INTERACTIVE SYSTEM WITH SPEECH THERAPY FOR CHILDREN WITH LEVEL 01 AUTISM SPECTRUM DISORDER

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MSc in Industrial Automation

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DECLARATION

I declare that this is my work, and this dissertation does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any other University or Institute of higher learning. To the best of my knowledge and belief, it does not contain any material previously published or written by another person except where the acknowledgment is made in the text. I retain the right to use this content in whole or part in future works (such as articles or books).

Signature: E.J.G.S Appuhamy Date: 2024.11.23

The above candidate carried out research for the Master's dissertation under my supervision. I confirm that the student's declaration above is true and correct.

Name of Supervisor: Professor A. G. Buddhika P. Jayasekara

Signature of the Supervisor: Date: 24/11/2024

Name of Supervisor: Dr. B. G. D. Achintha Madhusanka

Signature of the Supervisor: Date: 24-11-2024

DEDICATION

I dedicate this thesis to my loving wife and my family—my father, mother, sister, mother-in-law, and father-in-law. Your unwavering support and understanding have been my pillar throughout this journey. Your patience, encouragement, and love have been a constant source of strength, especially during the challenging phases of this research. Without your reassurance and belief in my abilities, this achievement would not have been possible. Thank you for everything.

ACKNOWLEDGMENT

I extend my heartfelt gratitude to all those who have supported and guided me throughout this project. Their contributions have been invaluable and significantly enriched this work's outcome. First and foremost, I would like to express my most profound appreciation to my supervisors, Professor A. G. Buddhika P. Jayasekara and Dr. B. G. D. Achintha Madhusanka, whose insightful guidance, unwavering support, and constructive criticism were instrumental in shaping this research. They provided invaluable expertise and encouragement at every stage, from the initial conceptualization to the final revisions. I sincerely thank Mrs. M.T.A. Sajini Perera, speech therapist, for her crucial role in identifying ASD behaviors and evaluating their unique needs in project implementation. Her dedication and expertise were pivotal in overcoming several challenges encountered during the research process.

I would like to acknowledge the support of hand I hand pre-school of special needs, Thimbirigaskatuwa, Sri Lanka which provided the necessary resources and environment conducive to conducting these research results. Furthermore, I am thankful to my colleagues and friends who provided encouragement and moral support during moments of doubt. Their belief in my abilities helped me stay motivated and focused. Lastly, I would like to acknowledge the contributions of all the researchers, scholars, and authors whose work laid the foundation for this study. Their pioneering efforts paved the way for new insights and discoveries.

In conclusion, completing this project would not have been possible without the generous support and assistance of all those mentioned above. While I have attempted to acknowledge everyone who contributed to this work, any omissions are unintentional, and I apologize sincerely. Again, thank you for your invaluable contributions and for being an integral part of this journey.

ABSTRACT

Autism Spectrum Disorder (ASD) is a complex neurodevelopmental condition characterized by social communication challenges and repetitive behaviors. Early intervention, typically before age two or three, is crucial despite the lack of a cure. Specialized therapies enhance communication, social skills, and quality of life. Severity levels range from Level 1 (least severe) to Level 3 (most severe). Speech therapy is essential for improving communication skills, using techniques to enhance speech, language, voice, and fluency. Technological innovations like facial expression and speech recognition improve diagnosis and treatment outcomes, aiding societal inclusion. The research aims to design an interactive system tailored for speech therapy for Level 01 ASD children around three. Objectives include integrating facial expression and speech recognition to enhance therapy effectiveness and developing an interactive platform for seamless communication during sessions. This approach aims to improve communication, social interaction, and therapeutic outcomes. The system includes sound and interactive touch systems for image selection and a PC-based intelligent system with a mic and webcam for interaction. Facial expression identification, interactive system engagement, and speech recognition are manually evaluated. The conclusion is based on facial expression identification, interactive system engagement, and speech recognition results. Results indicate good progress at 80%-100%, moderate progress at 50%-80%, and poor progress below 50% for Level 01 ASD children. The pre-trained facial expression recognition module effectively identifies emotions such as sadness, surprise, anger, and neutral states, integrating them into memory classification. During therapy, the system assesses similarities between typical human emotions and those of ASD children, enhancing interaction dynamics. The module includes a Haar cascade for face detection and a CNN model for facial expression identification. In the initial stage, the system uses real-time speech clips to construct the CNN model for speech recognition, aiding interaction during cartoon image selection. The overall accuracy of the developed system is 92.5% for together with speech recognition, facial expression identification and interactive platform engagement. This integrated approach aims to manage ASD symptoms effectively, improve communication skills, and enhance the quality of life for affected individuals. It underscores the importance of early intervention and personalized therapeutic strategies in supporting individuals with ASD.

Keywords: Autism Spectrum Disorder, Speech therapy, CNN development, Facial recognition, Speech recognition, TensorFlow- GPU, Interactive Platforms

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LIST OF ABBREVIATIONS

Abbreviation	Description
AI	Artificial Intelligence
IEEE	Institute of Electrical and Electronic Engineers
RNNs	Recurrent Neural Networks
CNNs	Convolutional Neural Networks
NLP	Natural Language Processing
LSTM	Long Short-Term Memory
FER	Facial Expression Recognition
HOG	Histogram of Oriented Gradients
YOLO	You Only Look Once
SSD	Single Shot MultiBox Detector
ASD	Autism Spectrum Disorder
GPU	Graphical Processing Unit
CUDA	Compute Unified Device Architecture
cuDNN	CUDA Deep Neural Network library
ROI	Region of Interest
MFCCs	Mel-frequency cepstral coefficients
GRU	Gated Recurrent Unit
STFT	Short-Time Fourier Transform
API	Application Programming interface