiveness of the proposed trust mechanism in real-world roommate matching scenarios.

X. CONCLUSION

This paper describes a blockchain-assisted decentralized roommate matching system that integrates machine learning-based compatibility prediction with a verifiable consent mechanism. The proposed system includes features such as structured preference collection, KNN-based compatibility prediction, roommate recommendation, user authentication, preference management, consent management, feedback functionality, and blockchain-based verification. The design of the system draws upon research themes in compatibility-based roommate matching [1], [2], [8] recommender systems and matching algorithms [4], [9], [10], and blockchain-assisted privacy and trust mechanisms [4], [7], [9], [10]. The system's contribution is in its integrated workflow, where roommate preferences are processed to generate compatibility results while user-authorized consent is recorded through Ethereum smart contracts. The current implementation reflects a balance between intelligent roommate recommendation and trust-oriented record management, while retaining MySQL for conventional application data and blockchain for verifiable consent-related operations. The evaluated KNN model achieved 84.5% accuracy on the test dataset, providing a measurable basis for the compatibility component. The described architecture, evaluation results, and identified limitations provide a foundation for future work involving larger real-world datasets, enhanced recommendation methods, additional verifiable records, and user-centered evaluation of roommate matching and consent transparency.

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