

Neurowell – an Ai Powered Early Mental Health Detection and Support System: A Review

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Abstract

Mental disorders like anxiety and depression frequently go untreated because of social stigma and low healthcare accessibility. NeuroWell is an AI-based platform that helps overcome these issues by applying Natural Language Processing (NLP), Emotion AI, and Behavioral Analytics to detect emotional distress, track well-being, and facilitate proactive interventions. The platform provides smart journaling, mood tracking, AI chat support, gamified self-care tasks, and administrative insights that in combination facilitate early detection, ongoing engagement, and active involvement in mental health management. NeuroWell aims to decrease stigma, increase resilience, and offer affordable mental health care in schools, the workplace, and communities. Through the integration of sophisticated AI and empathetic design, it showcases the capability of technology to provide socially relevant solutions to pressing mental health issues. In addition to improving individual welfare, NeuroWell promotes healthy environments where mental health treatment is normalized, available, and organized into one's lifestyle. In aggregate, the system is an innovative system that utilizes AI to provide timely, personalized, and fair mental health care while meeting both individual and societal needs.

Keywords

Mental Health, Artificial Intelligence (AI), Natural Language Processing (NLP), Emotion Recognition, Behavioral Analytics.

1. Introduction

Mental problems such as depression, stress, and anxiety are now major global health issues. They affect individuals of all ages as well as from various backgrounds. World Health Organization reports indicate that a person out of eight across the globe struggles with some form of mental disorder, and close to 970 million people were estimated to have mental health issues by 2023. Most of them still remain without treatment, however. Social stigma that discourages people is some of the reasons behind this. There is also genuinely a lack of professionals who are trained. In addition, therapy is expensive for so many. Conventionally, identifying mental health issues relies on self-reporting or what clinicians observe in clinic. These approaches result in time being taken to receive assistance.

Natural Language Processing and Machine Learning create new avenues to detect emotional cues. This occurs through means such as analyzing text, speech patterns, and behaviors observed. Natural Language Processing tools, emotion recognition systems, and behavioral analytics assist in identifying early warnings of distress. They can intervene in order to assist individuals before the condition worsens. What makes this research happen is the urgent need for improved access. A smart digital system may be able to recognize problems early on. It could provide assistance when it is actually needed, all while empathizing.

This research examines the root issue of lack of tools for early detection. There is no decent method to keep track of mental health continuously. Existing solutions do not mix emotional understanding with behavior monitoring. Analytics privacy remains a weak point as well. The system known as NeuroWell fills this gap. It combines multiple AI techniques to detect warning signs of mental health deterioration. The intention is to intervene before issues accumulate.

1.1 Objectives

The work centers on building and looking over NeuroWell. This platform uses AI for detecting mental health needs and providing support. Objectives include a few key areas. First, gather and review the latest AI methods for spotting mental health early. These draw from multimodal data sources. Second, put together a framework that links Natural Language Processing, emotion recognition, and behavioral analytics. Third, build in strong protections for data privacy. Ethical AI practices matter here, with secure learning and ways to anonymize information. Fourth, suggest ways to boost user involvement before issues arise. Focus on making it accessible and tied to emotional well-being. Finally, check the system on a conceptual level. Make sure everything lines up with real world use. It should scale well and fit social needs.

2. Literature Review

Baran et al. (2025), "AI-driven early diagnosis of specific mental disorders: a comprehensive study", published in *Cognitive Neurodynamics* (2025) offer an exhaustive overview of AI techniques for early disorder diagnosis (schizophrenia, autism, depression, bipolar disorder, dementia, ADHD), reviewing traditional ML (e.g., XGBoost,

LightGBM) and deep models (CNN, LSTM, GRU) on EEG, MRI and text, and observe the unavailability of big real-world clinical datasets and the necessity of additional clinical validation prior to deployment.

Amoako et al. (2024) ["Emotional Stress Detection Using the Variance of Deep Convolutional Neural Network (DCNN) Analysis Using Facial Images", (2024) IEEE SmartBlock4Africa Conference offer an exhaustive overview of AI techniques for early disorder diagnosis (schizophrenia, autism, depression, bipolar disorder, dementia, ADHD), reviewing traditional ML (e.g., XGBoost, LightGBM) and deep models (CNN, LSTM, GRU) on EEG, MRI and text, and observe the unavailability of big real-world clinical datasets and the necessity of additional clinical validation prior to deployment.

Donaghy et al. (2024), "A Review of Studies Using Machine Learning to Detect Voice Biomarkers for Depression", published in *Journal of Affective Disorders* (2024). This systematic review compares 19 studies between the years 2019 and 2022 that utilized machine learning approaches for identifying voice biomarkers of depression. The results indicate moderate effectiveness of depression detection; nevertheless, these models' performance is suboptimal compared to the PHQ-9 benchmark, which implies a necessity for further improvement and clinical validation.

Jose (2024), "Leveraging Sentiment Analysis and Emotion Detection for Mental Health Insights", *Journal of Medical Internet Research* (2024). This research uses natural language processing (NLP) methods to process 1,777 multilingual patient reviews to identify relevant factors like cost, communication, and depression, which affect mental health satisfaction and care. The study highlights the importance of sentiment and emotion analysis in obtaining meaningful insights from patient reviews, which can be used to inform enhancements in mental health care services.

Panigrahi et al. (2024), "Artificial Intelligence-driven Solution for Prompt Identification of Mental Health Concerns in Adolescents", *Journal of Adolescent Health* (2024). The paper introduces an AI framework combining NLP, sentiment analysis, and ensemble learning to examine adolescent data for early detection of mental health issues. The system showed effective detection abilities to enable timely interventions. The authors propose the use of multimodal data sources to widen the scope of the system's effectiveness and usefulness in real-world situations.

Prama et al. (2024), "AI-Enabled Deep Depression Detection and Evaluation Informed by DSM-5-TR", *Journal of Affective Disorders* (2024). This study applies LSTM-based deep learning models to clinically labeled tweets and extracts emotional, topical, and behavioral features to identify depression. The model recorded an MSE of 0.0023 and an R^2 of 0.61, better than conventional methods. The research indicates the value of social media information with deep learning methods in correct depression detection and proposes future research directions in this area.

Andreas et al. (2022), "CNN-Based Emotional Stress Classification Using Smart Learning Dataset", published in *Journal of Educational Technology & Society* (2022). This research focuses on the use of CNN models to classify emotional stress based on the Smart Learning Dataset. The model showed impressive accuracy and efficiency, reflecting the power of CNNs in stress detection. Future studies, the authors recommend, should be aimed at fusing multimodal data to better develop classification performance and usability in a variety of educational contexts.

Poria et al. (2019), "Emotion Recognition in Conversation: Research Challenges, Datasets, and Recent Advances", published in *IEEE Transactions on Affective Computing* (2019). This survey paper presents an overview of the challenges, datasets, and state of advances in conversational emotion recognition. The authors describe the role of context and speaker modeling in achieving high accuracy and note the challenges in detecting sudden emotion changes. The paper urges developing more advanced models and larger, more diverse datasets to tackle these challenges.

Pacula et al. (2014), "Automatic Detection of Psychological Distress Indicators and Severity Assessment in Crisis Hotline Conversations", *Journal of Crisis Intervention and Suicide Prevention*, (2014). The paper formulates an automated system based on linguistic and acoustic features for identifying psychological distress and its severity in crisis hotline calls. The system was found to have high accuracy, and hence it was posited that it could be useful for real-time crisis intervention. The authors place strong stress on ensuring interpretability and ethical thought in deploying such systems.

Jervis et al. (1996), "Detection of Brain Conditions from Evoked Responses Using Artificial Neural Networks", *Journal of Neural Engineering*,(1996). The artificial neural networks in this study are used to analyze evoked EEG responses for detecting brain conditions like Huntington's, Parkinson's, and schizophrenia. The model had good

sensitivity and specificity, showing the potential of EEG diagnostics. The study indicates that the inclusion of EEG information with behavioral data may improve diagnostic performance even further.

3. Proposed Methodology

The NeuroWell system uses Artificial Intelligence (AI) and behavior analytics to provide an integrated mental health support system. The methodology as a whole is segmented into separate modules as given below:

Step 1: User Input Module. Users engage through journaling (emoji or text), mental health surveys, and a chat companion for emotional support using AI. Face and voice inputs are optional to help identify tone, stress, and emotional expressions for improved understanding.

Step 2: AI Processing Module. This module applies NLP for analysis of sentiment and tone, Emotion AI for mood analysis, and Behavioral Analytics for monitoring habits. All three combined create a comprehensive insight into the user's emotional and behavioral condition.

Step 3: System Response Module. The system, on the basis of AI insights, provides pre-emptive warnings, self-care recommendations, and mindfulness exercises. A gamified dashboard monitors progress and encourages users towards mental wellness.

Step 4: Support and Action Module. For exigent situations, the system triggers SOS helplines and reaches out to mental health professionals for the users. Therapists gain access to admin insights for timely intervention and personalized assistance.

Step 5: Security and Privacy Layer. NeuroWell protects data confidentiality through federated learning and end-to-end encryption. User data is anonymized at all times to ensure trust and confidentiality within the system (Figure 1).

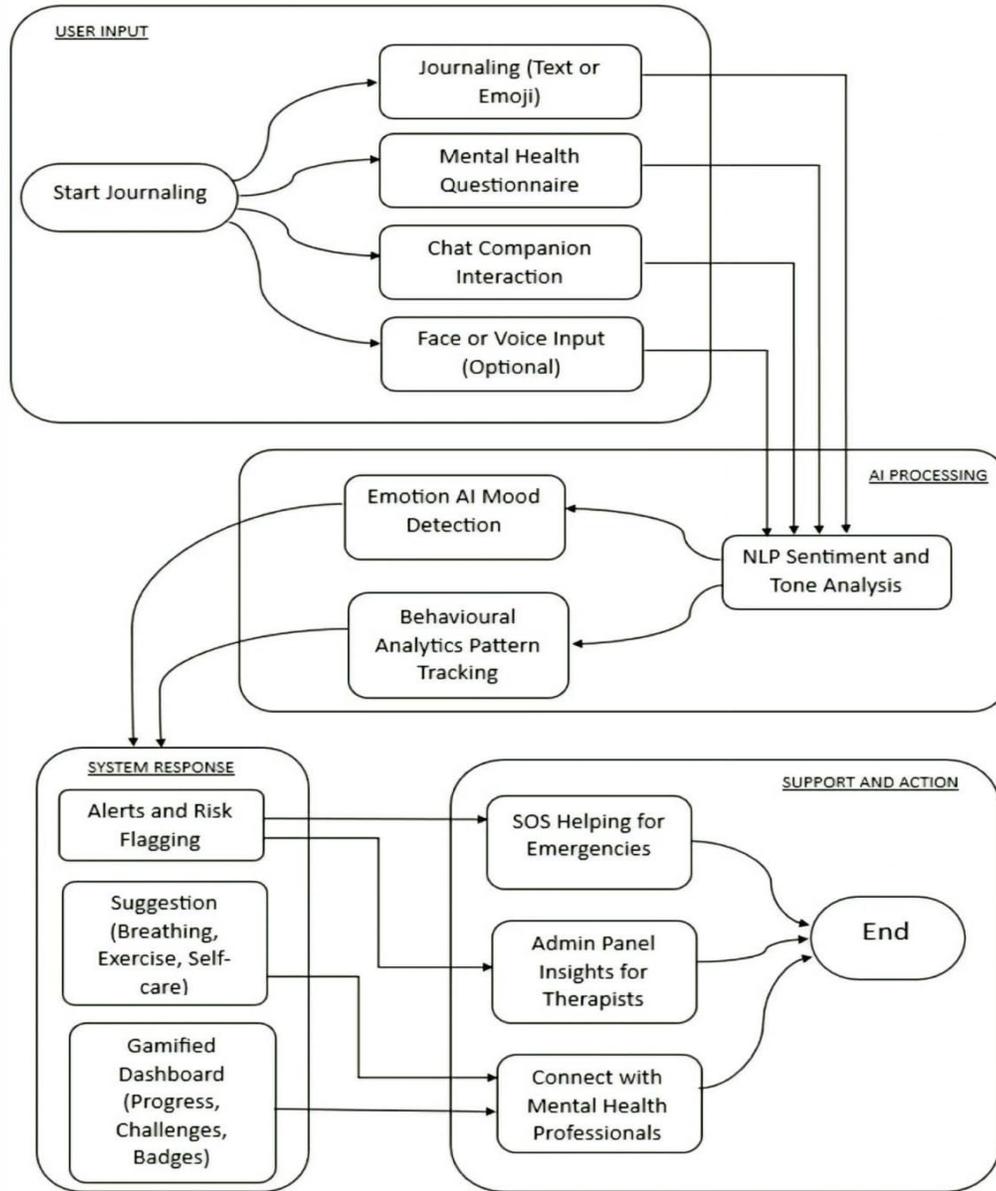


Figure 1. Proposed Methodology

3.1 Descriptive Analysis of the Proposed System

The NeuroWell framework is a conceptual model intended for the early identification and individualized management of mental health issues through Artificial Intelligence (AI). The system combines emotional, behavioral, and linguistic information to enable anticipatory mental well-being care. The analysis given in this section gives an in-depth theoretical description of the data flow, functional elements, and algorithms used within the NeuroWell structure.

Figure 2 depicts the range of input modes included in the conceptual framework. The design combines three main types of user input — text, voice, and facial expressions. Of these, text-based journaling is the most prevalent source of information, enabling users to log their emotions in private and in comfort. Voice and facial inputs add contextual depth by picking up paralinguistic cues like tone, pitch, hesitation, and micro-expressions. This multimodal data collection approach is inclusive since users are able to express themselves in a way that most accurately reflects their emotional state.

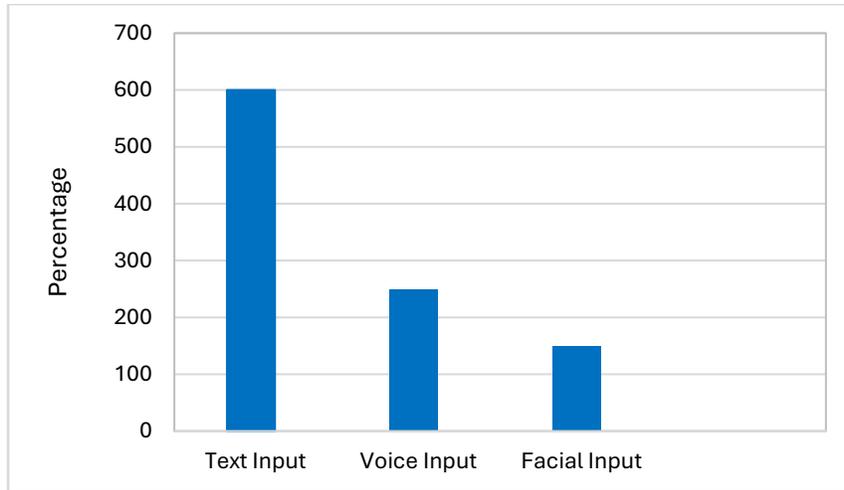


Figure 2. Distribution of NeuroWell Input Mode

The theoretical reasoning is that only with such an integrated convergence of multiple inputs can the accuracy of emotional inference be notably increased over single-mode systems. The information gathered from these sources is then processed further using a blend of **Natural Language Processing (NLP)** and **Emotion AI algorithms**. NLP uses **Bidirectional LSTM** and **Transformer-based architectures (such as BERT)** to identify sentiment, tone, and language patterns. Facial emotion detection is accomplished with **Convolutional Neural Networks (CNNs)** by the Emotion AI engine and **MFCC-based feature extraction** in voice emotion analysis to gain a comprehensive knowledge of user affective states.

Figure 3 reflects the expected distribution of emotional classes that NeuroWell is programmed to identify. The model has categorized emotions into six main classes-happiness, sadness, anger, fear, disgust, and neutral. The conceptual data indicates that the system can identify greater frequencies of neutral and sad emotions based on the reflective nature of journaling inputs. These findings are critical for determining early symptoms of anxiety, stress, or emotional exhaustion among users.

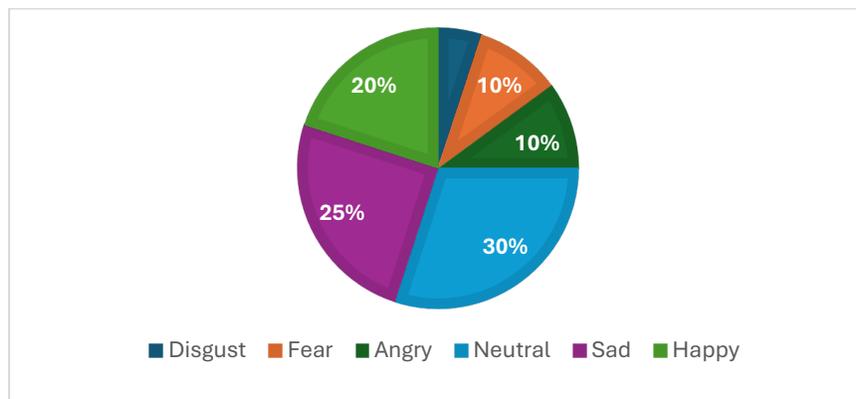


Figure 3. Projected Distribution of Identified Emotional Categories

In addition, the Behavioral Analytics module monitors non-verbal metrics like journaling frequency, response time, and engagement length, interpreting changes in user behavior across time using the **K-Means clustering** and Pattern Recognition algorithms. It is through the combination of these algorithms that NeuroWell can learn from patterns of user interaction and improve its customized recommendations over time.

Figure 4 displays the **expected demographic breakdown** of the target user base. NeuroWell largely targets young adults and students since these populations are more susceptible to psychological pressure and emotional ups and

downs based on study and lifestyle factors. The demographic concept analysis indicates that the overall projected users comprise almost half of those between the ages of 18–25, followed by working professionals between the ages of 26–35. This is consistent with NeuroWell's goal to encourage early intervention and awareness of emotions among digitally engaged populations.

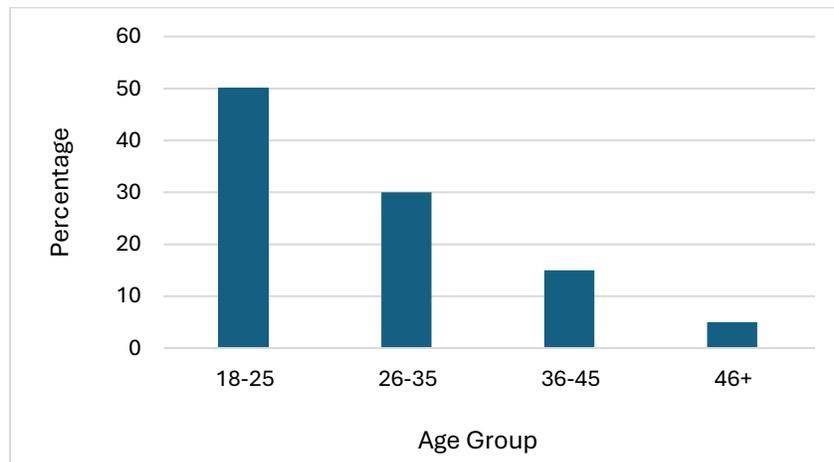


Figure 4. Theoretical Age Group Representation of Target Users

4. Results and Discussion

This section introduces the results of the analysis as well as a brief discussion of the findings. Section 3.1 contains the descriptive analysis, serving as the foundation for grasping the trends and insights obtained from the studies reviewed concerning AI in detecting mental health.

The literature review discloses major developments in the use of Artificial Intelligence (AI) to diagnose and treat mental health conditions like stress, anxiety, and depression. Research using Deep Convolutional Neural Networks (DCNNs), Natural Language Processing (NLP), and Emotion Recognition Models has been found to possess excellent potential in processing multimodal data—e.g., text, speech, and facial expressions—to identify initial psychological distress.

Techniques such as Sentiment Analysis, Long Short-Term Memory (LSTM) networks, and Multimodal Data Fusion have reached great accuracy in emotional state prediction. These models make machines more capable of interpreting human emotions through recognizing linguistic and behavioral patterns, presenting potential for early intervention and tailored mental health care.

Even with these developments, significant challenges still persist. Limited access to large, diverse, and representative datasets curtails model generalization. Biases in culture and language still impact the accuracy of predictions, and understanding overlapping or subtle emotions is still challenging. Additionally, a lack of privacy-preserving frameworks and ethics support diminishes user trust and hampers real-world deployment.

These results highlight the increasing demand for systems such as NeuroWell, which strive to reconcile accuracy, interpretability, personalization, and ethical data handling. Through incorporating these philosophies, NeuroWell strives to develop a more accurate and user-focused AI platform for early mental health detection and intervention, closing the gap between research innovation and real-world application.

5. Conclusions

After scrutinizing various research studies, it is possible to conclude that Artificial Intelligence (AI) has great potential to revolutionize mental health care with early detection and individualized intervention. Sophisticated methods like Natural Language Processing (NLP), Emotion AI, and Behavioral Analytics have shown promising outcomes in detecting psychological disorders such as depression, anxiety, and stress from multimodal data sources like speech, text, and facial expressions. Despite this, the current research identifies various limitations, for instance, the application of small and homogeneous datasets, absence of personalized strategies, and issues associated with data security and

privacy. Generally, the literature emphasizes the importance of holistic, user-centric, and ethically developed mental health care systems.

To address these shortcomings, the system NeuroWell proposed here is premised on multimodal data analysis, customized recommendations, and robust data protection systems to improve both diagnostic quality and user confidence. Therefore, AI-based platforms like NeuroWell can potentially make mental health services more available, anticipatory, and compassionate—enabling early diagnosis, fostering emotional health, and enabling comprehensive mental health management.

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Biographies

Dr. Mohammad Nasiruddin is an Associate Professor, Department of Electronics and Telecommunication Engineering, ACET. He joined Anjuman Polytechnic immediately after passing his B. E. in First Division from RTMNU, Nagpur in the year 1998 and thereafter he was transferred to Anjuman College of Engineering & Technology, Sadar, Nagpur in the year 2001. He completed his M. Tech. in Electronics & Communication Engineering in First Division and Ph. D. from RTMNU, Nagpur. He has total 27 years of teaching experience and 01 year of industrial experience. He published more than 23 papers in Scopus/International Journals/ Conference and more than 05 papers in National Journals/ Conference. He has organized so many workshops/seminars for the overall development of students. He is Life member of Indian Society for Technical Education (ISTE), and also the member of IEEE. Recently he is awarded by **Dr. A. P. J. Abdul Kalam Life Time achievement National Award** for his distinguished contribution to the development of the Nation and achieving outstanding excellence in the field of Teaching, Research and Publications.

Aliza Umam Khatib is studying a Bachelor of Engineering in Electronics and Telecommunication from Anjuman College of Engineering & Technology, Nagpur, India. She was a part of the project Skin Disease Diagnosis Using Deep Learning, which involved her in research, documentation, and making a user interface easy to use, utilizing advanced deep learning methods to create useful solutions. Today, she is a part of NeuroWell — an AI-Powered Early Mental Health Detection & Support System, doing research, documentation, and user interface development to bring

mental health support closer and more effective. She is particularly fascinated about using cutting-edge technologies and intelligent systems to address actual problems. She loves to experiment with new tools and techniques, marrying creativity with technical expertise to turn meaningful ideas into reality.

Roshani Zahera Dossani is an Electronics and Telecommunications Engineering student at Anjuman College of Engineering and Technology who is passionate about using technology to make a real difference. She enjoys web development and is deeply interested in the fields of artificial intelligence and machine learning. She has worked on a skin disease detection project, where she explored how AI can support medical diagnostics. She is currently part of NeuroWell, an AI-powered early mental health detection and support system, where she contributes to both frontend and backend development. These experiences have helped her strengthen her technical skills and inspired her to continue creating intelligent, user-focused applications that solve meaningful, real-world problems.

Saniya Anjum Khan is studying for a Bachelor of Engineering in Electronics and Telecommunication Engineering at Anjuman College of Engineering & Technology, Nagpur, India. She has been involved in the project Skin Disease Diagnosis Using Deep Learning, where she assisted with research, documentation, and front-end design. Her task included studying deep learning methods and designing an effective, user-friendly interface for real-world application. She is presently developing NeuroWell — AI-Powered Early Mental Health Detection & Support System on research, documentation, and interface development. She is enthusiastic about transforming innovative technologies and smart systems into practical solutions to real-world issues and looks forward to further developing herself by way of research and innovative project development.

Shreeya Sapate is completing a Bachelor of Engineering in Electronics and Telecommunication Engineering from Anjuman College of Engineering & Technology, Nagpur, India. She was a part of the project NOVA — Smart Assistant, in which she worked on front-end design, research, and system documentation. She was concerned with designing an easy-to-use and effective user interface to raise the level of user interaction. She is currently engaged in NeuroWell — AI-Powered Early Mental Health Detection & Support System, undertaking research, documentation, and interface design. Shreeya is interested in exploring future artificial intelligence technologies and creating innovative digital solutions that help bring technology closer, more practical, and more effective to real-life use.