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TIMEBANK: AI-Powered Skill Matching and Blockchain-Enabled Peer-to-Peer Time-Credit Service Exchange System – A Literature Survey

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ABSTRACT —

The rapid growth of the digital economy has created significant opportunities for skill sharing and collaborative learning; however, most existing service exchange platforms rely on monetary transactions, limiting access for individuals with valuable skills but limited financial resources. Although time banking promotes service exchange through time credits instead of money, traditional systems often lack intelligent service matching, secure transaction management, transparency, and mechanisms to establish user trust. These limitations reduce the efficiency, scalability, and reliability of existing time-based exchange platforms.This paper presents TimeBank: AI-Powered Skill Matching and Blockchain-Enabled Time-Credit Service Exchange System, an intelligent platform that facilitates peer-to-peer service exchange using time credits. The proposed system integrates artificial intelligence to provide personalized skill recommendations through collaborative and content-based filtering techniques, while blockchain technology ensures transparent, immutable, and secure recording of service transactions. In addition, trust scoring and AI-based fraud detection enhance user credibility and platform security by identifying suspicious activities. By combining AI, blockchain, and the principles of the sharing economy, the proposed platform promotes equitable access to services, strengthens community collaboration, and enables a scalable, secure, and sustainable ecosystem for skill exchange in educational institutions and professional communities..

1. INTRODUCTION

Time banking is an innovative approach to service exchange in which time is used as a currency instead of money.

Users earn time credits by providing services to others and redeem those credits to receive services from the community, promoting equal value for every individual's contribution regardless of profession or economic background. However, conventional time-banking platforms often face challenges such as inefficient skill matching, limited personalization, lack of transparency, and centralized transaction management, which reduce user trust and hinder large-scale adoption.

Recent advancements in Artificial Intelligence (AI), blockchain technology, cloud computing, and modern web frameworks have enabled the development of intelligent and secure service exchange platforms. AI-based recommendation techniques can analyze user profiles, skills, interests, availability, and previous interactions to provide personalized service recommendations, while blockchain technology ensures transparent, tamper-proof, and verifiable management of time-credit transactions. These technologies significantly improve platform reliability, scalability, and user confidence.

This paper presents *TimeBank: AI-Powered Skill Matching and Blockchain-Enabled Time-Credit Service Exchange System*, an intelligent platform that facilitates peer-to-peer skill exchange through a time-credit mechanism. The proposed system integrates AI-driven recommendation algorithms for efficient skill matching, blockchain-based transaction management for secure and immutable record keeping, trust scoring and AI-based fraud detection for enhanced platform security, and a scalable MERN-stack architecture for seamless user interaction. The concept was aimed at fostering collaborative effort within the community, lifelong learning, and equal access to services without financial constraints in addition to offering an eco-systemic environment for educational establishments, professionals, and societies.

2. EXISTING SYSTEMS

The service exchange portals that are being used at present have the following issues with them – they are based on a payment system wherein the users make payments for their respective services through online payment portals. Even though such portals provide an easy forum for bringing the service providers together, they always leave out people who are skilled but lack financial resources.

Community-based time banking systems were introduced as an alternative by enabling users to exchange services using time credits instead of money. Participants earn time credits by providing services and redeem them when receiving assistance from others. While these platforms promote inclusivity

and collaboration, most existing implementations rely on centralized databases for maintaining transaction records, making them vulnerable to data manipulation, limited transparency, and trust-related issues.

Artificial Intelligence has been increasingly adopted in recommendation systems to improve service discovery and user experience. Existing AI-based platforms utilize collaborative filtering, content-based filtering, and user profiling techniques to recommend relevant services. However, these recommendation systems are generally designed for commercial applications and often fail to integrate secure time-credit management, trust evaluation, and fraud detection within a unified service exchange ecosystem.

Blockchain-based service exchange platforms have demonstrated the potential of decentralized ledgers and smart contracts to provide secure, transparent, and tamper-proof transaction management. These systems improve data integrity and eliminate dependence on a central authority. However, many existing blockchain solutions focus only on secure transaction recording and lack intelligent skill matching, personalized recommendations, comprehensive trust management, and user-friendly interfaces required for large-scale community adoption

3. LITERATURE SURVEY

A. Time Banking Systems

Time banking is a community-driven service exchange model in which time is used as a currency instead of money, allowing individuals to earn time credits by providing services and redeem them to receive services from others. Unlike conventional service marketplaces that rely on financial transactions, time banking promotes equality by assigning equal value to every hour of service, regardless of the type of skill offered. This approach encourages community participation, skill sharing, mutual assistance, and equitable access to services while reducing financial barriers.

Recent studies have demonstrated the effectiveness of time banking in educational institutions, volunteer organizations, and community development programs by improving resource utilization and strengthening social collaboration. Modern time banking platforms maintain digital records of service exchanges and time-credit balances, enabling users to track their activities within a structured ecosystem. Research has shown that time banking serves as a sustainable socio-economic model that encourages reciprocal service exchange and long-term community engagement.

Although existing time banking systems successfully promote community collaboration, most implementations rely on centralized databases for managing time-credit transactions and user records. Such centralized architectures introduce challenges related to transparency, data integrity, transaction verification, and user trust. Furthermore, many existing platforms lack intelligent skill matching, personalized recommendations, and secure transaction verification, limiting their scalability and practical adoption. These limitations motivate the development of an integrated platform that combines Artificial Intelligence and blockchain technology to provide secure, transparent, and intelligent service exchange.

B. AI-Based Skill Recommendation Systems

Artificial Intelligence has significantly transformed recommendation systems by enabling personalized and efficient matching based on user preferences, behavior, and historical interactions. In skill exchange platforms, AI-based recommendation techniques analyze user profiles, skills, interests, availability, and previous service records to identify suitable service providers and seekers. This intelligent matching process minimizes manual searching, improves recommendation accuracy, and enhances the overall user experience by connecting users with the most relevant opportunities.

Among the various recommendation approaches, Collaborative Filtering and Content-Based Filtering are the most widely adopted techniques. Collaborative Filtering recommends services by identifying users with similar preferences and interaction patterns, while Content-Based Filtering suggests services based on the similarity of user skills, interests, and profile attributes. Recent research has demonstrated that combining these techniques produces more accurate and personalized recommendations, improves user engagement, and increases the efficiency of digital service exchange platforms.

Despite these advancements, most existing AI-based recommendation systems are primarily designed for e-commerce, entertainment, and social networking applications. They generally do not support time-credit-based service exchange, secure transaction management, or trust-aware recommendations. Furthermore, many existing systems are unable to dynamically incorporate user reputation, service quality, and fraud analysis into the recommendation process. These limitations highlight the need for an AI-powered recommendation framework that integrates intelligent skill matching with secure and trustworthy community service exchange.

C. Blockchain-Based Time-Credit Management

Blockchain technology has emerged as a secure and decentralized solution for managing digital transactions without relying on a central authority. In time banking systems, blockchain enables the recording of time-credit transactions on an immutable distributed ledger, ensuring that every service exchange is transparent, verifiable, and resistant to unauthorized modifications. Smart contracts further automate the execution and validation of service agreements, reducing manual intervention and improving the reliability of time-credit management.

Recent research has demonstrated the effectiveness of integrating blockchain with community service exchange platforms to enhance trust, accountability, and transaction security. Layer-2 blockchain networks such as Polygon provide faster transaction processing and significantly lower transaction costs compared to traditional blockchain networks, making them suitable for handling frequent micro-transactions such as time-credit exchanges. These advancements enable secure, scalable, and efficient management of digital service transactions while maintaining data integrity and transparency.

Despite these advantages, existing blockchain-based service exchange systems primarily focus on secure transaction recording and decentralized ledger management. Many platforms do not integrate intelligent recommendation systems, trust evaluation mechanisms, or fraud detection techniques within the blockchain framework. In addition, challenges related to scalability, interoperability, and seamless integration with modern web applications continue to limit the widespread adoption of blockchain-enabled time banking systems. These limitations highlight the need for an integrated platform that combines blockchain technology with Artificial Intelligence to provide secure, transparent, and intelligent time-credit service exchange.

D. Fraud Detection and Trust Management

Trust management plays a vital role in the success of collaborative service exchange platforms, as users are more likely to participate when they can confidently interact with reliable service providers and seekers. Traditional platforms primarily rely on user ratings and reviews to establish credibility; however, these approaches are often vulnerable to fake reviews, malicious users, and biased feedback. An effective trust management system evaluates user reputation based on service history, successful transactions, ratings, and overall platform behavior to create a more dependable service exchange environment.

Recent advancements in Artificial Intelligence and Machine Learning have enabled the development of intelligent fraud detection systems capable of identifying suspicious user activities and abnormal transaction patterns. Machine learning techniques, such as anomaly detection algorithms, analyze user behavior to detect fake accounts, fraudulent transactions, and unusual service requests before they affect the platform. These approaches significantly improve security, reduce the risk of misuse, and enhance user confidence in digital service exchange systems.

Despite these developments, many existing service exchange platforms continue to depend on static reputation models and basic authentication mechanisms that are insufficient for preventing sophisticated fraudulent activities. Most systems lack the integration of real-time fraud detection with dynamic trust evaluation, resulting in reduced transparency and platform reliability. These limitations emphasize the need for an intelligent trust management framework that combines AI-based fraud detection with continuous reputation assessment to ensure secure, transparent, and trustworthy time-credit service exchange.

E. Secure Authentication and User Identity

Secure authentication is essential for protecting user accounts, personal information, and service transactions in digital service exchange platforms. Authentication mechanisms verify the identity of users before granting access to the system, thereby preventing unauthorized access and ensuring secure participation. Modern authentication techniques, including JSON Web Token (JWT)-based authentication, OAuth-based Google Sign-In, and encrypted password management, provide secure session handling while offering a seamless user experience across web applications.

Recent research has emphasized the importance of robust authentication mechanisms in enhancing the security of online platforms. OAuth-based authentication simplifies user registration and login while reducing password management risks, and JWT enables secure communication between clients and servers by maintaining authenticated user sessions. These technologies improve usability, strengthen account security, and protect sensitive user information from unauthorized access and identity-related attacks.

Although existing authentication systems provide reliable user verification, many platforms rely solely on login credentials without integrating authentication with trust management and secure transaction processing. This limitation can expose service exchange platforms to fake accounts, identity misuse, and unauthorized activities. Therefore, an integrated authentication framework that combines secure user identity verification with trust evaluation and blockchain-backed transaction management is essential for building a reliable and secure time-credit service exchange platform.

4. PROPOSED SYSTEM

The proposed system, *TimeBank: AI-Powered Skill Matching and Blockchain-Enabled Time-Credit Service Exchange System*, is designed to facilitate secure and intelligent peer-to-peer skill exchange using time credits instead of monetary transactions. The platform integrates Artificial Intelligence, blockchain technology, secure authentication, trust management, and fraud detection into a unified ecosystem that promotes community collaboration, transparency, and equitable access to services. Users earn time credits by providing services and utilize these credits to receive services from other users, thereby encouraging reciprocal knowledge sharing and sustainable community engagement.

The system employs an AI-powered recommendation engine that utilizes Collaborative Filtering and Content-Based Filtering techniques to analyze user profiles, skills, interests, availability, and previous service interactions. Based on this analysis, the platform generates personalized service recommendations, enabling users to quickly identify suitable service providers or seekers while improving recommendation accuracy and overall user experience.

To ensure secure and transparent transaction management, every completed service exchange is recorded on a blockchain using smart contracts. The blockchain maintains an immutable ledger of time-credit transactions, ensuring that service records cannot be altered or manipulated. The integration of Layer-2 blockchain technology provides efficient transaction processing with lower operational costs while preserving transparency, accountability, and data integrity.

The proposed platform also incorporates a comprehensive trust management framework supported by Artificial Intelligence-based fraud detection. User credibility is continuously evaluated using transaction history, service ratings, successful exchanges, and behavioral analysis. Machine learning–based

anomaly detection techniques identify suspicious activities, fake accounts, and fraudulent transactions, thereby improving platform security and maintaining a trustworthy service exchange environment.

In addition, secure user authentication is implemented using Google Sign-In and JSON Web Token (JWT)-based session management to ensure authorized access and protect user information. The entire platform is developed using the MERN stack, providing a scalable, responsive, and user-friendly web application. By integrating intelligent skill matching, blockchain-enabled transaction verification, secure authentication, and AI-driven trust management within a single platform, the proposed system addresses the limitations of existing service exchange models and establishes a secure, transparent, and sustainable ecosystem for community-based skill sharing.

Furthermore, the proposed platform provides a comprehensive dashboard that enables users to monitor their time-credit balance, service history, completed transactions, trust score, and personalized recommendations in real time. Administrative functionalities allow efficient management of user accounts, service requests, dispute resolution, and platform activities, ensuring smooth system operation and effective monitoring of the overall service exchange process.

The modular architecture of the proposed system ensures flexibility, scalability, and ease of maintenance, allowing new services and advanced technologies to be integrated with minimal modifications. The platform can be extended to support educational institutions, professional organizations, volunteer communities, and government initiatives, promoting large-scale adoption of time-based service exchange. By providing a secure, transparent, and AI-driven ecosystem, the proposed system contributes to building a sustainable digital community that encourages collaboration, lifelong learning, and efficient utilization of human skills.

5. SYSTEM ARCHITECTURE

The overall architecture of the proposed TimeBank: AI-Powered Skill Matching and Blockchain-Enabled Time-Credit Service Exchange System is illustrated in Fig. 1. The system follows a centralized web-based architecture that integrates Artificial Intelligence, blockchain technology, and secure authentication to facilitate transparent and intelligent skill exchange using time credits. The architecture combines user management, AI-powered recommendation,blockchain-based transaction verification, trust management, and fraud detection into a unified platform, enabling secure and efficient peer-to-peer service exchange.

As seen from Fig. 1 below, initially, the user will register himself through Google Sign-in and authentication process using JWT authentication. Once the user logs in, he creates a profile where he mentions his skills, interests, availability, and preferences about the services he would like to avail. This data is analyzed through the AI recommendation engine, which utilizes Collaborative and Content-based filtering algorithms for this purpose.

Once the request for service is fulfilled, the system automatically credits the user's Time Credit Wallet through the blockchain technology of Polygon through smart contracts in Solidity programming language. All transactions related to the time credit will be stored on the blockchain which will keep a permanent record of every single transaction in a transparent manner.

At the same time, the Trust Management and Fraud Detection module is constantly analyzing the transaction history, the service ratings, and the behavior of users. The system uses the Isolation Forest algorithm to identify any anomalies in user behavior and transactions and update their trust ratings.

Last but not least, users and administrators have dashboards where they can view the history of services offered, blockchain transactions, time-credit balance, trust score, and other analytics on the same screen. The suggested architecture is scalable and secure enough to allow an AI-based recommendation, blockchain validation, and machine learning–driven fraud detection in order to create a transparent P2P skill-sharing environment.

Lastly, as shown in Fig. 1 below, the proposed architecture brings together all the necessary elements of the TimeBank system in a single architectural framework. The interactions among user authentication, AI-driven recommendation, blockchain-based transactions management, trust management, and fraud prevention make sure the skill exchange in the form of time credits is both safe and efficient. The architecture allows for intelligent service matching, secure transaction processing, and effective user management within a single platform. In general, the architecture proposed can be considered a scalable, secure, and user-friendly solution promoting collaboration within communities, trustworthy service exchange, and sustainable use of skills.

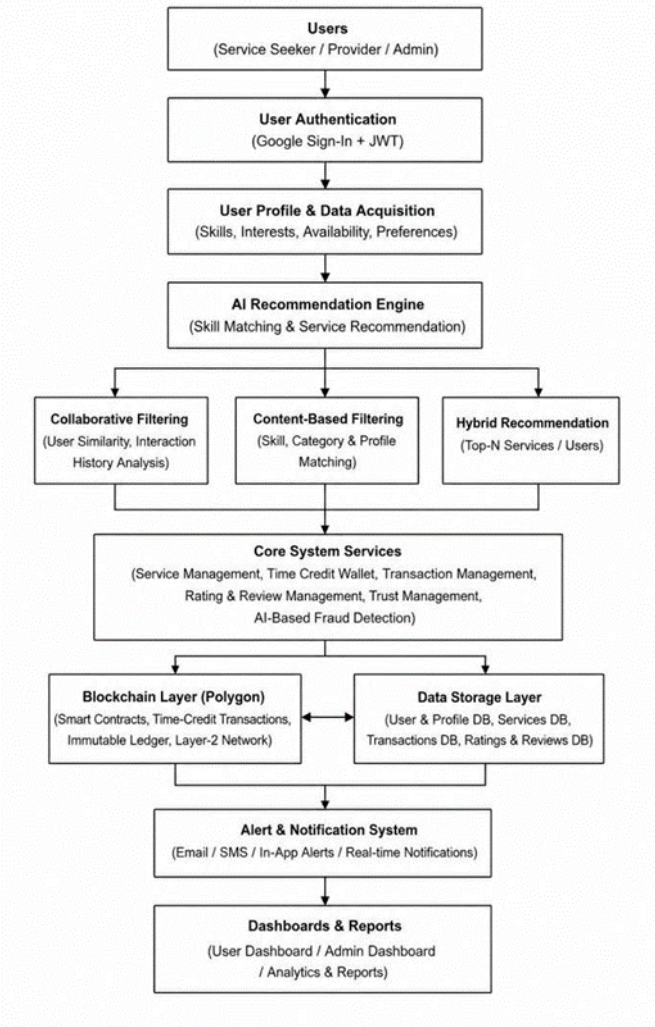


Fig.1. System Architecture of the Proposed TimeBank: AI-Powered Skill Matching and Blockchain-Enabled Time-Credit Service Exchange System..

The proposed architecture provides a scalable, secure, and intelligent framework for skill and service exchange by integrating AI-powered recommendations, blockchain-based time-credit management, trust evaluation, and fraud detection into a single platform. It enables transparent transactions, efficient skill matching, and reliable user interactions while promoting community collaboration, equitable access to services, and sustainable peer-to-peer knowledge sharing.

6. ADVANTAGES OF THE PROPOSED SYSTEM

The proposed TimeBank system offers several advantages over conventional service exchange platforms by integrating Artificial Intelligence, blockchain technology, and intelligent trust management into a unified framework. The AI-powered recommendation engine utilizes Collaborative Filtering and Content-Based Filtering algorithms to provide accurate and personalized skill matching, reducing the time required to identify suitable service providers and improving the overall user experience.

The integration of blockchain technology ensures that every time-credit transaction is securely recorded through smart contracts, providing transparency, immutability, and protection against unauthorized modifications. This decentralized transaction management enhances user confidence and eliminates the limitations associated with centralized databases.

The proposed system also incorporates AI-based fraud detection using the Isolation Forest algorithm and dynamic trust management to identify suspicious activities, fake accounts, and fraudulent transactions. This improves platform reliability and creates a secure environment for peer-to-peer service exchange. Furthermore, secure authentication using Google Sign-In and JWT protects user identities while ensuring authorized access to the platform.

The scalable MERN-stack architecture enables efficient management of users, services, transactions, and time-credit wallets while supporting future enhancements with minimal modifications. Overall, the proposed system promotes transparent service exchange, equitable access to opportunities, community collaboration, lifelong learning, and sustainable utilization of human skills, making it suitable for educational institutions, professional organizations, and community-based service networks.

7. FUTURE SCOPE

The proposed TimeBank: AI-Powered Skill Matching and Service Exchange Platform can be further enhanced by integrating mobile applications, multilingual support, and IoT-based attendance verification to improve accessibility and automatically validate service completion. The platform can also be deployed across VTU-affiliated colleges to digitally manage AICTE Student Activity Points, volunteering programs, peer mentoring, technical workshops, hackathons, and community service through a unified time-credit-based ecosystem.

Future enhancements include advanced AI models for more accurate and personalized skill recommendations, generative AI-based virtual mentors for career guidance and learning support, and federated learning techniques to enable privacy-preserving recommendation systems. The integration of decentralized identity (DID) frameworks and cross-chain blockchain interoperability can further strengthen digital identity management and facilitate secure time-credit exchange across multiple institutions.

Additionally, predictive analytics can be incorporated to forecast skill demand, recommend emerging learning opportunities, and support AI- powered career guidance. The platform can also be integrated with national initiatives such as Skill India, Digital India, and the Academic Bank of Credits (ABC) to promote skill development and lifelong learning. With its scalable architecture, the proposed system has the potential to evolve into a nationwide digital ecosystem connecting educational institutions, industries, startups, NGOs, and government organizations, thereby fostering secure, transparent, and sustainable peer-to-peer skill exchange.

Overall, continuous advancements in Artificial Intelligence, blockchain technology, recommendation systems, and decentralized computing will enable the development of more intelligent, scalable, and efficient skill exchange platforms. These technologies will enhance personalized service matching, secure time-credit transactions, transparent collaboration, and trustworthy community participation. As a result, the proposed TimeBank system has the potential to support sustainable peer-to-peer skill sharing and equitable access to services across educational institutions, professional communities, and society.

8. CONCLUSION

This paper presented a comprehensive literature survey on AI-powered skill matching and blockchain-enabled time-credit service exchange systems. The review of existing research highlighted the contributions of time banking, Artificial Intelligence–based recommendation systems, blockchain technology, trust management, and fraud detection in improving digital service exchange platforms. Although these technologies have demonstrated significant potential individually, most existing systems lack an integrated framework that combines intelligent skill matching, secure transaction management, and transparent trust evaluation within a single platform.

To address these limitations, the proposed TimeBank: AI-Powered Skill Matching and Blockchain-Enabled Time-Credit Service Exchange System integrates Collaborative Filtering, Content-Based Filtering, blockchain-based smart contracts, AI-driven fraud detection, and secure authentication to create a unified and scalable ecosystem for peer-to-peer skill exchange. The proposed architecture enhances recommendation accuracy, ensures transparent and tamper-proof time-credit transactions, strengthens platform security, and promotes trustworthy community collaboration.

Overall, the proposed system provides an intelligent, secure, and sustainable solution for skill and service exchange by leveraging modern Artificial Intelligence and blockchain technologies. It has the potential to transform educational institutions, professional communities, and social organizations by encouraging collaborative learning, equitable access to services, and efficient utilization of human skills while reducing dependence on monetary transactions.

9. REFERENCES

[1] A. Author et al., “In-depth Survey: Deep Learning in Recommender Systems,” Neural Computing and Applications, vol. 37, 2025.

[2] M. Author et al., “Secure Time Credit Management Using Blockchain and Smart Contracts,” Sustainability, vol. 12, no. 19, p. 8115, 2020.

[3] S. Author et al., “Deep Learning Based Collaborative Filtering Recommendation System,” Procedia Computer Science, vol. 252, 2025.

[4] “Current Trends in Recommender Systems: A Survey of Approaches and Future Directions,” ResearchGate Preprint, 2025.

[5] “A. Author et al., “Revisiting Recommender Systems: An Investigative Survey,” Neural Computing and Applications, vol. 37, 2025.

[6] Biometric Authentication in Digital Payments Utilizing AI and Big Data for Real-Time Security and Efficiency, ResearchGate, 2024.

[7] The Role of AI and Machine Learning in Strengthening Digital Wallet Security Against Fraud, ResearchGate, 2024.

[8] “Secured Payment System Using Face Recognition,” TIJER, 2024.

[9] “A Survey on Deep Neural Networks in Collaborative Filtering Recommendation Systems,” arXiv preprint arXiv:2412.01378, 2024.

[10] “Smart Contract-Based Reputation Management for Sharing Economy Platforms,” Computers in Human Behavior, 2024.

[11] “Blockchain Technology for Trust Management in Decentralized Systems,” Electronics, vol. 12, no. 3, p. 685, 2023.

[12] "Transforming Financial Systems: The Role of Time Banking in Promoting Community Collaboration and Equitable Wealth Distribution," ResearchGate, 2022.

[13] "Payment Transaction Using Face Recognition," ResearchGate, 2022.

[14] "The State of Play of Blockchain Technology in the Financial Services Sector: A Systematic Literature Review," Technological Forecasting and Social Change, vol. 155, 2020.

[15] "Transformative Effects of IoT, Blockchain and AI on Cloud Computing," arXiv preprint arXiv:1911.01941, 2019.

[16] "Secure Authentication for Banking Using Face Recognition," International Journal of Electrical and Electronics Engineering, 2013

[17] "AI-Powered Face Authentication System for Web and Mobile Applications," Semantic Scholar, 2012.

[18] D. Arner, J. Barberis, and R. Buckley, "FinTech, RegTech and Financial Regulation," Northwestern Journal of International Law & Business, vol. 37, no. 3, pp. 371–413, 2017.

[19] "Blockchain Adoption in Financial Services," Telecommunications Policy, 2018.

[20] W. Zhao, R. Chellappa, P. Phillips, and A. Rosenfeld, "Face Recognition: A Literature Survey," ACM Computing Surveys, vol. 35, no. 4, pp. 399–458, 2003.