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NeuroRod: An Electromagnetic Reflex Game for Cognitive Enhancement in Autism Spectrum Disorder (ASD)

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ABSTRACT: We propose a game for children and old age people on the autism spectrum disorder composed of a reflex based interactive game designed to improving mental faculties and motor skills. The proposed game is envisaged as a Play therapy tool aimed at improving autistic children and old age people social and mental abilities and brain power. We investigate the effect of gameplay and analyse the impact by monitoring the performance in real time through nero rod. Aim to improve attention , execution functioning and reaction time through engaging and therapeutic game play. In our preliminary experimental study, the proposed system showed an improvement in social interaction. Collaborative Play and therapeutic potential. Our results suggest that the proposed system can be a useful tool and technology for clinical and therapeutic game play for children and old age people with ASD (Autism spectrum disorder)

I. INTRODUCTION

Autism Spectrum Disorder (ASD) is a neurodevelopmental condition marked by challenges in social communication and repetitive behaviours. Children with ASD often struggle to engage in daily and community activities due to difficulty interpreting social cues and regulating emotions. This project introduces a reflex-based interactive game designed to stimulate cognitive and motor responses in individuals with ASD. Using electromagnetic mechanisms and adaptive complexity, the game aims to enhance neurological activity through therapeutic, engaging play. The goal is to promote better interaction, reduce anxiety, and support integration into everyday environments.

II. LITERATURE REVIEW

Yang et al.^[1] emphasized the importance of involving both children with autism spectrum disorder (ASD) and their caregivers in the design of mobile electroencephalogram (EEG)-based neurofeedback training (NFT) games. Their study highlighted the need for simplified and immediate feedback mechanisms tailored specifically for children with ASD. Unlike general edutainment games, ASD-specific NFT games require unique design strategies, while further exploration of data analytics and hardware optimization is essential to develop comprehensive neurofeedback solutions in educational settings.

Lyu et al.^[2] implemented a mobile augmented reality (AR) neurofeedback training system using a consumer EEG headband with an attention index mapped to interactive egg characters in an AR environment. Engagement was validated through both single- and multi-session studies, showing that playful AR interfaces can enhance accessibility and enjoyment of neurofeedback training for autistic children.

Charman and Gotham^[3] reviewed measurement issues and concluded that screening instruments alone do not improve early detection unless accompanied by professional training. Oosterling et al.^[4] demonstrated that combining practitioner training on early signs of ASD with the use of the Early Screening of Autistic Traits (ESAT) and a structured referral pathway reduced the average age of diagnosis from 83 to 64 months. Additionally, the proportion of cases diagnosed before 24 months increased from 12.7% to 24.3%. Similarly, M.Dereu et al.^[5] introduced the Checklist for Early Signs of Developmental Disorders (CESDD) to day-care workers caring for 6808 children aged 3 to 39 months. Their results indicated moderate-to-high sensitivity (0.68) but low positive predictive value (0.10), highlighting both the potential and the limitations of such tools. These findings suggest that practitioner training and ongoing developmental surveillance are as important as the screening tools themselves.



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The DSM-5^[6] defines the diagnostic criteria for ASD, and longitudinal studies have used these criteria to examine developmental trajectories in high-risk (HR) and low-risk (LR) infants. A study by the American Psychiatric Association analyzed developmental assessments conducted at 6, 12, and 24 months, and 3 years, followed by blinded expert diagnoses.

Block Diagram:

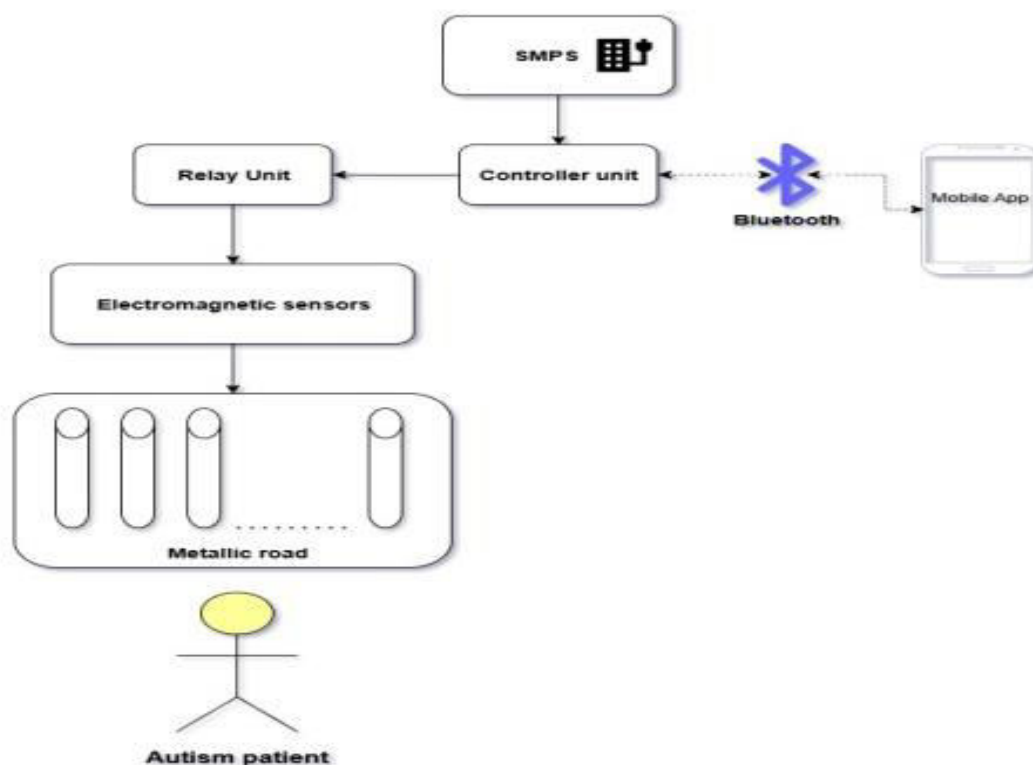


Fig 1: Basic block diagram of NeuroRod (ADS)

III. METHODOLOGY

This project employs an experimental, user-centered design to evaluate the effectiveness of an interactive reflex-based game in enhancing cognitive, sensory, and motor functions in individuals with Autism Spectrum Disorder (ASD).

1. Game Design and Mechanics

The game involves a metallic rod suspended above a platform and controlled by an electromagnetic system. The rod is released at randomized intervals and varying speeds, requiring players to catch it before it hits the ground. The unpredictability simulates real-world sensory challenges, promoting sensory adaptability and attention.

2. Participants

Participants will include children diagnosed with Autism spectrum Disorder (ASD), from young kids to old age Persons, selected through sampling with consent from caretaker.

3. Procedure

Participant will First be assessed for their current abilities in reaction time, focus and movement skills .They will then engage in game sessions over a period of [1 month], with increasing levels of difficulty targeting executive functions such as planning and impulse control.



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4. Data Collection

Quantitative data will be collected through in-game metrics such as:

- Reaction time (ms)
- Success rate in catching the rod
- Improvement across levels

Qualitative data will be collected through:

- Caregiver/therapist feedback
- Observation checklists

5. Analysis

Statistical methods will be used to evaluate improvements in reaction time and coordination. Thematic analysis will be used for qualitative data to assess behavioral and emotional responses.

6. Tools & Technology

- Controller unit
- Relay unit
- Electromagnetic sensors
- Metallic road
- Electromagnetic release system
- Game interface with feedback display
- Data logging module for performance tracking

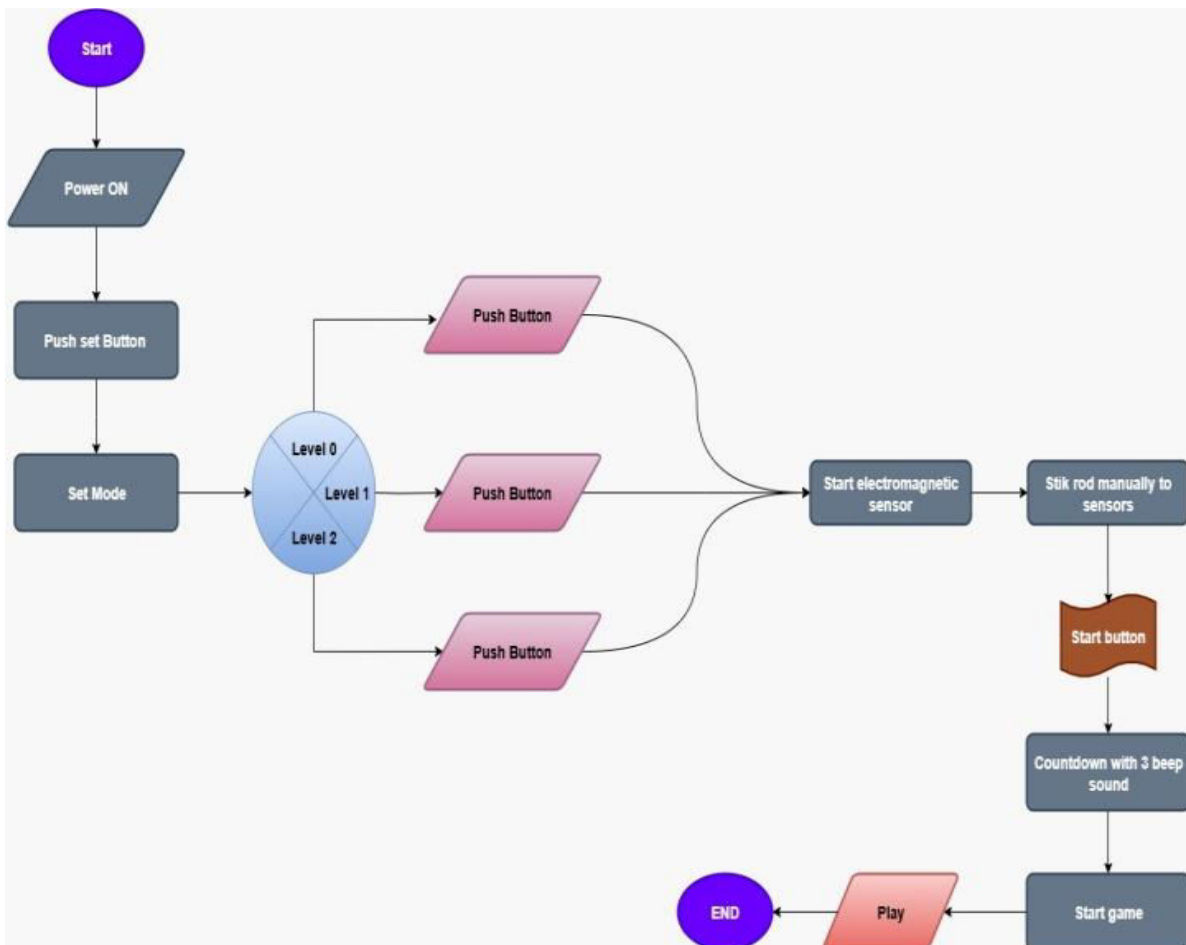


Fig 2: Flowchart of working in ADS



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IV. DESIGN IMPLEMENTATION

Table 1: Components used in project

| Component | Specification |
|----------------------|---|
| DC Electromagnet | <ul style="list-style-type: none"> • Combination of coil current and magnetic field • Provide feedback system for desired field. • Inbuilt thermal stability with overload protection |
| 12v relay sugar cube | <ul style="list-style-type: none"> • Supply voltage: 12V dc. • Coil Resistance: $320\Omega - 400\Omega \pm 10\%$ • Switching Current: 7A–10A (AC or DC) • Maximum Switching Voltage: 250V AC/30V DC • Configuration: 5-pin, SPDT (Common, Normally Open, Normally Closed) • Operating Temperature: -40°C to $+85^{\circ}\text{C}$ • Weight: $\sim 10\text{-}16\text{g}$. |
| Power LED | <ul style="list-style-type: none"> • Forward Current: Often 350mA for 1W, 700mA for 3W. • Forward Voltage (VF): 3.0V-4.0V Typically • Maximum junction temperature is usually around $120\text{-}150^{\circ}\text{C}$. |
| Relay Driver | <ul style="list-style-type: none"> • Logic voltage: compatibility with 3.3V, 5V Or higher CMOS/TTL levels. • Coil drive : strong current for break-before-make or welded contacts. • Input filter: for noise immunity. • Package type: SOT-23, TO-220, OR module format. • ESD Rating: protection against electrostatic discharge. |



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V. EXPECTED OUTCOMES OF PROJECT

- Improved reaction time, attention, and motor coordination in participants.
- High user engagement due to interactive and adaptive gameplay.
- Evidence supporting NeuroRod as a viable assistive tool for cognitive enhancement in ASD.
- A scalable framework for future therapeutic game-based interventions.

VI. CONCLUSION

NeuroRod presents a engaging and therapeutic game play. In enhancing cognitive, sensory, develops motor skills and engaging game play experience function in individual with ASD. System can be a useful tool and technology for clinical validation and therapeutic game play for children and old age people with ASD. Nero rod is a helpful tool for people with ASD. It can make therapy more engaging and effective leading to better outcomes.

REFERENCES

- [1] Z. Yang and P. An, "Designing Mobile EEG Neurofeedback Games for Children with Autism," Proc. ACM Int. Conf. Human-Computer Interaction with Mobile Devices and Services (MobileHCI), Toulouse, France, Sep. 27–Oct. 1, 2021.
- [2] H. Lyu et al., "Designing Mobile Augmented Reality Neurofeedback Training Games for Children with Autism Spectrum Disorder," 2025.
- [3] T. Charman and K. Gotham, "Measurement issues: screening and diagnostic instruments for autism spectrum disorders—lessons from research and practice," *Child Adolesc. Ment. Health*, vol. 18, pp. 52–63, 2013, doi: 10.1111/j.1475-3588.2012.00664.x.
- [4] Oosterling, M. Wensing, et al., "Early detection of autism in young children through practitioner training combined with screening," *Journal reference*, 2010.
- [5] M. Dereu et al., "Introducing the CESDD: A checklist for early signs of developmental disorders in day care," *Journal reference*, 2010.
- [6] American Psychiatric Association, *Diagnostic and Statistical Manual of Mental Disorders: DSM-5*, 5th ed. Washington, DC, USA: APA, 2013. doi: 10.1016/j.rasd.2014.07.021.
- [7] Emilia Barakova, Jan Gillissen, and Loe Feijs. 2009. Social training of autistic children with interactive intelligent agents. *Journal of Integrative Neuroscience* 8 (2009), 23–34. Issue 01.



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