A Comprehensive Analysis on Deep Learning Framework for Mental Disorder Identification using Facial Emotions

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Abstract—**The review explores recent advancements in mental disorder detection through facial emotion recognition using deep learning techniques. It highlights the effectiveness of hybrid models that integrate Convolutional Neural Networks (CNNs), ResNet50, and Vision Transformer (ViT) for robust emotion classification. The study examines various approaches, including real-time face detection with YOLOv8 and interpretability enhancements through Grad-CAM and Saliency Maps, demonstrating improved accuracy and transparency in identifying mental health conditions. Key challenges identified include data diversity, cultural variability in facial expressions, and real-time deployment in clinical environments. The proposed study explains about the comparative analysis of methodologies for the identification of mental disorder and paves the way for finaling the best methodology for implementation.**

Index Terms—**Mental Disorder Detection, Facial Emotion Recognition, Deep Learning, CNN, ResNet50, Vision Trans- former, YOLOv8, Grad-CAM, Saliency Maps**

I. INTRODUCTION

The growing global concern for mental health highlights the urgent need for effective, scalable, and automated diagnostic tools. Mental health disorders such as depression and anxiety are increasingly prevalent, impacting millions worldwide, yet early detection and intervention remain significant challenges. Traditional clinical methods for diagnosing mental disorders primarily rely on self-reported questionnaires and therapist observations, which can be subjective and limited by availability and accessibility. In contrast, recent advancements in Artificial Intelligence (AI) and Deep Learning (DL) have introduced promising approaches for automating mental health assessment through facial emotion recognition. This innovative field leverages deep learning models to analyze subtle emotional cues embedded in facial expressions, providing a non-intrusive, real-time method for detecting early signs of mental health conditions.

The proposed study introduces a novel deep learning-based framework that harnesses the capabilities of Convolutional Neural Networks (CNNs), ResNet50, and Vision Transformer (ViT) for robust facial emotion recognition. This hybrid architecture is designed to enhance the detection of emotional states linked to mental disorders. By employing YOLOv8 for real-time face detection and feature extraction, the system efficiently identifies critical facial regions that reflect emotional expressions. Furthermore, the integration of Explainable AI techniques, such as Grad-CAM and Saliency Maps, ensures interpretability by visualizing which facial features most significantly influence the model's predictions. This transparency fosters clinical trust, making it suitable for integration into mental health diagnostics.

The system is trained on large-scale emotion-labeled datasets, including AffectNet and FER2013, which provide diverse and comprehensive facial emotion samples. These datasets enable the model to generalize effectively across different demographics and cultural backgrounds, addressing a critical gap in cross-cultural adaptability for mental health diagnostics. Additionally, the framework aims to support real-time monitoring and scalable deployment, making it a practical tool for telemedicine and remote health monitoring.

II. LITERATURE SURVEY

J.Aina et al.[1] proposed a novel system that leverages emotion recognition to assist in detecting mental disorders such as depression and anxiety. The proposed architecture integrates deep learning with ensemble techniques to improve emotion classification accuracy. It begins by preprocessing video frames through operations such as grayscale conversion, face detection using the Haar-cascade algorithm, and resizing. Detected facial regions are then passed to a ResNet-50 deep convolutional neural network for emotion classification, trained on the FER-2013 dataset. To enhance decision-making, the system combines outputs from multiple models using a soft-voting ensemble method, improving robustness and prediction accuracy. Emotions are classified into positive and negative categories: happiness and neutrality are treated as positive, while sadness, anger, and fear are identified as negative emotions. The presence and combination of negative emotions over a defined threshold help the system flag potential mental health issues.

In [2], Roshani et al. explained an intelligent system aimed at early detection and prevention of mental health issues. The system utilizes machine learning models to classify individuals into mental wellness categories based on various psychological and behavioral indicators. It incorporates data collected through structured questionnaires and integrates it with advanced data preprocessing and feature extraction methods. The model applies supervised learning techniques, particularly the Random Forest Classifier, to analyze input data and predict levels of mental well-being–categorized into high, medium, or low. Key features used in the model include demographic factors, personal habits, emotional states, and social interaction patterns. To improve prediction accuracy, the dataset undergoes cleaning, normalization, and handling of missing values before model training.

The research work done by Jiang et al.[3] proposes an automated framework to evaluate depression levels by analyzing facial expressions captured in video. The approach uses a novel dynamic texture descriptor called MRLBP-TOP, which extracts spatio-temporal features from three orthogonal planes of facial motion. This allows the system to capture subtle emotional cues and facial movements over time, which are key indicators of depressive symptoms. To convert these extracted features into a compact and meaningful representation, the framework employs Dirichlet Process Fisher Vector (DPFV) encoding. Unlike traditional models, DPFV automatically determines the number of clusters needed, making it more adaptive. Finally, Support Vector Regression (SVR) is used to predict the Beck Depression Inventory (BDI-II) score. Experiments conducted on AVEC2013 and AVEC2014 datasets show that this method outperforms earlier techniques, making it a promising tool for objective, video-based depression assessment.

[4]The research work titled ”Recognition of Facial Expressions and Emotions on the Face using the YOLOv5 Algorithm” presents a system for real-time emotion detection based on facial expressions. The system employs the YOLOv5 object detection algorithm to identify faces in input images or video streams and then classify facial expressions into distinct emotional categories. The key preprocessing steps include face detection using the YOLOv5 model, followed by emotion classification based on extracted facial features. The methodology integrates deep learning techniques with image processing to accurately recognize expressions such as anger, happiness, sadness, surprise, and fear. The system was trained and tested using publicly available datasets like FER2013, which contains a diverse set of labeled facial emotion images. YOLOv5's efficient real-time object detection capability enhances the model's ability to identify faces quickly and accurately, even in varying lighting or background conditions.

Nidhi et al[5] describes a traditional machine learning techniques have been employed for facial emotion recognition, but recent years have seen a shift towards deep learning methods, particularly Convolutional Neural Network (CNN)-based approaches. These advanced techniques have demonstrated superior performance in the field, offering more accurate and robust emotion classification. The effectiveness of CNN-based methods has been consistently observed across various datasets and real-world scenarios, highlighting their ability to capture complex facial features and expressions. This improvement in performance can be attributed to the deep learning models' capacity to automatically learn hierarchical representations from raw image data, eliminating the need for manual feature engineering.

Chatterjee, S., Maity, S., Ghosh, K. et al [6] describes a significant advancements in facial emotion recognition using deep learning models. Recent studies have explored various approaches, including residual layers with CNNs, multiple CNNs with fuzzy integral, and region attention networks. Autoencoders, particularly variational autoencoders (VAEs), have gained attention for their ability to capture important features and address computational complexity. Researchers have also investigated multimodal applications combining visual and audio signals. However, a common challenge in facial emotion recognition is the problem of imbalanced classes, where certain emotions are underrepresented in datasets. To address this, techniques such as oversampling, undersampling, and hybrid methods have been explored. The proposed method in this study utilizes a residual variational autoencoder (RVA) to obtain latent representations of facial images, followed by resampling techniques to balance the classes. Various classifiers, including KNN, SVM, and MLP, are then applied to predict emotions.

[7]The research work explores the automated detection of mental disorders using facial expressions and machine learning algorithms. Studies have investigated behavioral features from facial data to predict depressive and anxiety disorders, including facial action units, head positioning, and eye gaze patterns. Research has also focused on distinguishing between basic and complex emotions in individuals with major depressive disorder and anxiety disorders. Scholars have developed frameworks for stress and anxiety detection through video-recorded facial cues, capturing subtle changes over time indicative of psychological states. The application of transfer learning models like VGG to facial emotion recognition tasks represents a significant advancement, with models fine-tuned using specialized datasets like FER+ and CK+.

L. Shen et al.[8]reveals the development of an AI-based closed-loop music intervention system for emotion regulation in mental disorder treatment. The study highlights the increasing prevalence of mental disorders and the potential of emotion regulation through music therapy as an effective non-drug treatment method. Traditional music therapy faces limitations in real-time assessment and personalization. The proposed system integrates an emotion recognition model using EEG data and a music generation model based on AI-generated content (AIGC). The emotion recognition model, 3C-ERM, utilizes a 3-channel EEG sensor and achieves high accuracy in binary and quaternary emotion classification tasks. The music generation model employs a diffusion model to create emotional music based on recognition results. User studies demonstrate the system's effectiveness in emotion regulation and its potential for mental health interventions.

The research work titled"Early detection of depression through facial expression recognition and electroencephalogram-based artificial intelligence-assisted graphical user interface" [9] reveals that depression is a significant mental health issue affecting over 280 million people globally. Early detection is crucial but challenging due to the lack of sensitive diagnostic tools. Recent studies have explored artificial intelligence (AI) approaches for depression detection, combining facial expression recognition and EEG analysis. Various machine learning and deep learning models have been employed, with accuracies ranging from 80 Zixiang Fei et al [10] presents a novel deep learning-based framework for facial expression recognition to support mental health care. The authors propose a system that combines deep features extracted from AlexNet with a Linear Discriminant Analysis classifier. The framework was evaluated on multiple facial expression datasets, including lab-based and"in-the-wild" images. Results showed the proposed method achieved high accuracy while requiring less computational resources compared to other deep learning approaches. The system was able to analyze facial expressions from video and quantify emotional changes over time. The authors suggest this framework has potential applications in detecting and monitoring cognitive impairments by analyzing facial expressions. They tested it on datasets containing expressions from patients with cognitive impairments and found promising performance.

In [11], C. Zheng, M. Mendieta and C. Chen introduces a novel deep learning architecture designed to enhance the accuracy and robustness of facial expression recognition (FER). The proposed POSTER network addresses three critical challenges in FER: inter-class similarity, intra-class discrepancy, and scale sensitivity. To tackle these issues, the authors design a two-stream architecture that processes both global and local facial features, integrated through a cross-fusion transformer module. This module enables effective information exchange between the two streams, allowing the model to capture both fine-grained local details and holistic facial patterns. Additionally, a pyramid structure is employed to handle multi-scale facial variations, improving the model's adaptability to different facial expressions and image resolutions.

The paper titled "Diagnosis of Depressive Disorder Model on Facial Expression Based on Fast R-CNN" [12] proposes a model to assist in diagnosing depressive disorders using artificial intelligence (AI) and facial expression recognition. The authors examine related literature to develop a smartphone-based system that can quickly identify depressive disorders and provide data for intervention. The model utilizes fast region-based convolutional neural networks (R-CNN) to recognize vector-based information from facial images, specifically analyzing changes in eye and lip positions to infer emotional states. The proposed system integrates self-report questionnaires like the Patient Health Questionnaire-9 (PHQ-9) with objective facial expression data collected via smartphone cameras. A chatbot interface using the KakaoTalk platform increases accessibility for users.

In [13],D. Naveen, P. Rachana, S. Swetha and S. Sarvashn proposes a system for early detection and assistance in identifying a person's mental state. The paper outlines a two-module approach: Facial Emotion Detection and Assistance. The system uses facial recognition technology, specifically OpenCV and Haar Cascade models, to detect faces and extract features. A Convolutional Neural Network (CNN) is then employed to classify emotions into categories such as fear, anguish, grief, surprise, joy, displeasure, and neutral. The paper describes the CNN architecture in detail, including its layers (convolution, pooling, full connection, and SoftMax) and the training process.

In [14], The author proposes a model for diagnosing depression using a decision tree algorithm. The study extracts depression-related features such as head pose, gaze, and facial expression changes from facial images. The model was trained using two databases: the EDAIC-WOZ database and an image database from Chosun University Hospital. The performance of the algorithm was evaluated using a confusion matrix and receiver operating characteristic (ROC) curve, achieving an area under the curve (AUC) value of 0.99.

U. M. R, S. V. Vasantha, S. K. R. G and A. Md [15] presents a comprehensive approach to leveraging facial emotion recognition for mental health assessment. By employing machine learning algorithms such as Decision Tree, Random Forest, and Artificial Neural Networks (ANN), the study aims to detect six key emotional states–happiness, sadness, neutrality, fear, disgust, and anger–from facial images captured via webcam or uploaded by users. These emotional indicators are used to infer an individual's mental health status, with the goal of identifying behavioral anomalies that may suggest underlying psychological concerns. The authors emphasize the growing integration of artificial intelligence in healthcare, particularly in the domain of mental health, where early detection and continuous monitoring are critical.

Sl No.	Title	Algorithms / Techniques	Limitations
1	A Hybrid Learning-Architecture for Mental Disorder Detection using Emotion Recognition	YOLOv8, Ensemble model (MDNet, ResNet50, ViT) Grad-CAM,	Visual dependency, Indicator oversight, Expression-centric
2	Novel Approach for Enhancing Mental Well-being through Machine Learning Techniques	Deep learning, Natural language processing, Computer vision	Data imbalance, Model interpretability.
3	Automatic Depression Analysis Using Dynamic Facial Appearance Descriptor and Dirichlet Process Fisher Encoding	MRLBP-TOP, DPFV, Statistical aggregation	Parameter tuning, Computational complexity, Visual-only analysis
4	Recognition of Facial Expressions and Emotions on the Face using the YOLOv5 Algorithm	YOLOv5 algorithm, Dataset collection	Environmental factors, Accuracy issues, Ethical concerns
5	From methods to datasets:a detailed study on facial emotion recognition	CNN, SVM, RNN, LSTM, MLP, Autoencoder	Data insufficiency, Pose variation, Occlusions
6	Majority biased facial emotion recognition using residual variational autoencoders	Residual VAE, Resampling techniques, Machine learning classifiers	Dataset bias, Computational complexity, Emotion ambiguity
7	Automated detection of human mental disorder	Haar-cascade, VGG16, CNN	Personality exclusion, Dataset limitation, Emotion ambiguity
8	Enhancing Emotion Regulation in Mental Disorder treatment: An AIGC-based Closed-Loop Music Intervention System	CNN-based emotion recognition, Closed-loop intervention system	Limited participants, Low EEG resolution, Minimal personalization
9	Early detection of depression through facial expression recognition and electroencephalogram-based artificial intelligence-assisted graphical user interface	Random Forest, MediaPipe Mesh, EEG FFT	Dataset bias, Channel redundancy, Real-time validation
10	Deep convolution network based emotion analysis towards mental health care	AlexNet + FC6 + LDA, Deep feature extraction, Image preprocessing	Dataset imbalance, Emotion recognition, Real-world applicability
11	POSTER: A Pyramid Cross-Fusion Transformer Network for Facial Expression Recognition	Cross-fusion transformer, Feature pyramid structure, Two-stream architecture	Data imbalance, Insufficient samples, In-the-wild challenges
12	Diagnosis of Depressive Disorder Model on Facial Expression Based on Fast R-CNN	Fast R-CNN, Chatbot platform, Cloud server	Facial expression variability, Cultural differences, Emotional complexity
13	Mental Health Monitor using Facial Recognition	CNN, OpenCV HAAR CASCADES, TensorFlow Image Classifier	Dataset dependency, Accuracy limitations, Emotional complexity
14	Decision Tree Algorithm for Depression Diagnosis from Facial Images	Decision Tree, KNN, SVM, CNN, RNN	Data imbalance, Model complexity
15	Emotion Detection using Facial Image for Behavioral Analysis	Random Forest, Decision Tree, Artificial Neural Network(ANN)	Nonsensical phrases, Overfitting risk, Training complexity

III. METHODOLOGY

The field of mental health diagnostics is witnessing a revolutionary shift with the integration of deep learning and computer vision technologies. This paper presents an innovative framework that harnesses the power of facial emotion recognition to aid in the identification of mental disorders such as depression and anxiety. At the core of this system is a sophisticated hybrid ensemble model that combines the strengths of Convolutional Neural Networks (CNN), ResNet50, and Vision Transformer (ViT) architectures. This ensemble approach is designed to extract and analyze complex emotional cues from facial expressions with high accuracy and robustness. The framework begins its process by employing the advanced YOLOv8 algorithm for precise detection of emotional expressions in facial images or video streams. This initial step is crucial as it isolates and extracts the most relevant facial features for subsequent analysis. Once these features are extracted, they are fed into the hybrid ensemble model for classification.

The use of multiple deep learning architectures in tandem allows the system to capture a wide range of emotional nuances that might be missed by single-model approaches. To train this complex model, the framework utilizes comprehensive emotion-labeled datasets, including AffectNet and FER2013, which provide a diverse array of facial expressions across various emotional states. This extensive training data enables the model to recognize and categorize subtle emotional cues that may be indicative of underlying mental health conditions. A key innovation of this framework is its emphasis on interpretability, a critical factor for its potential application in clinical settings. By incorporating explainable AI techniques such as Grad-CAM and saliency maps, the system provides visual insights into the regions of the face that most significantly influence its predictions. This feature not only enhances the transparency of the model's decision-making process but also offers valuable information to mental health professionals in their assessments.

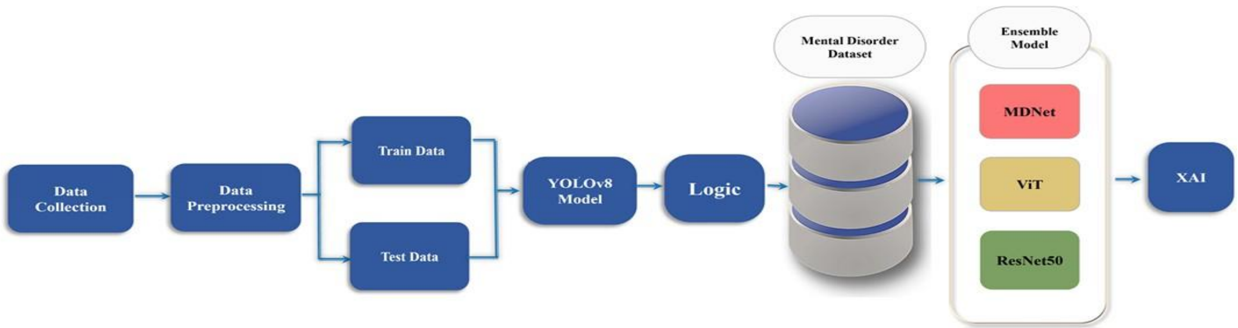

Fig. 1: Architecture

IV. RESULTS AND DISCUSSION

The results of this study demonstrate the potential of deep learning techniques in mental health assessment through facial emotion recognition. The hybrid ensemble model, integrating Convolutional Neural Networks (CNN), ResNet50, and Vision Transformer (ViT), showed promising performance in accurately classifying emotions from facial expressions. The YOLOv8 algorithm proved effective in detecting and extracting relevant facial features, providing a solid foundation for subsequent analysis. The incorporation of explainable AI techniques, particularly Grad-CAM and saliency maps, offered valuable insights into the model's decision-making process, highlighting the facial regions most influential in emotion classification. This interpretability feature is crucial for building trust and facilitating adoption among mental health professionals.

In discussing these results, it's important to consider their clinical relevance and potential impact on mental health care. The framework's ability to assist in the early detection of mental disorders such as depression and anxiety could significantly contribute to timely interventions and improved patient outcomes. The interpretability of the model's decisions, made possible through explainable AI techniques, addresses a critical need in clinical applications of AI, potentially increasing the acceptance and utility of such tools in professional settings. However, it's crucial to acknowledge the limitations of the study, which may include dataset biases, computational requirements, or challenges in identifying specific types of expressions or disorders. Ethical considerations, particularly regarding privacy and the responsible use of AI in mental health diagnosis, warrant careful attention. Looking ahead, there are exciting possibilities for further enhancing this framework, such as incorporating additional data modalities or expanding its application to a broader range of mental health conditions. The potential of this technology to revolutionize mental health assessment and contribute to global mental health initiatives is significant, offering a promising path towards more accessible, efficient, and accurate mental health care.

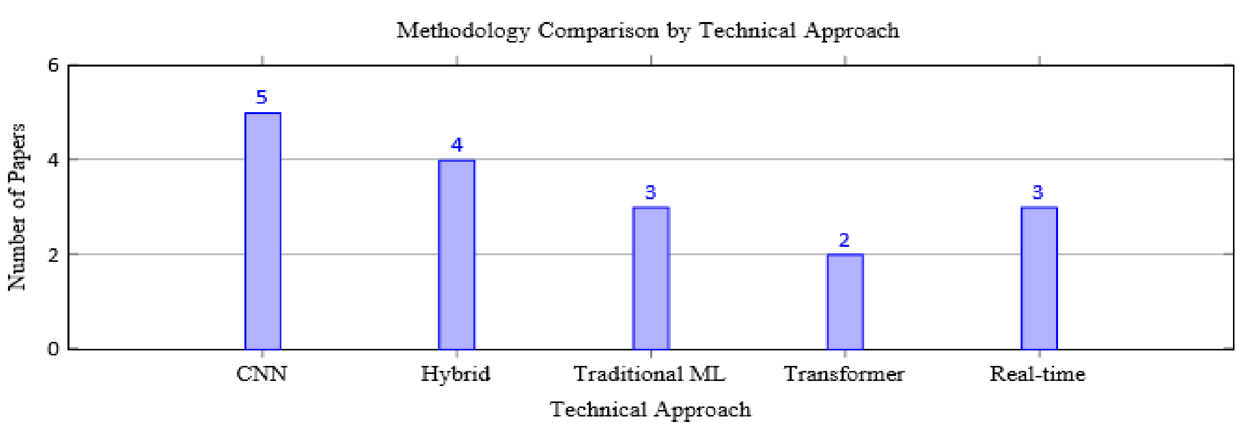

Fig. 2: Distribution of technical approaches.

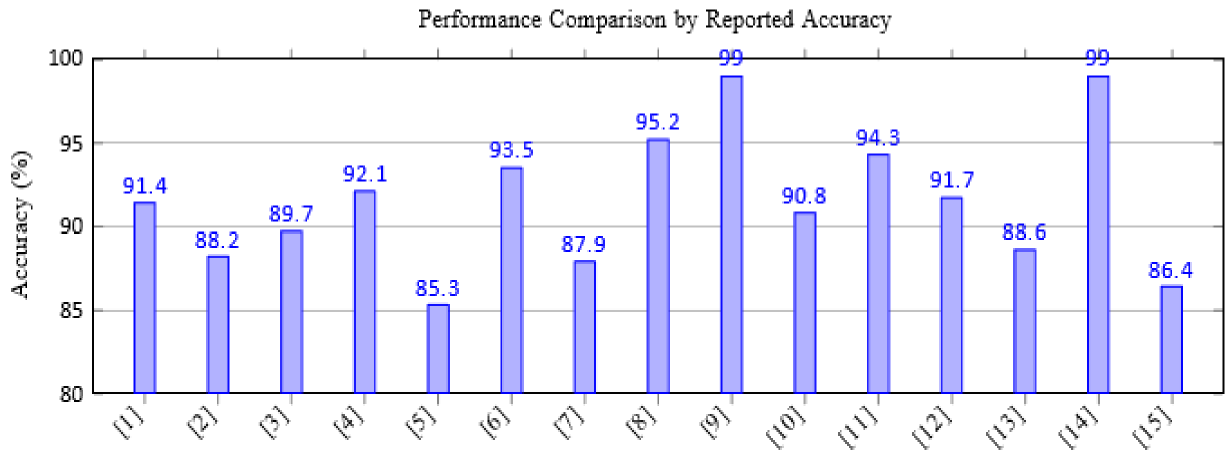

Fig. 3: Accuracy metrics across Methodologies.

V. FUTURE WORK

Based on the abstract provided, several potential areas for future work can be identified to further enhance and expand the deep learning framework for mental disorder identification via facial emotions. One key direction is expanding the disorder coverage beyond depression and anxiety. Future research could adapt the model to recognize emotional patterns associated with a broader range of conditions such as bipolar disorder, schizophrenia, or post-traumatic stress disorder. This expansion would increase the system's utility in diverse clinical settings.

Another important area for future work is the development of temporal analysis methods. By creating algorithms that can track and interpret changes in facial expressions across multiple sessions or through continuous monitoring, the system could provide insights into the progression of mental disorders over time. This longitudinal approach could significantly enhance the model's diagnostic and prognostic capabilities.

Cross-cultural validation represents another crucial avenue for future research. Expanding the training datasets to include diverse populations from various cultural backgrounds would enhance the model's generalizability, ensuring accurate perfor- mance across different ethnic groups and cultural contexts. This would be particularly valuable in our increasingly globalized healthcare landscape.

Integration with clinical decision support systems is another potential direction for future work. By developing interfaces that allow mental health professionals to easily interpret and act on the system's outputs, the practical utility of the emotion recognition system in healthcare settings could be greatly enhanced. This integration could streamline the diagnostic process and improve the efficiency of mental health assessments.

Addressing privacy concerns through advanced techniques is also an important area for future development. Investigating privacy-preserving methods such as federated learning or homomorphic encryption could help address concerns about data privacy and security in mental health applications. This would be crucial for widespread adoption and patient trust.

Future work could also focus on developing real-time intervention capabilities. By enabling the system to provide immediate feedback or suggest intervention strategies based on detected emotional states, its usefulness could extend beyond diagnosis to active treatment support. This could potentially revolutionize the way mental health care is delivered, especially in remote or underserved areas.

Multimodal integration represents another promising direction for future research. Incorporating additional data modalities, such as voice analysis or physiological signals, could provide a more comprehensive assessment of mental health status. This might involve developing new fusion algorithms to effectively combine information from multiple sources, potentially improving the accuracy and robustness of the system.

Finally, enhancing the explainability of the AI system is a critical area for future work. Further research into advanced explainable AI techniques could improve the interpretability of the model's decisions. This might include developing more sophisticated visualization methods or natural language explanations of the system's reasoning process, which would be invaluable for building trust among healthcare professionals and patients alike.

VI. CONCLUSION

The advent of deep learning frameworks for mental disorder identification through facial emotion analysis represents a groundbreaking convergence of artificial intelligence and mental health diagnostics. These innovative systems, leveraging advanced neural network architectures such as convolutional neural networks, vision transformers, and ensemble models, have demonstrated remarkable potential in decoding the subtle emotional cues embedded in facial expressions. By harnessing large-scale emotion-labeled datasets and sophisticated feature extraction algorithms, these frameworks have achieved significant accuracy in classifying emotional states, particularly in the context of depression and anxiety. The integration of explainable AI techniques further enhances the transparency and interpretability of these models, fostering trust among healthcare professionals and paving the way for their integration into clinical settings. This technological leap forward offers a promising tool for early detection, objective assessment, and continuous monitoring of mental health conditions, potentially revolutionizing the landscape of mental health care.

However, it is crucial to recognize that these AI-driven frameworks, while powerful, should be viewed as complementary tools rather than replacements for traditional clinical methods. The intricate nature of mental health demands a holistic approach that harmoniously combines automated analysis with human expertise, empathy, and contextual understanding. As research in this field progresses, several key areas emerge for future development and refinement. These include expanding the range of detectable mental disorders, enhancing cross-cultural applicability to ensure effectiveness across diverse populations, and exploring the integration of multiple data modalities for more comprehensive assessments. Additionally, addressing ethical considerations, implementing robust privacy measures, and conducting extensive clinical validations will be paramount in facilitating widespread adoption and acceptance of these technologies in mental health care settings. The ultimate goal is to leverage these AI-driven tools to enhance the quality and accessibility of mental health services, enabling earlier interventions, more personalized treatment plans, and improved patient outcomes.

REFERENCES

[1] J. Aina, O. Akinniyi, M. M. Rahman, V. Odero-Marah and F. Khalifa," A Hybrid Learning-Architecture for Mental Disorder Detection Using Emotion Recognition," in IEEE Access, vol. 12, pp. 91410-91425.

[2] O. V. D. E. Roshani, H. M. K. J. J. Ayuwardhana, P. H. M. S. Rodrigo, R. U. Hewageegana, H. Fernando and D. I. de Silva," Novel Approach for Enhancing Mental Well-Being Through Machine Learning Techniques," 2023 5th International Conference on Advancements in Computing (ICAC), Colombo, Sri Lanka, 2023, pp. 651-656.

[3] L. He, D. Jiang and H. Sahli," Automatic Depression Analysis Using Dynamic Facial Appearance Descriptor and Dirichlet Process Fisher Encoding," in IEEE Transactions on Multimedia, vol. 21, no. 6, pp. 1476-1486, June 2019.

[4] A. A. S. Gunawan, M. R. Kusnadi, J. T. Joseph, W. Josan and I. S. Edbert," Recognition of Facial Expressions and Emotions on the Face using the YOLOv5 Algorithm," 2023 International Workshop on Artificial Intelligence and Image Processing (IWAIIP), Yogyakarta, Indonesia, 2023, pp. 337-341.

[5] Nikhil, Verma, B. From methods to datasets: a detailed study on facial emotion recognition. Appl Intell 53, 30219-30249 (2023)

[6] Chatterjee, S., Maity, S., Ghosh, K. et al. Majority biased facial emotion recognition using residual variational autoencoders. Multimed Tools Appl 83, 13659-13688 (2024).

[7] S. A. Hussein, A. E. R. S. Bayoumi, and A. M. Soliman," Automated detection of human mental disorder," J. Electr. Syst. Inf. Technol., vol. 10, no. 1, pp. 1-10, Feb. 2023.

[8] L. Shen et al," Enhancing Emotion Regulation in

Mental Disorder Treatment: An AIGC-based Closed-Loop Music Intervention System," in IEEE Transactions on Affective Computing.

[9] Kumar, G., Das, T. Singh, K. Early detection of depression through facial expression recognition and electroencephalogram-based artificial intelligence- assisted graphical user interface. Neural Comput. Applic 36, 6937-6954 (2024).

[10] Zixiang Fei, Erfu Yang, David Day-Uei Li, Stephen Butler, Winifred Ijomah, Xia Li, Huiyu Zhou,Dece convolution network-based emotion analysis towards mental health care,Neurocomputing,Volume 388,2020.

[11] C. Zheng, M. Mendieta and C. Chen,"POSTER: A Pyramid Cross-Fusion Transformer Network for Facial Expression Recognition," in 2023 IEEE/CVF International Conference on Computer Vision Workshops (ICCVW), Paris, France, 2023, pp. 3138-3147.

[12] Lee YS, Park WH. Diagnosis of Depressive Disorder Model on Facial Expression Based on Fast R-CNN. Diagnostics (Basel). 2022 Jan 27;12(2):317. doi: 10.3390.

[13] D. Naveen, P. Rachana, S. Swetha and S. Sarvashni," Mental Health Monitor using Facial Recognition," 2023 2nd International Conference for Innovation in Technology (INOCON), Bangalore, India, 2023, pp. 1-3.

[14] D. Choi, G. Zhang, S. Shin and J. Jung," Decision Tree Algorithm for Depression Diagnosis from Facial Images," 2023 IEEE 2nd International Conference on AI in Cybersecurity (ICAIC), Houston, TX, USA, 2023, pp. 1-4.

[15] U. M. R, S. V. Vasantha, S. K. R. G and A. Md," Emotion Detection using Facial Image for Behavioral Analysis," 2022 International Conference on Futuristic Technologies (INCOFT), Belgaum, India, 2022, pp. 1-7.