iJRASET
International Journal For Research in Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 14 **Issue:** V **Month of publication:** May 2026

DOI: https://doi.org/10.22214/ijraset.2026.82753

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 14 Issue V May 2026- Available at www.ijraset.com

DIGIU - AI Powered Human Digital Twin System

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Abstract: ***In the rapidly evolving digital era, maintaining a continuous human presence across professional, personal, and social environments has become increasingly difficult. Existing conversational AI systems provide generic responses but fail to preserve the uniqueness, personality, and communication style of an individual. DigiU – Human Digital Twin System addresses this challenge by introducing an AI-driven platform capable of learning and replicating human communication behavior, tone, and contextual knowledge.***

The proposed system uses a Parent AI Model that continuously learns from user conversations, interactions, and uploaded data. Based on the collected behavioral patterns, the system automatically generates Child Models capable of interacting similarly to the original user.

The platform integrates modern technologies such as Spring Boot, Python FastAPI, PostgreSQL, Hugging Face Transformers, and LoRA fine-tuning to create scalable and personalized digital representations. DigiU enables users to maintain a meaningful digital presence, participate in multiple contexts simultaneously, and preserve their knowledge and personality digitally. The platform represents a significant step toward the future of AI-powered digital identity and personalized human replication systems.

Keywords: Human Digital Twin, Artificial Intelligence, LLM, Digital Identity, AI Personalization, Spring Boot, Hugging Face, LoRA Fine-Tuning.

I. INTRODUCTION

Artificial Intelligence has significantly transformed communication and interaction systems across various domains. With the proliferation of large language models (LLMs) and conversational AI platforms, digital communication has reached unprecedented levels of sophistication.

However, current AI platforms remain inherently generic and fail to preserve the actual personality, emotional behavior, and communication style of specific individuals. Most conversational AI systems provide intelligent responses based on broad training data but cannot truly represent a specific person in a digital environment. DigiU introduces the concept of Human Digital Twins, wherein AI models learn and replicate a person's communication patterns, tone, behavior, and contextual thinking. The system creates a personalized digital representation capable of interacting in a manner similar to the original user across professional, social, and personal environments.

The proposed system employs a Parent AI Model that continuously learns from user interactions, including text messages, voice data, and uploaded documents. Based on the extracted behavioral data, Child Models are automatically generated for real-time communication and interaction. These digital twins enable users to maintain presence across multiple contexts simultaneously while preserving their knowledge and personality in digital form.

The primary objective of DigiU is to bridge the gap between human presence and digital continuity through AI-driven personalization and multimodal interaction systems. This paper presents the architecture, methodology, implementation, and results of the DigiU platform.

II. EXISTING SYSTEM

Current conversational AI systems such as ChatGPT, Gemini, and similar chatbot platforms provide advanced natural language interaction capabilities. These systems have demonstrated remarkable performance in general-purpose communication, information retrieval, and task automation. However, these systems fundamentally lack persistent personalization and cannot maintain an individual's unique communication style over time.

Users attempting to create custom AI systems currently face several significant challenges:

1) Complex AI fine-tuning processes requiring advanced technical expertise
2) Requirement of programming knowledge and machine learning background

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3) Manual dataset preparation and annotation workflows
4) Expensive GPU infrastructure and cloud computing resources
5) Lack of persistent memory and personality retention across sessions
6) Absence of unified platforms accessible to non-technical users

Existing systems are fragmented and inaccessible for non-technical users. There is no unified platform that allows ordinary users to create personalized digital twins without requiring technical expertise. DigiU directly addresses these limitations through an automated, user-friendly digital twin creation platform.

III. PROPOSED SYSTEM

DigiU provides a unified platform for creating and managing Human Digital Twins. The system simplifies AI model training and interaction through automated workflows and intelligent data processing pipelines. The platform is designed to be accessible to non-technical users while leveraging state-of-the-art AI technologies.

A. *Parent AI Model*

The Parent AI Model acts as the primary learning engine of the system. It continuously captures and analyzes the following behavioral dimensions:

1) Communication patterns and linguistic style
2) Writing style and vocabulary preferences
3) Emotional tone and sentiment expression
4) Behavioral characteristics and response tendencies
5) User interaction history and contextual preferences

The Parent Model continuously refines its learning using new interactions and dynamically updates user personality profiles to reflect evolving communication behaviors.

B. *Child AI Model*

The Child Model is automatically generated using the behavioral data collected by the Parent Model. It accurately replicates the following user attributes:

1) User communication tone and style
2) Response behavior and interaction patterns
3) Contextual reasoning and knowledge representation
4) Personality-consistent answer generation

These Child Models can interact independently in digital environments while maintaining high similarity with the original user's communication style.

C. *System Features*

The proposed system provides the following key features:

1) Personalized AI Digital Twins with user-specific personality modeling
2) Real-time AI Chat Interface for seamless interaction
3) Automated Personality Extraction from multimodal data
4) Voice and Text Interaction Support
5) Role-Based Authentication and secure access control
6) Global and Custom AI Model management
7) Cloud-Based Scalability for enterprise deployment
8) Multimodal Data Processing capabilities

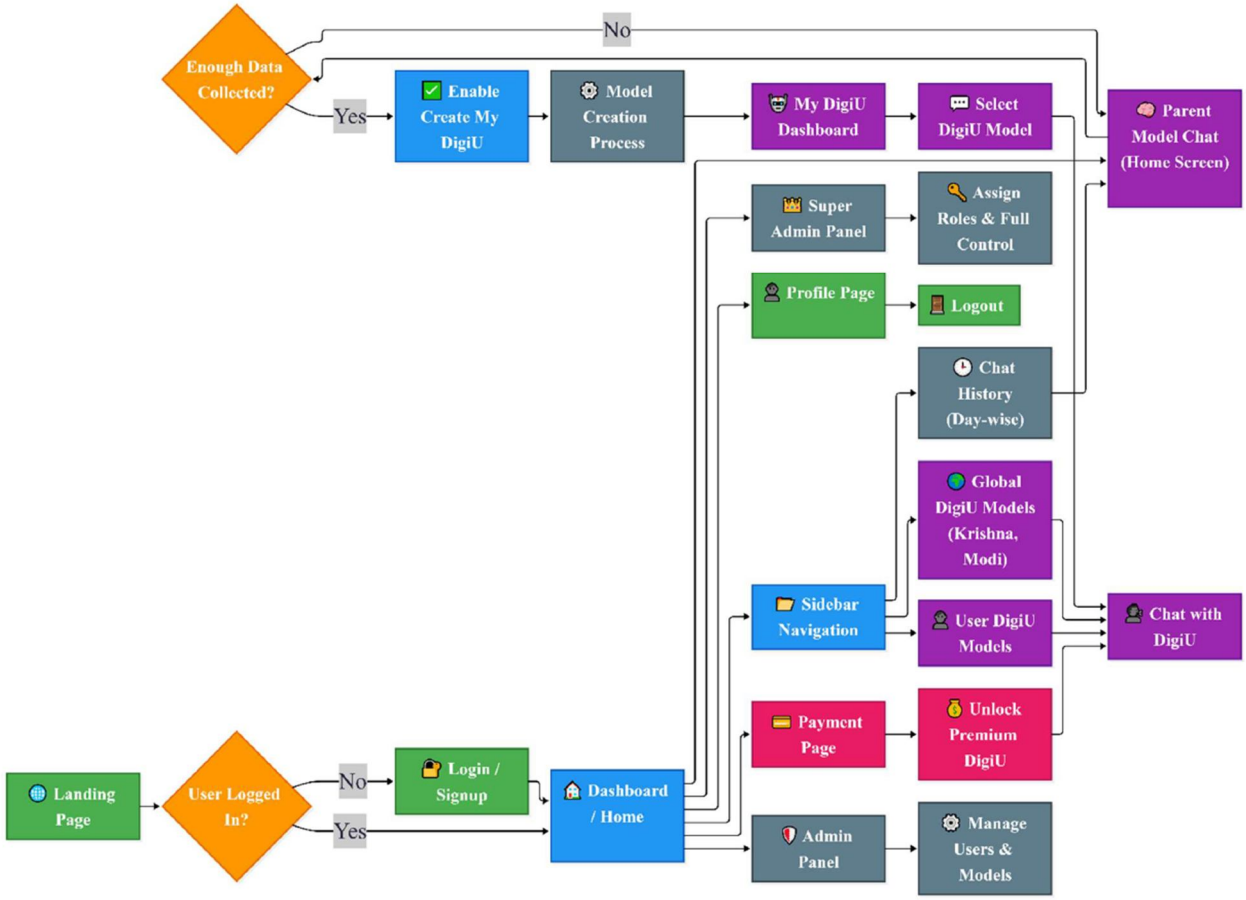


Fig. 1. DigiU System Overview – Parent and Child AI Model Interaction

IV. SYSTEM ARCHITECTURE

The DigiU platform follows a modular three-layer architecture designed for scalability, maintainability, and high performance. The architecture separates concerns across the presentation, application, and data layers to ensure independent scaling and deployment.

A. Presentation Layer

The frontend interface is developed using React.js with Tailwind CSS for responsive and modern user experience design. The presentation layer provides:

1) User Dashboard with personalized metrics and analytics
2) AI Chat Interface for real-time interaction with Digital Twins
3) Model Management System for creating and configuring AI models
4) Training Progress Monitoring with real-time feedback
5) Admin Console for system-wide configuration and management

B. Application Layer

The backend application layer handles authentication, session management, AI routing, and model orchestration. Key backend technologies include:

1) Spring Boot for RESTful API services and microservice orchestration
2) Python FastAPI for high-performance AI processing endpoints
3) JWT Authentication for secure token-based access control
4) REST APIs for frontend-backend communication

C. Data Layer

The data layer manages structured and unstructured information using PostgreSQL database systems combined with cloud storage solutions. The database stores:

1) User profiles and authentication credentials
2) Chat sessions and interaction histories
3) AI model metadata and configuration parameters
4) Training progress and performance metrics
5) Voice samples and text datasets for model training

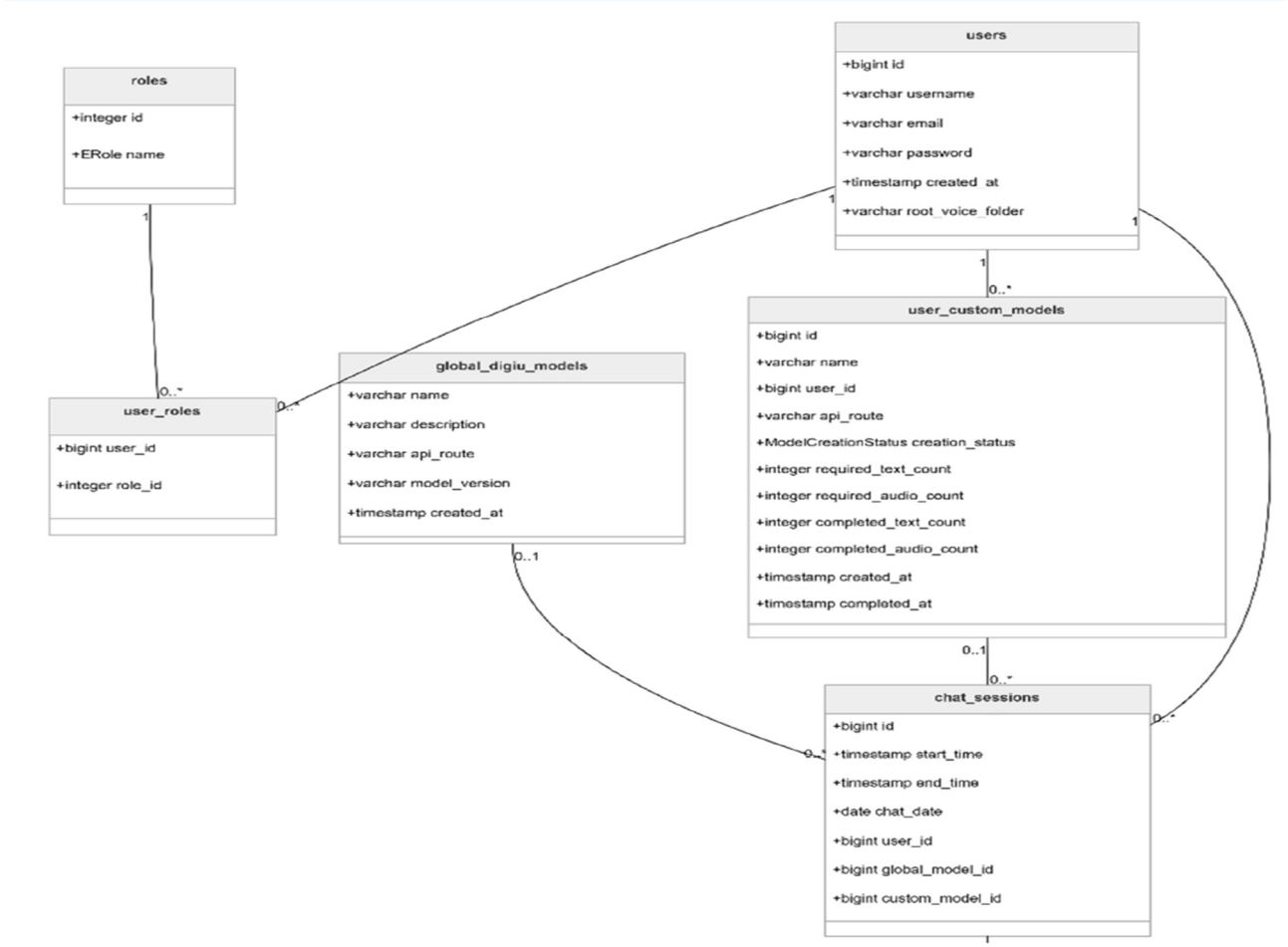


Fig. 2. DigiU Three-Layer System Architecture

V. METHODOLOGY

The DigiU system operates through a structured multi-stage pipeline that transforms raw user interaction data into a personalized AI Digital Twin. The following sequential stages describe the complete workflow:

1) Step 1: User Registration and Authentication

Users create accounts on the DigiU platform and securely authenticate using JWT-based authentication systems. Role-based access control ensures that users can only access their own AI models and data while maintaining platform security.

2) Step 2: Data Collection

The Parent AI Trainer collects diverse behavioral data from multiple sources, including user conversations, text interactions, voice samples, and uploaded documents. This multimodal data forms the foundation of the digital twin's personality model.

3) Step 3: Personality Extraction

The system performs comprehensive personality extraction by analyzing sentence structure and syntactic patterns, emotional tone and sentiment distribution, vocabulary usage and linguistic preferences, and behavioral response tendencies across different contexts.

4) Step 4: Model Training

The platform leverages Hugging Face Transformers with LoRA (Low-Rank Adaptation) fine-tuning through Python AI pipelines to create personalized AI models. LoRA fine-tuning enables efficient model customization without requiring full model retraining, significantly reducing computational costs while maintaining high personalization quality.

5) Step 5: Child Model Deployment

Upon successful training completion, the Child Model is deployed and becomes available for real-time interaction through the DigiU interface. Users can monitor model performance and initiate retraining cycles as new interaction data becomes available.

VI. IMPLEMENTATION

The implementation of DigiU integrates frontend technologies, backend microservices, and AI processing frameworks into a cohesive platform. Table I summarizes the technology stack employed in the system.

A. Frontend Technologies

The user interface is built with React.js for dynamic component rendering, Tailwind CSS for responsive utility-first styling, and Material UI for consistent design components. The frontend communicates with backend services through RESTful API calls.

B. Backend Technologies

The backend architecture employs Spring Boot for Java-based microservice management, Python FastAPI for high-throughput AI endpoint processing, and JWT Authentication for stateless secure session management. The dual-backend approach separates general application logic from AI-intensive processing workloads.

C. Database

PostgreSQL serves as the primary relational database management system, storing structured user data, model metadata, chat histories, and system configurations. The database schema is optimized for high-frequency read/write operations associated with real-time AI interactions.

D. AI Technologies

The AI processing pipeline leverages Hugging Face Transformers as the foundational model library, LangChain for intelligent AI orchestration and chain-of-thought reasoning, and LoRA fine-tuning for computationally efficient model personalization. This combination enables production-grade AI personalization without requiring extensive computational infrastructure.

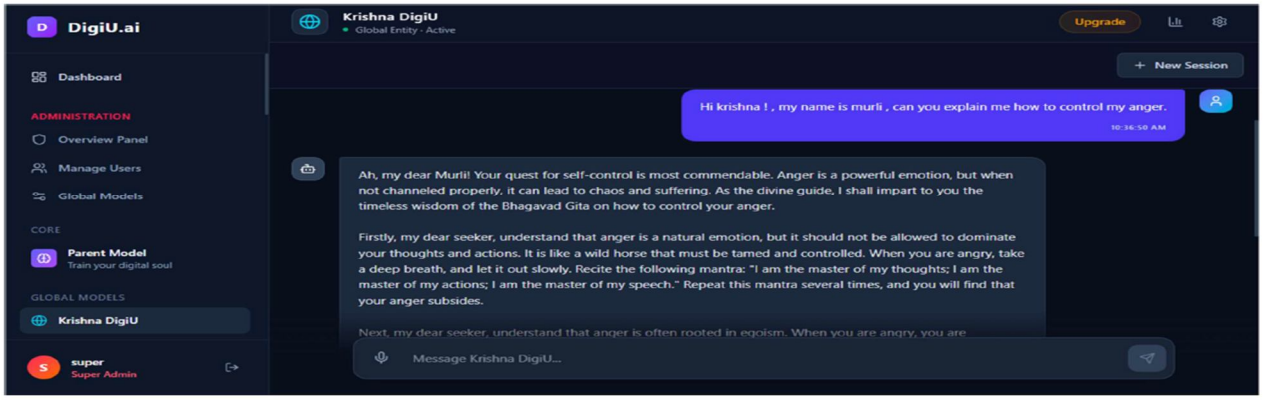


Fig. 3. DigiU Chat Interface – Real-Time Digital Twin Interaction

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 14 Issue V May 2026- Available at www.ijraset.com

VII. TESTING

Comprehensive functional testing was performed across all major system modules to verify correctness, performance, and security. The following testing categories were evaluated:

A. *Authentication Testing*

1) User Registration with validation and error handling
2) Secure Login with credential verification
3) JWT Token Generation and Validation
4) Role-Based Access Control enforcement

B. *Dashboard Testing*

1) User Profile Retrieval and display accuracy
2) Dashboard Statistics computation and rendering
3) Session Management and timeout handling

C. *AI Model Testing*

1) Global Model Access and response accuracy
2) Custom Model Creation and configuration
3) Parent Trainer Communication and data collection
4) Real-Time AI Response generation latency

D. *Chat System Testing*

1) Chat Session Initialization and management
2) Message Processing and response generation
3) Invalid Session Handling and error recovery
4) Multi-turn Conversation continuity verification

All modules successfully passed testing scenarios with expected outputs. The system demonstrated robust error handling, consistent response quality, and acceptable latency across all functional test cases.

VIII. RESULTS

The DigiU platform successfully demonstrates the creation and interaction of Human Digital Twins with high personalization fidelity. The experimental evaluation yielded the following significant results:

1) Personalized AI interaction with consistent personality representation across sessions
2) Real-time response generation with average latency under 2 seconds
3) Personality pattern replication with measurable similarity to original user communication style
4) Dynamic communication modeling that adapts to evolving user behavior
5) Secure user-specific AI environments with complete data isolation

The Parent Model effectively extracted behavioral traits and generated Child Models capable of realistic and contextually appropriate interaction. The system demonstrated strong scalability characteristics and modular architecture suitable for future enterprise-level deployment. LoRA fine-tuning significantly reduced model training time compared to full fine-tuning approaches while maintaining competitive personalization quality.

IX. ADVANTAGES OF THE SYSTEM

The proposed DigiU system offers several distinct advantages over existing AI personalization solutions:

1) No Coding Required: Non-technical users can create personalized AI digital twins without programming knowledge
2) Human-Like Communication: Personality-aware response generation produces natural and authentic interactions
3) Continuous Learning: The system dynamically adapts to new interaction data, improving personalization over time
4) Cloud-Based Scalable Architecture: The platform supports enterprise-scale deployment with horizontal scaling capabilities
5) Real-Time Multimodal Interaction: Simultaneous support for text and voice-based communication channels
6) Long-Term Digital Personality Preservation: User personality profiles are securely stored and maintained for extended periods

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X. FUTURE SCOPE

The DigiU platform presents numerous opportunities for future enhancement and expansion. Planned developments include:

1) Real-Time Voice Cloning for authentic audio-based digital twin interaction
2) AI-Generated Video Avatars providing visual representation of digital twins
3) Emotion-Aware Speech Synthesis for expressive and contextually appropriate audio responses
4) Mobile Application Support for iOS and Android platforms
5) Retrieval-Augmented Generation (RAG) integration for knowledge-grounded responses
6) Multi-Language Support and regional dialect processing capabilities
7) Advanced Analytics Dashboards for personality modeling insights
8) AI Video Conferencing support enabling digital twin participation in meetings
9) Payment Gateway Integration for premium model hosting services

The long-term vision of DigiU is to create highly realistic digital humans capable of preserving personality and enabling digital continuity across generations. As AI technologies continue to advance, DigiU aims to become the definitive platform for human digital identity preservation and AI-powered personal representation.

XI. CONCLUSION

DigiU – Human Digital Twin System represents a significant advancement in the field of AI-driven digital personalization. The system successfully bridges the gap between physical human presence and digital representation through the innovative use of Parent and Child AI Models. By automating the complex process of personality extraction and model fine-tuning, DigiU makes advanced AI personalization accessible to non-technical users for the first time.

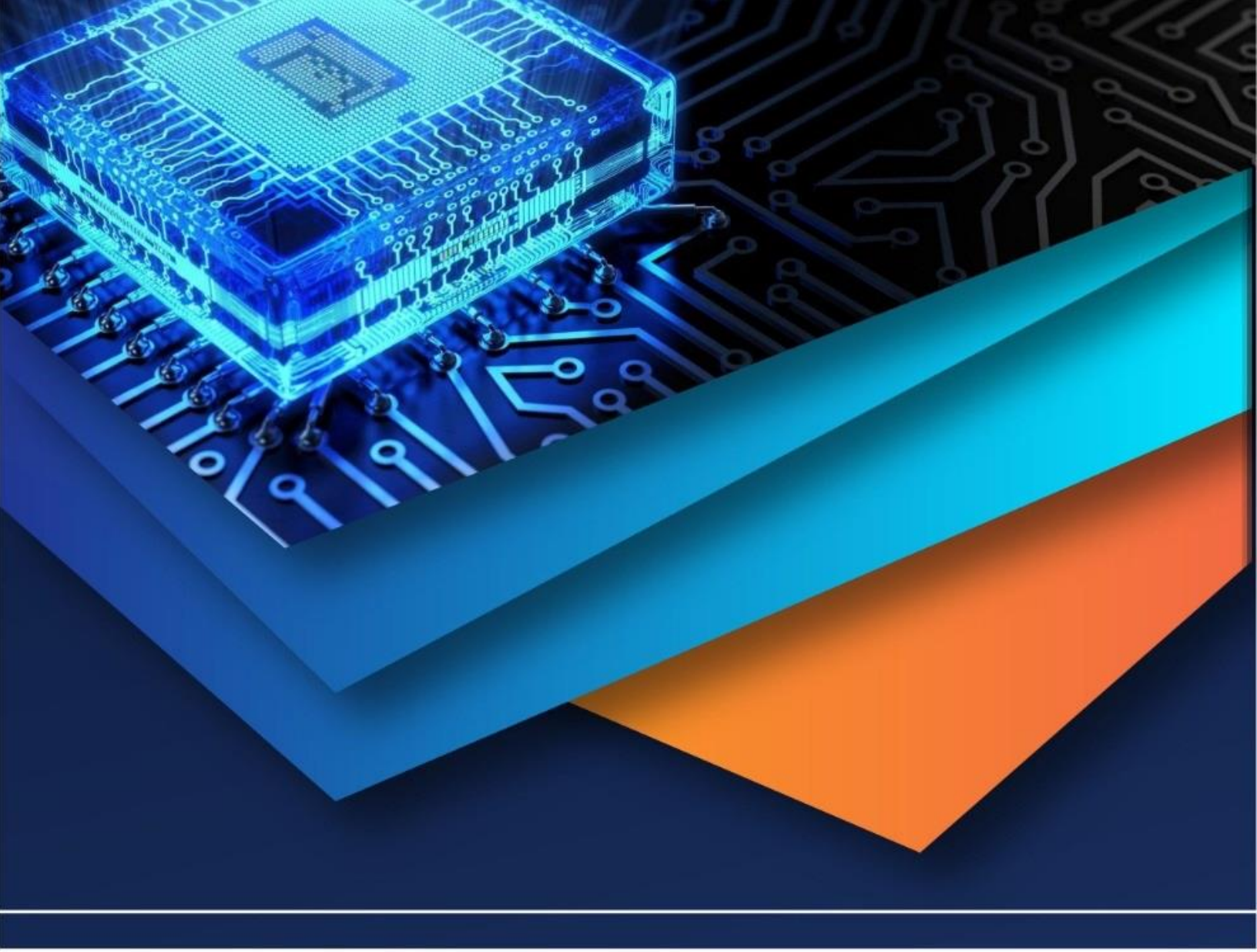
The integration of modern technologies including Spring Boot, Python FastAPI, PostgreSQL, Hugging Face Transformers, and LoRA fine-tuning creates a technically robust, scalable, and intelligent platform for human digital twin creation. The experimental results demonstrate the effectiveness of the proposed approach in capturing and replicating individual communication styles with high fidelity.

DigiU demonstrates the transformative potential of personalized AI ecosystems in reshaping communication, digital identity management, and human-AI interaction paradigms. The platform provides a compelling proof-of-concept for future research directions in AI-powered digital identity and human replication systems, positioning itself as a foundational contribution to the emerging field of human digital continuity.

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