IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

NeuroJoy: An Accessibility-First Mental Health and Communication System

[1]Samiksha Mane, [2]Parthvi Gadekar, [3] Parth Jamsandekar, [4]Veena Patil

[5]Prof. Tejashree P. Gurav

*[1,2,3,4] Student, Data Science, D.Y. Patil College of Engineering & Technology, Kolhapur, Maharashtra, India.

*[5] Professor, Data Science, D. Y. Patil College of Engineering & Technology, Kolhapur, Maharashtra, India.

Abstract: In The NeuroJoy system is an accessibility-first mental health and communication application designed to support disabled, neurodiverse, and non-verbal users. It addresses the lack of inclusive communication tools and integrated wellness solutions often overlooked by mainstream technology. With a high-contrast interface, customizable text-to-speech paths, and voice prompts, NeuroJoy enables effortless self-expression while reducing visual strain. Its multi-user profile management makes it ideal for therapy, classrooms, and caregiving environments, while smart sorting of common communication paths ensures faster, smoother interactions. To further broaden accessibility, the platform supports localization in English, Hindi, Marathi allowing users and caregivers worldwide to engage without language barriers.

Index Terms - Neurodiverse individuals, Text-to-speech (TTS), Multilingual support, Disabled users

I. INTRODUCTION

In today's digital landscape, mobile applications play a crucial role in shaping how people communicate, connect, and manage their daily lives. However, despite rapid technological progress, a significant accessibility gap continues to exist for individuals with disabilities— especially those who are non-verbal, neurodiverse, or living with cognitive impairments. These users often face major challenges in articulating their needs, emotions, and thoughts. Such barriers not only limit independence but can also contribute to social isolation, reduced opportunities for interaction, and declining mental health. Although a number of Augmentative and Alternative Communication (AAC) tools are available, many suffer from issues such as high cost, overly complex designs, or a lack of integrated features that combine communication with emotional and cognitive support. This leaves users and caregivers with fragmented solutions that fail to address their holistic needs.

The NeuroJoy application has been envisioned as a comprehensive, accessibility-first platform designed to fill this gap. Built around a philosophy of simplicity, inclusivity, and empowerment, NeuroJoy integrates assistive communication tools with mental wellness features into a single, seamless experience. Its high-contrast user interface caters to individuals with visual sensitivities, while customizable communication paths paired with text-to-speech technology ensure that users can express themselves naturally and effortlessly. Beyond communication, NeuroJoy seeks to nurture overall well-being through planned extensions such as daily mood check-ins for emotional tracking, simple cognitive and relaxation activities like breathing exercises or memory games, and secure therapy logs that enable individuals and caregivers to track progress and share insights when appropriate. By combining these elements, NeuroJoy is positioned not just as a communication aid but as a holistic digital companion—

one that empowers users, fosters independence, and supports caregivers in creating an environment of dignity, connection, and growth.

In addition, NeuroJoy is designed with collaboration at its core. Caregivers, educators, and therapists can be integrated into the user's support network through secure sharing options, enabling real-time insights and more personalized interventions. This interconnected approach not only reduces the burden on caregivers but also ensures that every user receives consistent, compassionate, and context-aware support across different aspects of their daily life. By bridging the gap between individual needs and collective care, NeuroJoy has the potential to redefine accessibility and inclusion in the digital age.

II. LITERATURE REVIEW

A number of studies have examined the usability, accessibility, and functionality of current Augmentative and Alternative Communication (AAC) applications, highlighting both their potential and their limitations. For instance, Sharma et al. [1] found that although many contemporary AAC apps provide a wide range of features, they often suffer from steep learning curves and cluttered user interfaces. These usability challenges can hinder effective adoption, particularly for non-verbal users or individuals with cognitive impairments. The authors emphasize the importance of designing applications that prioritize simplicity, intuitive navigation, and user-led customization, enabling users and caregivers to tailor the tools to their unique needs rather than struggling with rigid, overly complex systems.The significance of interface design for accessibility is further underscored by Chen & Lee [2], whose research demonstrates that high-contrast color schemes combined with large, legible typography can substantially reduce cognitive load, improve task completion speed, and enhance overall user experience for individuals with visual impairments. This highlights the critical role that thoughtful UI/UX design plays in making digital applications truly inclusive.

Beyond usability, the integration of mental wellness features in assistive tools is an emerging area of interest. Gupta and Singh [3] explore the potential of using simple, non linguistic games and interactive modules to support emotional regulation, cognitive stimulation, and relaxation. They argue that embedding these features into communication apps can transform them from purely functional tools into holistic platforms that support overall well-being, offering both therapeutic and engaging experiences for users.

Another critical dimension highlighted in the literature is linguistic inclusivity. Rodriguez et al. [4] demonstrate that the absence of multilingual support often excludes non native English speakers from accessing essential digital aids. Their findings underscore the necessity for cross-lingual design, enabling users from diverse linguistic backgrounds to engage with assistive technologies without barriers.

A substantial body of research has explored the usability, accessibility, and functional effectiveness of current Augmentative and Alternative Communication (AAC) applications, revealing both their transformative potential and persistent shortcomings. Sharma et al. [1] observed that while many contemporary AAC platforms incorporate extensive communication features, predictive text systems, and customizable symbol libraries, they frequently present users with steep learning curves, overly complex workflows, and visually cluttered interfaces. These challenges can significantly impede adoption, particularly among non-verbal individuals, users with cognitive disabilities, or caregivers seeking efficient communication support. The study emphasizes that successful AAC systems must prioritize simplicity, intuitive navigation, and adaptive personalization to ensure users can tailor communication pathways according to their unique cognitive and physical requirements rather than conforming to rigid technological structures. The importance of user-centered interface design is further reinforced by Chen & Lee [2], whose findings demonstrate that accessibility-focused design principles—such as high-contrast visual themes, larger typography, simplified layouts, and reduced sensory overload—substantially improve task efficiency and reduce cognitive burden for users with visual or neurological impairments. Their research highlights that accessible UI/UX is not merely a design preference but a foundational requirement for digital inclusivity.

III. System Architecture

The system architecture of NeuroJoy is designed as a modular and layered framework to ensure scalability, accessibility, and efficient data processing. It consists of three primary layers: the user interface layer, the application logic layer, and the data storage layer. The architecture enables seamless interaction between users and the system while ensuring fast and reliable communication output.

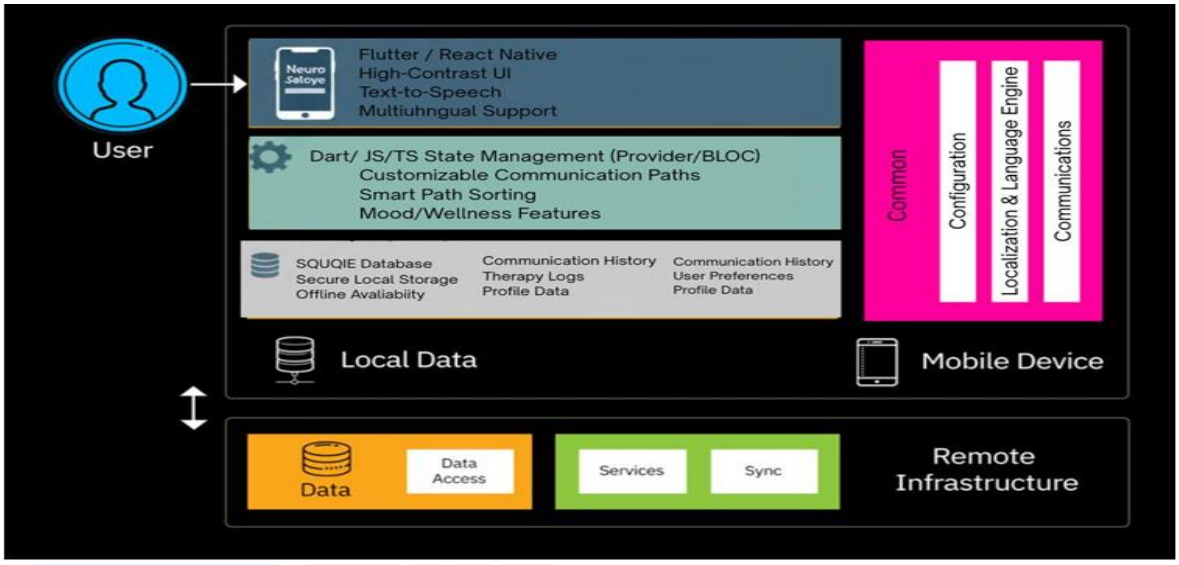


Fig. System Architecture

1. User Interface Layer

The User Interface Layer serves as the primary interaction point between the user and the NeuroJoy application. Built using cross-platform frameworks such as Flutter or React Native, this layer focuses heavily on accessibility and inclusivity. It incorporates a high-contrast visual design, large readable typography, multilingual support, customizable communication paths, and text-to-speech functionality to ensure ease of use for disabled, neurodiverse, and non-verbal individuals.

2. Application Logic Layer

The Application Logic Layer acts as the functional core of NeuroJoy, managing all major system operations and user workflows. This layer processes user interactions, controls communication path customization, organizes frequently used communication options through smart sorting, and supports emotional wellness features such as mood tracking and cognitive activities..

3. Data Storage Layer

The Data Storage Layer is responsible for securely storing all essential user-related information locally through SQLite database integration. This includes communication history, therapy logs, profile data, user preferences, and wellness records. Local storage ensures offline functionality, allowing users to access key features even without internet connectivity. By prioritizing secure and efficient data management, this layer supports privacy, quick data retrieval, and uninterrupted communication support, which is especially valuable in therapy sessions, educational settings, and caregiving environments.

4. Common Services Layer

The Common Services Layer provides shared functionalities that support multiple components of the NeuroJoy system. This includes localization engines for multilingual accessibility, communication services, configuration settings, and profile customization modules. These services ensure consistency across the platform while simplifying future upgrades and maintenance.

5. Remote Infrastructure Layer

The Remote Infrastructure Layer extends NeuroJoy's capabilities beyond local device functionality by enabling cloud synchronization, remote backups, and service scalability. Through remote databases, APIs, and synchronization services, this layer allows caregivers, therapists, and users to securely access profiles, therapy logs, and progress data across multiple devices.

6. Security and Scalability

Security and scalability are fundamental architectural principles of NeuroJoy. The system ensures user privacy through secure local storage, protected therapy logs, and controlled cloud synchronization. Its

modular design allows future expansion, including additional languages, AI-powered communication tools, advanced wellness tracking, and broader healthcare integration.

IV. IMPLEMENTATION

The implementation of NeuroJoy was carried out using an iterative and modular development approach to ensure flexibility, maintainability, and scalability. Each module including user interface, communication engine, language localization, and profile management was developed, tested, and integrated systematically.

1. Frontend Development The user interface was implemented using Flutter, chosen for its cross-platform compatibility and native performance on Android and iOS. A high-contrast UI theme was designed to improve readability for visually sensitive users. Layouts were built using Flutter's widget hierarchy, ensuring responsiveness and accessibility. The Text-to-Speech (TTS) functionality was integrated using the flutter_tts package, allowing users to convert text into natural-sounding speech in multiple languages. Parameters like speech rate, pitch, and volume were customizable to match individual preferences.

2. Backend and Data Handling NeuroJoy utilizes SQLite via the sqflite package for local data storage. This enables offline access, ensuring uninterrupted functionality even without internet connectivity — a crucial feature for accessibility. DYPCET, Kolhapur 8 The local database stores user profiles, saved communication paths, and therapy logs securely. Each profile maintains its own settings and preferences, allowing a multi-user environment suited for therapy sessions or shared caregiving setups.

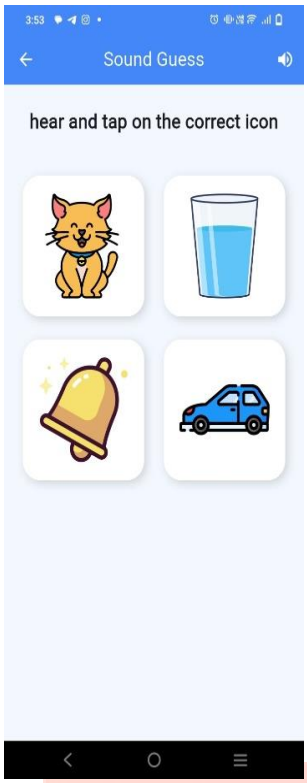
3. State Management and Logic Layer The internal logic of the application was structured using the Provider package for efficient state management. This pattern ensures real-time updates across different UI components whenever user input or data changes occur. This modular approach also simplifies the integration of adaptive learning features that track and suggest commonly used communication paths for faster user interactions.

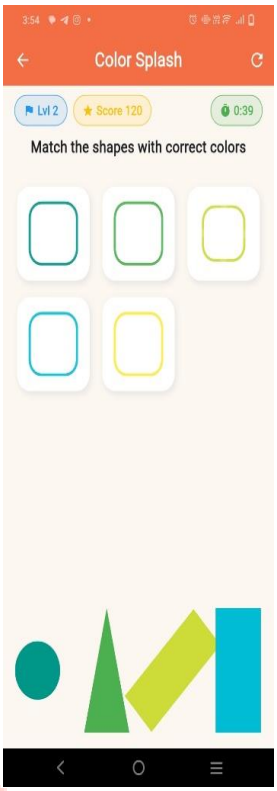
4. Localization and Language Support To promote inclusivity, the easy_localization package was used for multilingual support. English, Hindi, Spanish, and French translations were integrated into the app. The locale management allows users to switch languages seamlessly within the interface without restarting the app.

5. Testing and Optimization Implementation was validated through functional testing on multiple Android and iOS devices. Testing covered key areas such as voice output accuracy, offline data access, UI responsiveness, and accessibility compliance.

6. Future Integration The system architecture is designed for scalability, enabling easy integration of upcoming features such as mood check-ins, cognitive mini-games, and therapy progress tracking. The modular database schema and event-driven state management ensure that new features can be added without disrupting existing functionalities.

V.RESULT & DISCUSSION





Feature / Aspect	Existing Systems	NeuroJoy Project
Accessibility Design	Basic or moderate accessibility	High-contrast UI, voice prompts, inclusive design
Communication Mode	Limited AAC or single-mode	Multimodal (Text-to-Speech + Voice + Wellness)
User Personalization	Minimal customization	Customizable communication paths and profiles
Mental Wellness Integration	Rare or absent	Mood tracking, therapy logs, cognitive mini-games
Multilingual Support	Mostly English-only	English, Hindi, Spanish, French
Caregiver Support	Limited	Multi-user profile management
Offline Availability	Partial	Secure local storage with offline support
Data Security	Standard	Private therapy logs and secure profile data
Adaptability	Low to moderate	High, modular and scalable
Real-World Readiness	Functional but limited	Practical, inclusive, future-ready

Existing System

Existing assistive communication and AAC systems primarily focus on basic communication support, often offering limited text-to-speech functionality or symbol-based communication tools. While these systems help users express essential needs, many suffer from complex user interfaces, steep learning curves, and insufficient personalization options. Accessibility features are often moderate, lacking optimized high-contrast designs, cognitive simplicity, or adaptive navigation for neurodiverse and visually impaired users. Additionally, most traditional systems provide minimal multilingual support, frequently restricting usability to English-speaking populations. Mental wellness tools such as mood tracking, therapy logs, or cognitive support modules are generally absent, making these platforms largely functional rather than holistic.

Proposed NeuroJoy System

The NeuroJoy system significantly enhances traditional AAC platforms by providing an accessibility-first, holistic digital ecosystem that combines communication, emotional wellness, and cognitive support into a unified application. NeuroJoy offers a high-contrast, user-friendly interface with customizable communication paths, multilingual support in English, Hindi, Spanish, and French, and integrated text-to-speech with voice prompts for seamless communication. Unlike conventional systems, NeuroJoy extends functionality through daily mood check-ins, cognitive mini-games, private therapy logs, and wellness tracking, creating a more comprehensive support system for users. Its multi-user profile

management makes it highly practical for therapists, caregivers, classrooms, and families, while smart communication path sorting improves interaction speed and usability.

VI. Conclusion

The NeuroJoy system presents an effective and accessible solution for improving communication and supporting mental wellness among non-verbal, neurodiverse, and cognitively impaired users. By integrating Text-to-Speech (TTS) technology with a high-contrast and user-friendly interface, the system enables users to express their needs and thoughts efficiently.

The application successfully incorporates key features such as multi-user profile management, multilingual support, and offline functionality using SQLite, making it practical and reliable in real-world scenarios. The modular architecture ensures scalability and allows future enhancements without affecting existing functionalities.

The results demonstrate that the system provides smooth performance, easy usability, and improved accessibility, making it suitable for both individual users and caregiving environments. NeuroJoy bridges the gap between assistive communication tools and mental wellness support by offering a unified platform.

Future work includes the integration of AI-based prediction for faster communication, mood tracking features, and cognitive training modules to further enhance user experience and system intelligence.

VII. Future Scope

The future scope of NeuroJoy lies in expanding its capabilities beyond its current role as an assistive communication and wellness platform into a more intelligent, adaptive, and globally accessible digital ecosystem. One major area of enhancement is the integration of Artificial Intelligence and Machine Learning algorithms to provide predictive communication suggestions, personalized user behavior analysis, and adaptive communication pathways based on individual usage patterns. This would significantly improve communication speed and user experience, especially for non-verbal and neurodiverse users.

Another promising direction is the incorporation of advanced mental health support features such as emotion recognition, AI-based mood analysis, guided therapy sessions, and real-time mental wellness recommendations. These additions could transform NeuroJoy into a comprehensive therapeutic assistant that not only supports communication but also actively contributes to emotional regulation and psychological well-being.

The platform can also expand its multilingual accessibility by introducing additional regional and global languages, making it more inclusive for users from diverse cultural and linguistic backgrounds. Integration with wearable devices and IoT-based health monitoring systems could further enhance the system by enabling real-time tracking of stress levels, physical health indicators, and emotional states.

Cloud infrastructure and remote healthcare integration offer another significant opportunity, allowing therapists, educators, and caregivers to monitor progress, manage therapy plans, and provide personalized interventions remotely. This would strengthen collaborative care models and improve support efficiency across healthcare and educational settings.

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