CHILD EMOTION DETECTION THROUGH FACIAL EXPRESSION RECOGNITION USING MACHINE LEARNING

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ABSTRACT

Facial expression recognition (FER) plays a crucial role in understanding human emotions and behaviors, particularly in the context of child development and attention assessment. This study presents a novel approach for detecting and classifying facial expressions in children to analyze their attentional states using Support Vector Machine (SVM) algorithm.

The proposed system utilizes a large dataset of facial images of children captured during various attention-demanding tasks. Preprocessing techniques are applied to extract relevant facial features, including key points and facial landmarks. A feature extraction process based on deep learning is employed to represent high-dimensional facial information in a compact manner. Next, the extracted features are fed into an SVM classifier to categorize facial expressions into distinct attention states, such as focused, distracted, and neutral. The SVM model is trained and optimized using a cross-validation approach to achieve optimal performance and generalization ability.

The performance of the proposed system is evaluated using a comprehensive set of metrics, including accuracy, precision, recall, and F1-score, to assess the classifier's ability to discern different attention levels accurately. The results demonstrate the efficacy of the SVM-based approach in accurately identifying child attention states based on facial expressions. The developed system offers valuable insights into understanding children's attentional patterns and can be utilized in various practical applications, such as educational settings, child psychology, and child-care centers. Additionally, it lays the groundwork for further research and development of more sophisticated models to assess attention-related behaviors in children, potentially leading to early detection and intervention of attention-related disorders. However, challenges related to the generalization of the model across diverse cultural and demographic contexts need to be addressed to enhance its applicability and inclusiveness.

Keywords: Facial expression recognition, SVM algorithm, child attention, feature extraction, deep learning, attention assessment.

1. INTRODUCTION

Purpose

The main purpose of this project is to identify Child Attention through Facial Expression Recognition by using SVM Algorithm.

Scope

Deciding the capacity of kids to center in an exceptionally youthful age is something that is vital for grown-ups to know for them to comprehend the kid's learning capacity. The advancement of their consideration abilities during their more youthful years influences how a lot greatness they can perform during their youth stage. Since most consideration identification investigates are much of the

time done through eye look location, this exploration is centered around identifying the consideration of a kid through looks.

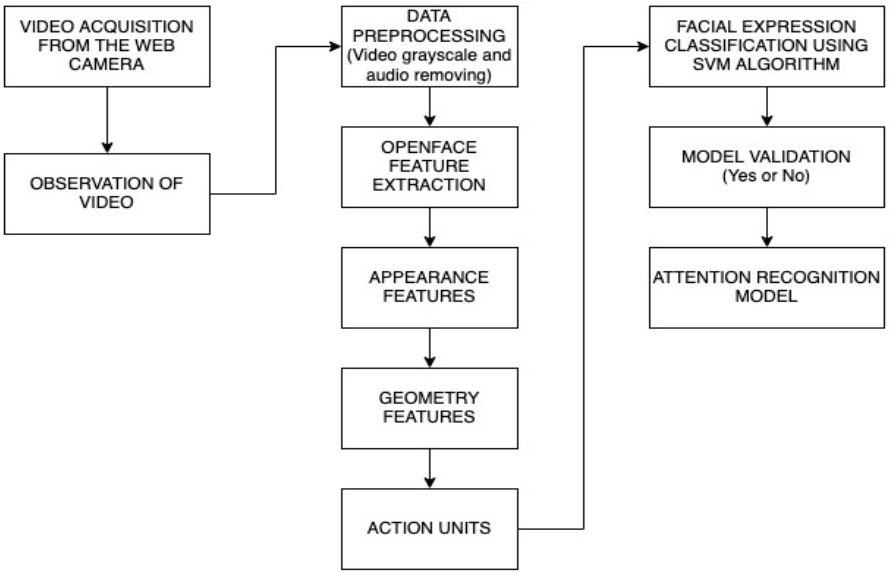

Fig. 1: Model to detect child attention.

Attention is considered essential for learning. Educators often discuss attention as a general mental state where the mind focuses on a particular feature of the environment. There is good evidence that attention skills firmly predict educational achievement for all students, not just those suffering from attention deficit hyperactivity disorder (ADHD). An effective attention system has effects that are beneficial which can be noticed very early in development.

The attention skills of a child can predict his or her intelligence as an adolescent creating a difference of up to 20 IQ points in combination with environmental differences. In several academic institutions, students are now required to have their own laptops or tablets, stable internet connection, and most instructors prefer to use e-learning tools in discussing their lessons and administer assessment of student understanding. Navigating on the internet can result in cognitive overload for an average user, and for a student with ADD/ADHD it may be impossible to stay focused and remain on-task. The analysis of facial expression is quickly starting to become a scope of great interest in the society of human computer interaction design and computer science. The most demonstrative and suggestive way humans show their emotions is through their facial expressions. According to the child psychologist that the researchers have consulted, examining the child's facial expression will help determine the child's emotional state and then identify how these emotional states are linked to the child's comprehension and understanding of the subject.

The combination or set of algorithms applied in previous studies relating to attention detection and facial expression recognition focused on the area of the eyes, particularly the eye gaze of the person. This paper gives an opportunity to do further research by adding more facial features such as the mouth and brows hoping to contribute to the progressing research on modern developments of more accurate models for attention detection system.

2. LITERATURE SURVEY

[1] Piontkowski, D., & Calfee, R. (1979). Attention in the Classroom. Attention and Cognitive

Development, 297–329. doi:10.1007/978-1-4613-2985-5_11].

Trying to observe instruction in an active first-grade classroom can be a humbling experience. So much is going on and the distractions are so many, the wonder is that teacher and student make any sense of the situation. Yet they generally do—instruction and learning go on with a fair degree of success. The critical factor is attention. When the observer's attention is properly focused, when he has learned what to look for and what to ignore, significant patterns become clear to him. Likewise, teacher and student work together effectively when each attends to the situation in an active, selective fashion.

[2] Breslau, N., Breslau, J., Peterson, E., Miller, E., Lucia, V. C., Bohnert, K., & Nigg, J. 2010. Change in Teachers' Ratings of Attention Problems and Subsequent Change in Academic Achievement: A Prospective Analysis. Psychological Medicine, 40(1). 2010. 159-166.

Background: Recent research has documented a link between attention problems at school entry and later academic achievement. Little is known about the association of change in attention problems during the early school years with subsequent change in academic achievement.

Method: A community-based cohort was followed up and assessed for attention problems at ages 6 and 11 (Teacher Report Form; TRF) and for academic achievement in math and reading at ages 11 and 17 (Woodcock-Johnson Psycho-Educational Battery). Complete data were available on 590 children (72% of the initial sample).

Results: Change in teachers' ratings of attention problems from age 6 to age 11 was negatively associated with change in math and reading from age 11 to age 17, controlling for children's IQ and family factors. Externalizing problems had no significant association with change in math or reading, when added to the multivariable model.

Conclusions: Increases in teacher-rated attention problems from age 6 to age 11 were followed by declines in academic achievement from age 11 to age 17; decreases were followed by gains. The results underscore the need for research on the course of attention problems, the testing of interventions to address children's early attention problems and the evaluation of their effects on subsequent academic achievement.

[3] Sigman, M., Cohen, S. E., & Beckwith, L. (1997). Why does infant attention predict adolescent intelligence? Infant Behavior and Development, 20(2), 133-140.

Ninety-three 18-year-olds were tested with measures thought to tap information processing, sustained attention, executive function, and intelligence. The visual fixation patterns and home rearing conditions of these adolescents, born preterm, had been observed in early infancy. Infant fixation durations were negatively associated with information processing, executive function, and intelligence scores but did not predict ability to sustain attention. Continuity between infant attention and adolescent intelligence was moderated by qualities of the home environment so that "short-looking infants" whose caregivers vocalized a great deal had mean intelligence quotients that were 20 points higher than "long-looking infants" with less vocal caregivers. The results suggest that at least some of the continuity between infant attention and adolescent intelligence stems from infant capacities to process information efficiently and to inhibit prepotent responses and that this continuity is affected by caregiver responsiveness.

[4] Assiter, K. (2008). Attention and learning in the connected classroom. Journal of Computing Sciences in Colleges, 24(1), 219-226.

Increasingly, students are spending a large percentage of their time connected to the internet (in and

out of the physical classroom), and instructors are using online tools to disseminate course information and administer assessment of student understanding. In fact, homework assignments are often completed on students' personal laptops while they're connected to the internet. Traditionally, the course instructor directed student attention to relevant material during lecture. Increasingly, students self-navigate to course material online, and, as a result, they must resist distracting elements such as advertisements, social networking invitations, entertainment sites and contentheavy web pages. Staying focused on academic tasks while online must be difficult for today's student; and almost impossible for students with ADD/ADHD. This paper describes a preliminary study of the impact of online learning on student productivity, part of an ongoing investigation into methods, tools and techniques for improving attention and learning in the connected classroom.

[5] Stipek, D., & Valentino, R. A. (2015). Early childhood memory and attention as predictors of academic growth trajectories. Journal of Educational Psychology, 107(3), 77.

Longitudinal data from the children of the National Longitudinal Survey of Youth (NLSY) were used to assess how well measures of short-term and working memory and attention in early childhood predicted longitudinal growth trajectories in mathematics and reading comprehension. All predictors were significantly associated with academic achievement and years of schooling attained, although the latter was at least partially mediated by predictors' effect on academic achievement in adolescence. The relationship of working memory and attention with academic outcomes was also found to be strong and positive in early childhood but nonsignificant or small and negative in later years.

3. PROPOSED SYSTEM

The proposed system shows that based on a child's facial expression, it can determine their attention skills which has given accurate results. A total of forty (40) grade one (1) students took part in this research. The data gathered was in the form of a recorded video obtained from the web camera. Each video was processed frame by frame to extract necessary facial features that is needed in determining the facial expression through OpenFace application.

The SVM algorithm was used in training and testing the model's validity. The model is written in a Java Programming Language and has an output of a subtitle file which will be imported into the recorded video. From there, the subtitle file has a label of the student's facial expression, thus determines their attention. To determine the predictive power of the model, K-fold cross validation method was used.

Advantages

The accuracy of detecting the facial expression of the subjects through the given regions of interests (brows, eyes, mouth) and necessary data – appearance features, geometry features and action units of the student's face is limited to the capability of the software that does the feature extraction.

Constant head movements, side view faces and positions where the entire region of the face cannot be completely seen or detected by the software decreases the accuracy of determining the facial expression. Upon acquiring the features, the model acquired a 74.49% for accuracy in detecting attention.

4. RESULTS AND DISCUSSIONS

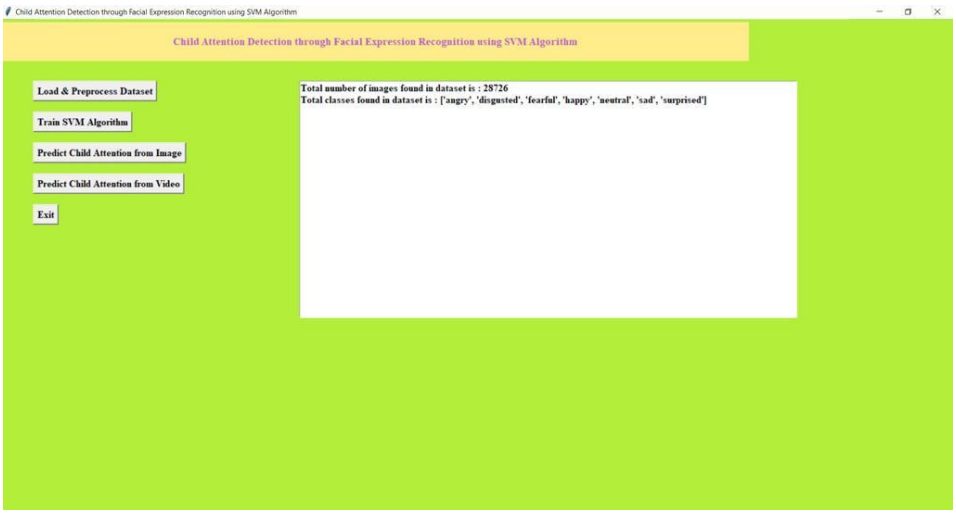

Fig. 2: Load and Preprocess Dataset

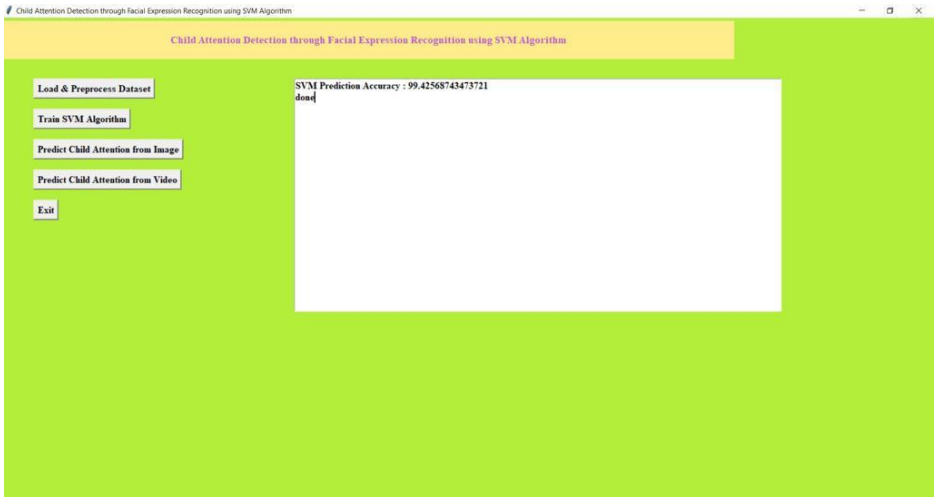

Fig. 3: Train SVM Algorithm

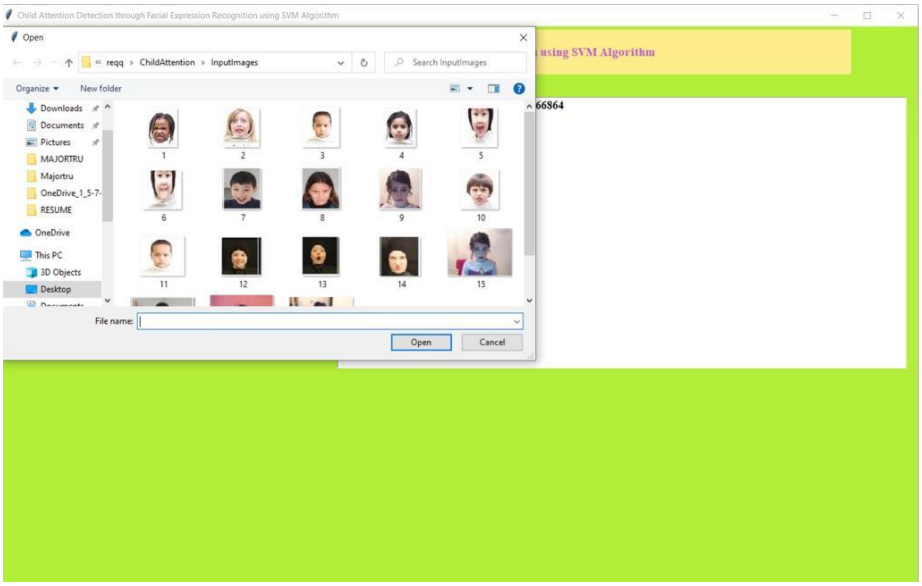

Fig. 4: Selecting and uploading .png file.

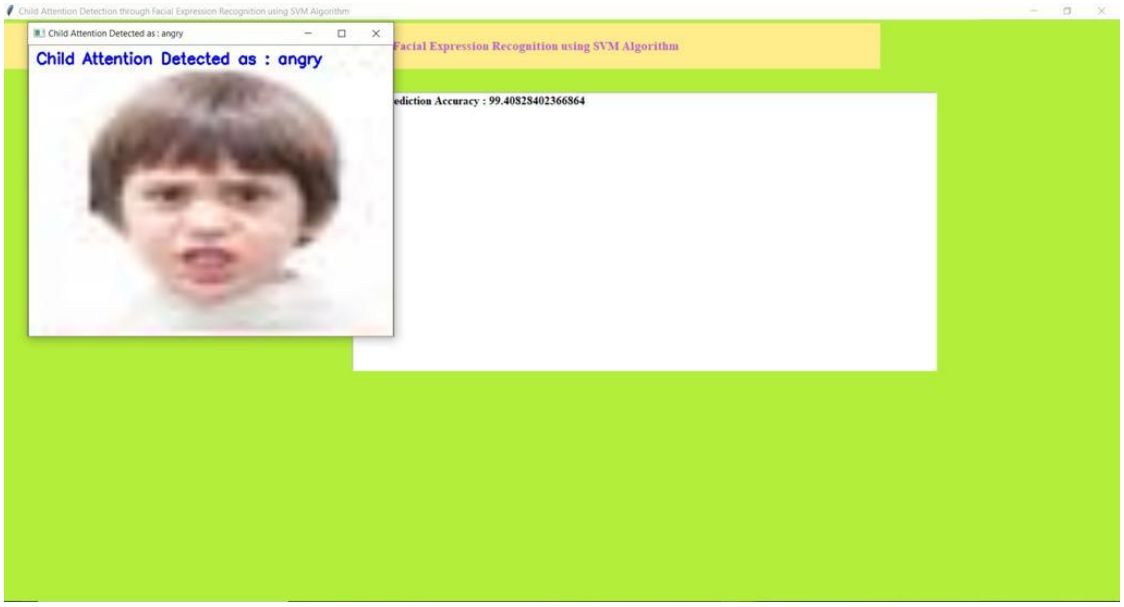

Fig. 5: Predicting child attention from image.

5. CONCLUSIONS AND FUTURE SCOPE

This study shows evidence that facial expressions can be a means to detect and recognize attention through children of younger ages. The more likely they react and express themselves through their faces, the possibility of them being attentive is higher. The subjects that were detected with multiple expressive faces resulting them to be very attentive, were also the same subjects that had higher scores during the test and interview.

The accuracy of detecting the facial expression of the subjects through the given regions of interests (brows, eyes, mouth) and necessary data – appearance features, geometry features and action units of the student's face is limited to the capability of the software that does the feature extraction. Constant head movements, side view faces and positions where the entire region of the face cannot be completely seen or detected by the software decreases the accuracy of determining the facial expression. Upon acquiring the features, the model acquired a 74.49% for accuracy in detecting

attention.

The researchers recommend using a longer video for the subjects to watch since the researchers had only used a 10 – 15-minute video. This would also give the opportunity for them to compare their expressions if they are still that expressive during the first few minutes and during the last few minutes.

Future Scope

The facial expressions in this study were limited to happy, sad, angry and surprised, it would be better to add more facial expressions for future researchers. And lastly, trying this in different age groups to see if children from younger or older ages can still use facial expression to detect attention.

Based on the information collected and modeled (until May 15, 2020), we can affirm that, by changing the relationships of the air flow, the risk of a second outbreak of COVID 19 can be minimized; however, we cannot quantify how much it can help.

REFERENCES

[1] Piontkowski, D., & Calfee, R. (1979). Attention in the Classroom. Attention and Cognitive Development, 297–329. doi:10.1007/978-1-4613-2985-5_11]

[2] Breslau, N., Breslau, J., Peterson, E., Miller, E., Lucia, V. C., Bohnert, K., & Nigg, J. 2010. Change in Teachers' Ratings of Attention Problems and Subsequent Change in Academic Achievement: A Prospective Analysis. Psychological Medicine, 40(1). 2010. 159-166.

[3] Sigman, M., Cohen, S. E., & Beckwith, L. (1997). Why does infant attention predict adolescent intelligence? Infant Behavior and Development, 20(2), 133-140.

[4] Assiter, K. (2008). Attention and learning in the connected classroom. Journal of Computing Sciences in Colleges, 24(1), 219-226.

[5] Parcon, Apryl Mae. (2018, October 24). Interview.

[6] Stipek, D., & Valentino, R. A. (2015). Early childhood memory and attention as predictors of academic growth trajectories. Journal of Educational Psychology, 107(3), 77

[7] B. Kort, B. Reilly, and R. Picard. 2001. An Affective Model of Interplay between Emotions and Learning: Reengineering Educational Pedagogy - Building A Learning Companion. In Advanced Learning Technologies, 2001. Proceedings. IEEE International Conference on. IEEE, Madison, USA, pp. 43– 46

[8] Zaletelj, J. (2017, September). Estimation of students' attention in the classroom from kinect features. In Image and Signal Processing and Analysis (ISPA), 2017 10th International Symposium on (pp. 220-224). IEEE. –878, 2010.