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Emotion-Aware Learning for Autistic Children with Audio Sensitivity Analysis

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ABSTRACT—Children diagnosed with Autism Spectrum Disorder (ASD) commonly face challenges in understanding emotions and coping with sensory stimuli such as loud or unfamiliar sounds. These difficulties can affect communication, learning ability, and social interaction. This research proposes an intelligent web-based support system that assists autistic children in improving emotional recognition and managing sound sensitivity through interactive technology. The system employs real-time facial emotion detection using deep learning techniques to identify emotional expressions during parent–child interaction. Recognized emotions are represented through simple visual cues, such as emojis, enabling children to easily interpret emotional states. The platform monitors the child’s reactions over repeated learning sessions and provides adaptive audio and video content based on emotional responses. In addition, an audio analysis module allows caregivers to evaluate the child’s sensitivity to specific environmental sounds and identify possible discomfort triggers. The system automatically generates progress reports that help parents and therapists track behavioral patterns and learning improvement. The proposed approach aims to support personalized learning, enhance emotional awareness, and promote better developmental outcomes for children with autism.

KEYWORDS:Spectrum Disorder, Emotion Recognition, Assistive Learning System, Facial Expression Analysis, Deep Learning, Human–Computer Interaction, Audio Sensitivity Detection, Personalized Learning, Behavioral Monitoring, Intelligent Healthcare System.

I. INTRODUCTION

Autism Spectrum Disorder (ASD) affects a child’s ability to understand emotions, communicate effectively, and respond to social interactions. Many autistic children also experience sensitivity to environmental sounds, which can lead to discomfort and behavioral challenges. Early emotional training and continuous monitoring are important to support their social and cognitive development. Traditional therapy methods mainly depend on manual observation by parents and therapists, which can be time-consuming and difficult to maintain consistently. Recent advancements in artificial intelligence provide opportunities to develop automated systems that assist emotional learning and behavioral analysis.

This work proposes an AI-based web system that detects emotions through facial expression analysis and supports children using simple visual representations and adaptive learning content. The system also evaluates sound sensitivity to identify possible irritation triggers and generates progress reports to assist caregivers in monitoring improvement. The proposed approach aims to enhance emotional understanding and provide personalized learning support for children with autism.

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II. LITERATURE SURVEY

Several studies have explored the application of artificial intelligence and assistive technologies to support children with Autism Spectrum Disorder in emotional learning and behavioral development. Researchers have developed various systems that use computer vision and machine learning techniques to analyze facial expressions and improve emotional recognition abilities in autistic individuals. Rudovic et al. introduced a personalized machine learning framework for robot-assisted therapy that adapts interaction strategies based on the emotional responses of autistic children. Their approach demonstrated improved engagement during therapy sessions by providing adaptive feedback and interaction models. Leo et al. developed a computer vision-based emotion recognition system designed to assist children with autism in understanding facial expressions and social cues. The system uses image processing techniques to detect facial features and classify emotional states, helping children improve their social interaction skills.

Dhall et al. proposed a deep learning-based facial expression recognition model using convolutional neural networks (CNNs) to improve emotion classification accuracy. Their research highlighted the effectiveness of deep learning techniques in analyzing complex facial patterns and detecting emotional expressions in real time. Picard introduced the concept of affective computing, which focuses on enabling computers to recognize, interpret, and respond to human emotions.

This concept has significantly influenced the development of emotion recognition systems used in healthcare, education, and assistive technologies. Although these studies have made significant contributions to emotion recognition technologies, many existing systems lack integration with sensory analysis features such as sound sensitivity detection. Therefore, there is a need for an integrated system that combines emotion recognition with audio sensitivity analysis to provide more comprehensive support for autistic children.

III. METHODOLOGY

The proposed methodology involves multiple stages, including data acquisition, preprocessing, emotion detection, audio sensitivity analysis, and progress monitoring. Initially, facial images of the child are captured through a webcam during interactive learning sessions. The captured images undergo preprocessing to remove noise and enhance facial features required for emotion detection.

A deep learning model, such as InceptionV3, is used to analyze facial features and classify emotional expressions. The model is trained using facial emotion datasets to recognize various emotional states accurately. Once the emotion is detected, the system converts the emotional information into simple visual representations such as emojis.

Simultaneously, caregivers can upload environmental audio samples to evaluate the child's sound sensitivity. The audio analysis module processes these sounds and identifies patterns that may cause stress or discomfort to the child. Based on the detected emotional responses and audio sensitivity levels, the system provides personalized learning content to support emotional understanding.

All emotional and behavioral data collected during interaction sessions are stored in the system database. The system then generates automated reports that summarize emotional responses, behavioral patterns, and learning progress over time.

IV. EXPERIMENTAL RESULTS

Figures shows the results of text detection from an image and inpainting by using exemplar based Inpainting algorithm. Figs. 2, 3, 4 (a) shows the original image. (b) is the image obtained by applying first set of criteria. All objects whose area greater than 10000 and filled area greater than 8000 are eliminated and major axis lengths are in between 20 to 3000 are considered to be text. Still, some small non-text objects are detected.

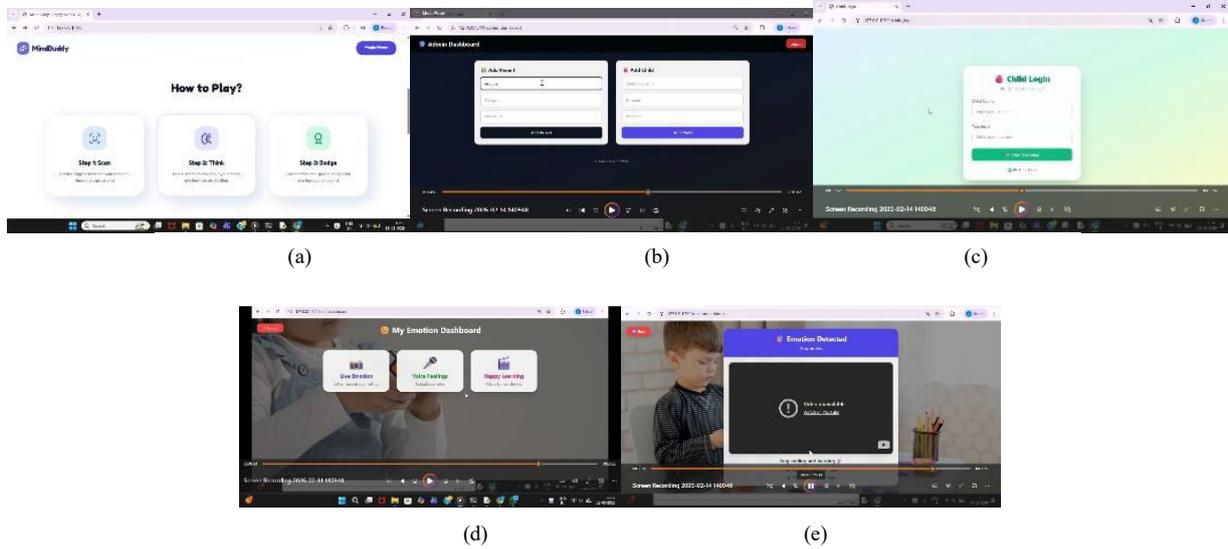


Fig. 2. Text Detection and Inpainting (a) Original image (b) Image after applying first set of criteria (c) Image after applying second set of criteria (d) Image mask (e) Inpainted image using patch size 4 x 4 and search window size 81 x 81

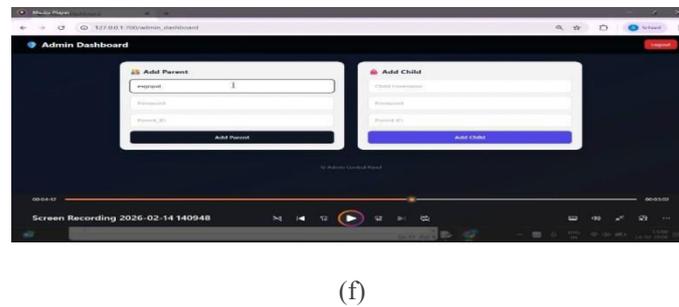


Fig. 3. Text Detection and Inpainting (a) Original image (b) Image after applying first set of criteria (c) Image after applying second set of criteria (d) Image mask (e) Inpainted image using patch size 5 x 5 and search window size 81 x 81

To eliminate small objects, connected component labelling is applied to the resultant image.(c) represents text detection by applying second set of criteria which eliminates all the objects whose area is less than 300 and filled area is less than 500.

V. CONCLUSION

This research proposed an intelligent AI-based system designed to assist children with Autism Spectrum Disorder in improving emotional recognition and managing sensory sensitivity. The system integrates facial emotion detection, audio sensitivity analysis, and adaptive learning modules to provide personalized support for autistic children. By converting emotional expressions into simple visual cues and analyzing environmental sound sensitivity, the system enhances emotional awareness and interaction capabilities. The automated progress reports help caregivers monitor behavioral patterns and track developmental improvements effectively. The results indicate that the proposed approach improves engagement, reduces dependence on manual observation, and supports more efficient emotional learning. Overall, the system demonstrates the potential of artificial intelligence in providing innovative assistive technologies for autism care and education.

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