The intelligent toy car review

# Reviewer #1

The manuscript describes a trial study of multi modal early screening of ASD in children. Apart from minor correction in the use of English language, following major changes are recommended.

1. Compare the present work with the following previous works that have implemented intelligent models for children with ASD

* An Experimental Trial: Multi-Robot Therapy for Categorization of Autism Level Using Hidden Markov Model. <https://doi.org/10.1177/07356331211040405>

Thanks for your suggestion the below sections will add to the related work section.

In addition to the ASD screening studies listed above, several studies focused on measuring the severity of ASD in children. For instance, Sara Ali et al. proposed a method to assess ASD levels using the hidden Markov model. They experimented on 12 children, 8 in the test group and 4 in the control group; after analyzing joint attention and imitation factors, their model accurately predicted the ASD level with 76% accuracy.

* Toddler Screening for Autism Spectrum Disorder: A Meta-Analysis of Diagnostic Accuracy <https://doi.org/10.1007/s10803-018-03865-2>

Particularly, with the recent research that provides the statistical significance of technology-based ASD screening tools like García Sanchez et al which conduct a meta-analysis on diagnosing accuracy, these methods were proven to be reliable. According to García Sanchez et al study, Their pooled sensitivity was 0.72, and the specificity was 0.98 which showed consistent statistically significant results and therefore are adequate to detect autism at 14–36 months.

* An Adaptive Multi-Robot Therapy for Improving Joint Attention and Imitation of ASD Children, <https://doi.org/10.1109/ACCESS.2019.2923678>

Our method focused on ASD screening via the analysis of children's play patterns, and our research did not address the therapeutic aspects of ASD rehabilitation in children with autism.

2. Is there any effect on attention of the child when following features are changed,

size and shape of car

speed, trajectory of car

color patterns of the car

We did not study the impact of various sizes, but based on our observations and consultation with ASD experts, we chose a car that was an appropriate size for young children to hold. However, it is an intriguing issue for further research.

While speed and trajectory were not explicitly considered in our research, the accelerations measured by the three-axis accelerometer were used to present the speed in our data processing. On the other hand, assessing trajectory requires expensive internal or external sensors beyond our cost-effective scope.

We saw no significance for the color of the intelligent toy throughout our experiments and therefore decided not to include it as a parameter in our study.

3. Please elaborate why the toy car is being called intelligent as it is not adapting itself with the requirements or needs of the child?

The intelligent toy car did not adapt to its surroundings based on the data it collected; therefore, it was called the intelligent toy car to differentiate it from a regular toy car that lacked the equipment to gather data from playing patterns. In the future, it may include the capability for evaluating the acquired data locally and responding to the ASD status.

4. Please provide some statistical analysis for your results showing significance of the data.

# Reviewer #2

The authors propose an intelligent toy car as a tool combined with a simple Support Vector Machine classifier for screening children with ASD.

The idea is very interesting and it is extremely important to study a non-invasive approach that can be used during a non-stressful evaluation session, particularly with children.

To make the motivations stronger, the authors should include some recent state-of-the-art studies that support this idea, such as:

Li, Jingzhen, et al. "Non-invasive monitoring of three glucose ranges based on ECG by using DBSCAN-CNN." IEEE Journal of Biomedical and Health Informatics (2021). <https://doi.org/10.1109/JBHI.2021.3072628>

Bertini, Flavio, et al. "Automatic Speech Classifier for Mild Cognitive Impairment and Early Dementia." ACM Transactions on Computing for Healthcare (HEALTH) 3.1 (2021): 1-11. <https://doi.org/10.1145/3469089>

Enayati, Moein, Nasibeh Zanjirani Farahani, and Marjorie Skubic. "Machine Learning Approach for Motion Artifact Detection in Ballistocardiogram Signals." Proceedings of the 14th EAI International Conference on Pervasive Computing Technologies for Healthcare. 2020. <https://doi.org/10.1145/3421937.3421970>

We are forced to rely on methods such as SVM and random forest algorithms to distinguish between children with ASD and typically developing children due to the limitations of collecting behavioral data, such as the limited number of test cases, particularly in situations such as COVID19, as well as the requirement of a sufficient amount of data for developing neural networks such as MLP or Deep networks such as CNN and the lack of trained networks for similar types of data. As a result, the articles indicated above are beyond the scope of our study.

Moreover, the authors should discuss classification results using different methods or at least motivate better way only SVMs.

Based on the previous study on intelligent toy car which analyse different classifier architecture for this purpose and select SVM as a suitable option, we extend conducted research and add different modality to improve accuracy and reliability. Although amid previous available data which support the application of SVM, we tested other classifiers like random forrests and KNN on collected data. Our experiments did not show any improvements by adopting other types of classifiers so consequently, we propose SVM as our classifier architecture.

Minor comments:

Introducing acronyms: the first time you use the term, put the acronym in parentheses after the full term.

Check figures and tables descriptions

Review typos

# Reviewer #3

This paper presents an extension of an intelligent toy car functionalities by adding shaft encoders to detect attention to details and interest in rotating objects in children with ASD, Using the two modalities to detect different ASD symptoms improved our screening accuracy by more than ten percentage.

the paper is well organized and presented according to the respect of the template of the journal.

However, a comparison part against a similar methodology (other than the authors' own method) is strongly recommended for publication in a similar journal.

I advise you to highlight a comparison subsection in which you demonstrate the consistency and robustness of the methodology used in this paper.

Due to our relatively innovative idea of using accelerometer data for ASD screening, particularly augmenting these types of sensors with ordinary toys, we couldn’t find any similar study for comprehension. However, we mentioned a few studies in related works sections such as “Capturing Play Activities of Young Children to Detect Autism Red Flags” and “Detection of Motion Disorders of Patients with Autism Spectrum Disorders” that was closer to our research.