[1]K M Manjuath,[2] Dr.V.Vijayaraghavan

Turkish Online Journal of Qualitative Inquiry (TOJQI)
Volume 12, Issue 8, July, 2021:7403 – 7413

Research Article

Estimation of Adverse Drug Effect in Autism Children through Repetitive behavior Analysis from Thermal Video Processing and Machine Learning Algorithms

[1]K M Manjuath,[2] Dr.V.Vijayaraghavan

1K. Manjunath

Assistant Professor, VIGNAN'S Deemed to be University Research Scholar, Guntur,

2 Dr.V.Vijayaraghavan

Associate Professor, VIGNAN'S Deemed to be University, Guntur,

Abstract

In this review paper, the adverse drug effect in autism children is studied after consuming the prescribed drug dosage level suggested by Physicians through computer vision-based physiological monitoring. The prescription of drug and dosage level for the autism children is done after clinical signs such as repetitive behaviour, dyspraxia, abnormal gait, and abnormality of motor functions for accurate prescription of drug dosage level. Autism children need more effective and continuous monitoring for assessment and measurement of clinical signs. The continuous and effective monitoring of autism children for the clinical sign is a challenging task for any physician. In this paper, the above problem-solve through the Drug Based Autism Child Repetitive Behaviour Estimation (DARBE) method, which is continuous monitoring of the autistic child by a thermal imaging system. Thermal imaging captures the autistic child repetitive behaviour analysis, spatial temperature levels are recorded for measurements such as Mood assessment, heart rate, and variability, finger temperature, and the temperature of the skin. The thermal imaging and logistic regression predicts the clinical signs of autistic children through thermal video processing for accurate dosage level perception and avoids adverse drug effects because of over/under dosage level of drugs.

Keywords : Autism Disorder, Machine-Learning, Thermal Image Camera, Adverse Druf Effect

1. Introduction

Autism Spectrum Disorder (ASD), a neurodevelopment syndrome occurs at an early age of the child. Few children with ASD may dwell without dependence and may need lifelong care and needs support due to disability. ASD varies in children through intellectual disability syndrome and features by the cognitive shortfall in mental abilities such as abstract thinking, a problem facing and solving ability, and many children with attention-deficit. An autistic child fails to make normal relations with other individuals. Nowadays, ASD is predicated at eighteen months based on the kid's social interaction but many kids are detected only at three years or in the first step to their schools. The different types of Autistic disabilities are Autistic Disorder, Asperger's Disorder, Childhood Disintegrative Disorder, Rett's Disorder, and Pervasive Developmental Disorder-Not Otherwise Specified. Autistic Disorder, a type of individuals delay with social interaction, stereotyped patterns or behaviors interests, and restricted repetitive. This disorder affects the individual's motor skills, lack of eye contact, and may have a fixation on specific parts of an object that are viewed by the individuals. Asperger's syndrome, characterized as a unique ASD because they have normal communication/language development, though they have difficulty in understanding normal conventional social rules or lack of understanding of other's behaviors.

Childhood Disintegrative Disorder (CDD) is also called as regressive autism. It is characterized in the age of 2 to 4 years of normal development followed by the onset of autism symptoms like severe and sudden reversals in language, motor skills, social interaction, and behaviors. Rett's Disorder is a neurological disorder and affects only the girl baby. The children with Rett's syndrome have slow growth when they are between 12 to 18 months

age and their head is usually small in size. Depending on the child, Rett's syndrome shows different symptoms such as breathing, sleep problems, teeth grinding, stereotyped patterns and slowly they lose their abilities in each level of their age. Pervasive Developmental Disorder Not Otherwise Specified children has impairments in social communication such as interactions or often repetitive behaviors like Hand-flapping, rocking, twirling, or jumping. They may have a lack of eye contact, trouble in controlling emotions, and high-pitched. Speech Sound is the articulation of the phoneme, as individual sounds, which combines the spoken words. Speech echo generation needs phonological knowledge of speech sounds and the power to align movements of articulators, such as jaw, tongue, and lips with the breathing and the vocalizing for the speech. For an autistic child at the age of 4, the entire speech will be unintelligible and at the age of 2 years, 50% of the speech will be understandable. The Characteristic Features of ASD Impaired Social Interaction, Behaviour Patterns, Cognitive Problems, and Sensory Aspects are shown in Figure 1.

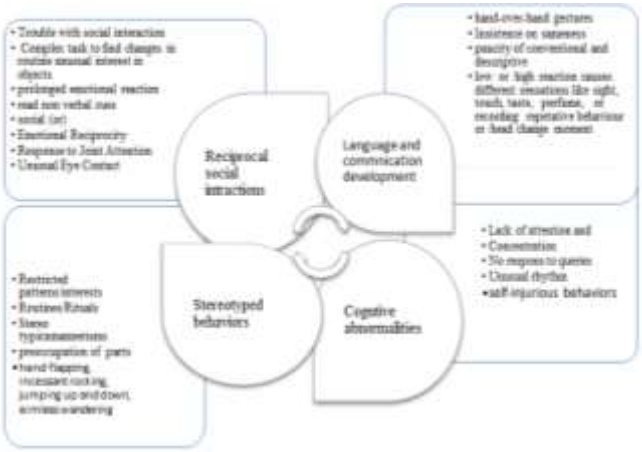

Fig. 1. ASD Child behaviour and abnormalities

The autism diagnoses can be integrated with machine learning algorithms for more precise analysis in this review, concentrates on the application of Machine learning methods and algorithms in ASD diagnosis. Most image processing algorithms are applied in ASD and such algorithms are initially reviewed. In addition, the review focuses on machine learning algorithms in image processing in various areas such as Feature mapping, Image registration, Image Classification through algorithms such as artificial neural networks, convolutional neural networks (CNNs).

2. Machine Learning Algorithms in Image Processing For ASD Prediction

The review focuses on the scope of logistic regression algorithms used in electronic medical records (EMRs) and predicts ASD in an early stage. The performance metrics of each classifier such as logistic regression algorithms including multilayer perception random forest methods in detecting ASD with more accurate and efficient, predicts the earlier stage of ASD in a small or large group of child-targeted [1]. However, more accuracy in detection requires more data set. From the larger data sets, detection of autism and mental ability disorders in the child is possible Figure 2 shows the detection of ASD in the early stage (Leo et al., 2015).

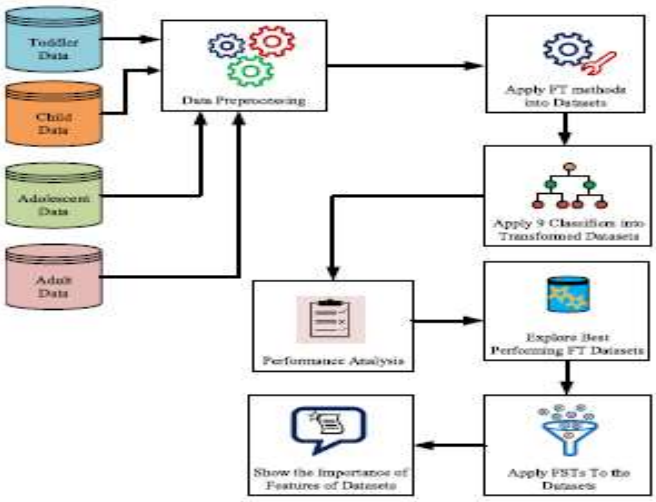

Fig. 2. Detection of ASD at an early stage fro in different ages groups

Autism detection through a set of rules by applying Rules-Machine Learning (RML) algorithms in autistic traits cases and Results shows identification in toddlers is very difficult (Thabtah & Peebles, 2020).to Speeding up the process in ASD detection is done through Random forests support vector machine with Naive Bayes features which achieve an accuracy of 87% than other models in terms of efficiency (Lee et al., 2019). Moreover, facial emotions predict the facial expressions and also various parameters such as Skin temperature, artistic child behavior through Thermal imaging and applications in computer vision algorithms Support Vector Machine (SVM) classification algorithms predict Infrared thermal facial images and Principal component analysis (PCA) and estimate the mental description for autism child (Raj & Masood, 2020). Autism child repetitive behaviours are estimated using Logistic Regression, neural networks, and Ridge Classifier and predicts the repetitive behavior. The study was limited only to Autistic children, not with non Autistic children (Thabtah et al., 2018). However, Emotions and behavioural study from facial expressions of thermal images are Adopted through various methods such as K nearest neighbour algorithm, Linear Discriminant Analysis, linear models to identify the facial expressions from thermal images and also identify the various levels in autism through prediction performance metrics and emotions of the artistic disorder (C.M.Naveen Kumar, 2017).Autistic child learning aptitude and social abilities identify by applying Hybrid models such as PCA+PSO+SVM and Autistic child aptitude algorithms to predict with high accuracy was viable to enlarge the survey by utilizing diverse classification (Mohamed Shanavas, 2015) ASD detection from the face, eye movement, and behaviours by applying SVM classifier and estimate performance metrics such as ROC and AUC curves to achieve good accuracy, sensitivity and the specificity of different regions of face image Figure 3 shows the flow diagram of ASD classification (Liu et al., 2016).

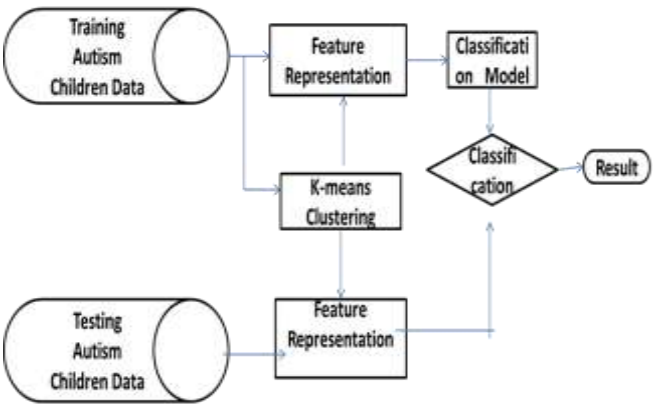

Fig. 3. ASD Classification through Classifier Algorithms

Autism detection through continuous monitoring and behavioural analysis using Machine learning algorithms and predicts by metrics such as sensitivity and specificity from Data set which contain fewer samples .Autism

detection from brain images and Clinical models compared with classifiers such as Support Vector Machine, Random Forest and Deep Neural Network produces more Accuracy, which is proportional to data set size (Heinsfeld et al., 2018). Autism detection from MRI scan images through SVM classifier and Extracts the features such as time, frequency, and Stock well transform. To estimate the performance of the children's accomplishment to learn novel skills are transforms and applied. A manual diagnosis of ASD takes more time to identify the diagnosis (Yoo, 2015). Early detection of autism can be done through video monitoring and Logistic regression algorithm [3].

3. Study on the Adverse Drug Effect (ADE) in Autism Children

The Adverse Drug Effect (ADE) in autism children through repetitive behaviors such as violence (i.e. crimes against persons), in-person threatening and theft-related behaviors, verbal/physical debate/manner misbehaving, fighting, damage the property, and school policy violations are analyzed through thermal camera monitoring. The severity of ADR predicts through thermal imaging and machine learning for repetitive behaviors from recorded thermal video and analysis. The dosage level of the autistic child is suggested after evaluating the in thermal images through a machine learning algorithm for behavior analysis. Fig.no.6 shows the Drug Based Autism Child Repetitive Behavior Estimation (DARBE) method for adverse effects in the artistic child after extracting various features such as heartbeat rate, Mood assessment, heartbeat rate variations, finger temperature, and Skin temperature from thermal images. The data set comprises of the drug intake level and extracted features from the thermal images..

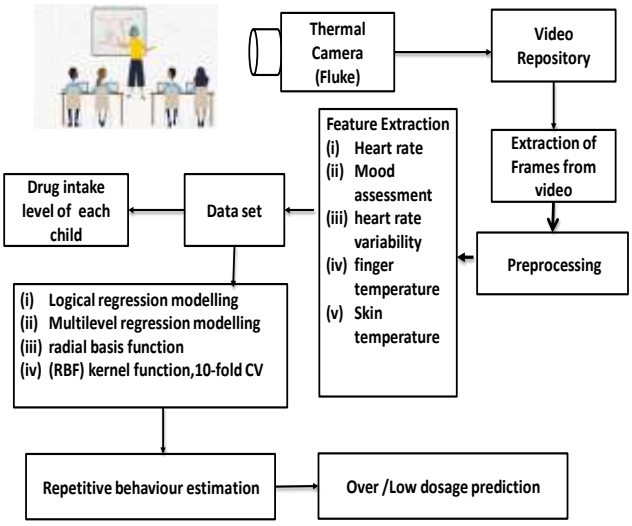

Fig. 6. Proposed DARBE method on the Adverse Drug Effect (ADE) in Autism Children

The drug symptoms in the Children's age groups of 6 to 12 are the defeat of hunger, sleeplessness, abdominal pain, exciting accountability, sickness, anxiety, vomiting, excitement, and despair. In Adolescents of age within 13 to 16, the common adverse drug effect reactions are (≥5% and with a superior rate than on placebo) loss of taste, wakefulness, abdominal pain, weight loss, dry mouth, headache, mood, blurred vision, difficulty having a bowel movement and nervousness. Were as nausea, anxiety, agitation, and dizziness. The machine learning algorithms predict repetitive behavior and estimate the dosage level from the correlation of data set and the current image obtained from the thermal camera. Table 1 shows the Adverse Drug effect of autism children

Table 1 Adverse Drug Effect of Autism Children

Medicine	Adverse Drug Effect
Clonidine	Fever, irregular heartbeat, flaking of the skin raised red swellings on the skin, skin rash
Buspirone	Heat pain, confusion state of mind ,fast or pounding heart pumping, fever,

	incoordination, mental stress
Donepezil0	Diarrhea, loss of desire, influence cramps sickness, problem in sleeping
Riluzole	amnesia, fair skin, fast heartbeat , considering, hearing, or sensation of things can not be recognize
Diazepam	blurred vision, fast feeling sad, yellow eyes or skin
Zolpidem	Chest pain, hives, itching, or skin rash
aripiprazole	distorted hallucination, trouble with a intestine movement, dehydrated mouth, panic, passion,
risperidone	Aggressive behavior
Trazodone	blurred vision, nervousness, slow or fast heartbeat

4. Visual Interpretation of Autistic Child Due to Over dosage

Thermal imaging is used to investigate a wide range of diseases where the temperature of the skin may withstand for the Presence of inflammation in the underlying tissues or where the blood flow is increased/decreased due to a clinical irregularity. Actually, many physicians need thermal imaging cameras to detect a variety of medical circumstances such as recurring strain injury, power pain, and circulatory issues Table. 2 shows the diagnosis of disease and neuropathic through the thermal image and Table 3 shows ASD Diagnosis for MRI and CT Images

Table 2 The Thermal Image in diagnosis and disease identification

Author/ Year	problems	Methodology/ algorithms	Advantage/ Disadvantage
(Kopaczka et al., 2019)	Thermal Infrared Image camera predicts the Facial Landmarks and facial behaviour analysis.	Cross-validation of identification facial landmark prediction, face tracking, and facial head moment detection from point annotation applying for suitable training data.	thermal camera limits narrow field depth and identifies behaviour analysis .
(Cruz-Albarran et al., 2017)	Infrared Thermal image diagnoses emotions such as joy, nauseate, angriness, fearfulness, and perpetual sadness	a therm that diagnoses of autism children feelings was obtained and it was experienced on six twenty-five subjects (Thermograms	The favourable position of IR Thermal cameras using as a non-obtrusive framework, it can anticipate future investigations connecting IR camera with behavior analysis and which in turn are seen as is there intelligent life of system..
(Fernández-Cuevas et al.,2015)	sorting parameters to determine the use of Infrared thermal system for humans	Infrared thermography (IRT) predicts the skin temperature of humans.	further investigation needs to determine the indefinite pressure with most of the parameters of skin temperature.
(Cardone et al., 2015)	Infrared thermal image predicts topological theoretic state and its ability to monitor physiological activity.	From the thermal IR image derived from reflexive tracked region of interest and added acoustic activity reduction by two-stage algorithm to be discards difficult to trace frames causes bad results	Detecting a specific emotional state of person There were no specific studies for this moment.
Christiane Goulart(2019)	Infrared Thermal Imaging is an attracting attention to record variations of the skin, emotions such as	Attracting attention technique for Infrared Thermal Imaging is used for recording thermal variations on various parameters	Precise thermal video cameras with enough temperature sensitivity and computative resolution,

Author/ Year	problems	Methodology/ algorithms	Advantage/ Disadvantage
	happiness and sadnesson the facial expressions.	such as skin, mood assessment and also using Thermal Video Processing and Facial Detection techniques.	are becoming expensive
(Lin et al., 2020)	Extracted feature of proposed method reactively as well as regenerates the feature thermal image and image matrix.	Deep learning and random forest methods predict the De-identification of facial images.	Various types of input data set can be collaboratively raised through learning design to reduce the possibility of typographical error.
(Buddharaju et al., 2007)	Genetics -Based Face identification Using Thermal Infrared Spectrum	measurable face Bayesian segmentation and a anatomical element feature extraction customized to the thermal IR image predicts facial emotions	Identified few glasses and thick facial emotions, as well as extensive sweating. Which produce the exertion of heat.
(Cantin-Garside et al., 2020)	Behavior Analysis of ASD detecting injurious by applying ML techniques	K nearest neighbours algorithms and support vector machines(SVM) are applying for Behaviour Analysis of autism.	Results of this study support of this results designing an efficient monitoring system for autism children.
(Jian et al., 2017)	Activation Maps Based through recorded IR Thermal Image predicts local facial regions.	Infrared thermal image system predicts construct emotional activation maps and regional activation	It improves Cognitive theraphy, and facilitating subsequent development analysis of the correlation between temperature and facial emotions.
(Rusli et al., 2019)	The proposed method identifies the significant analyses of five distinctive basic emotions of ASD.	Emotions of autistic child extracted features from facial thermal distribution were analyzed with the help of Gray Level Matrices and k-NN and SVM classifier	Few images seem to be individual and inconsistent were few children's face negative/ positive experiences.

Table 3 ASD Diagnosis for MRI and CT Images

Author/ Year	Problems	Methodology / Algorithms	Advantage / Disadvantage
(Duan et al., 2020)	structural covariance-based MRI images identify social interaction, stereotypic and repetitive behaviour of young children with ASD	The volumetric-based method, structural covariance approach, and statistical concept to estimates such as age, gender, and whole-brain of the artistic child.	the group size of our discover essential features are comparatively small for different age groups of children with ASD
(Küpper et al., 2020)	Establish the identity of predicts features of ASD for clinical test samples of different age groups.	machine learning models on the training and test set for the age subgroups “Adolescents”.	Investigations are expected to assess to reduced classifiers enable to generalize clinical values of autism.
(Hashemi et al., 2018)	Vision based approach investigation for proposition repetitive Behaviours of autism children.	The computer vision-based approach extracts the child-specific behavioural analysis through continuous monitoring through mobile camera recorded video.	Head turn movement responses the child’s estimation is never.
(Martin et al., 2018)	This research carries out certain limitations of head movement’s variability children with and without ASD by applying	Recorded children video from the camera capturing such as head movement pitch, facial expressions to scale angular	Children with and without ASD in head displacement and velocity were obtained in a small sample and also it

Author/ Year	Problems	Methodology / Algorithms	Advantage / Disadvantage
	machine learning algorithms.	velocity and head tracking system Computer vision-based.	identified head movement intended variance by verbal and non-verbal communication.
(Del Coco et al., 2017)	Understanding Emotional movements of ASD Children by using single-camera predicts the facial expression and facial extraction from data to analyze ASD children.	Computer Vision-based approach such as multi-face tracking, linear classifier, Histogram of Oriented Gradients (HOG) predicts ASD Children from Facial extraction.	Trouble with understanding emotions of exclusive with crucial situation of the Childs behaviours and mental condition.
(Egmose et al., 2017)	origin of the human moment of head emotions, and facial behaviour predicts the boundaries and facial expressions	Elliptic model to trace face boundaries are identified and applying double-threshold method, Edge detection from Facial extraction of Geometric face model.	The 2D geometric model cannot fit the facial feature extraction and 3D model to adjust rotations of faces.
(Nadig et al., 2007)	An ASD child at the age of 1 year predicts Infants at health spoil for ASD children. .	the longitudinal method identifies the infants At health spoil for ASD with different age groups of the ASD children.	The performance metrics of sensitivity and specificity decreased response screen for ASD and other developmental delays.
(Akter et al., 2019)	Early detection of brain performance and the social interaction patterns of ASD	Their experimental appearance with in 3 years of children infants were transformed into ASD children.	Better performance of artistic children in other high-risk infants, it will be essential to analyze the functional MRI imaging.
(Thangaiyan, 2020)	Methods for Improving the Predictive Accuracy of Autism children by applying M L Algorithms	automate the diagnosis of the disease of autism enhance the parameters such as accuracy, The Autism and Developmental Disorder Monitoring system (ADDMS)	Better results of the diagnosis and predicts good accuracy levels of test samples, better screening process ASD
(Luyster et al., 2009)	Diagnostic analysis for Autism children for early age groups.	cross-validation sample and clinical methods can be tested and their metrics are estimated sensitivity and specificity	The size of the test is small and didn't allow fine grained of various age groups of autism children.

5. Basic adverse drug effect analysis through image processing

The adverse drug effect (ADEs) affects the quality of a child's life, as well as producing an increased literary work on the neuro development disorder system for analyses is more a challenging hypothesis of behaviors. Adverse drug effect campaigns morbidity and mortality globally it will carry on a significant feature of autistic children with the increased complexity of drug dosage level, to address various illnesses can I aging society. This review scoping aims to allow the most common hostile drug effect (HDEs) experient in the primary preservation of mental and physical health by preventing drug effected children or adult, the drug dosage normally connected with different types or levels of hostile drug effect (HDEs) predict from the thermal image through continuous monitoring behavior analysis of autistic child developmental disabilities shows the Table.4. Adverse drug effect analysis through image processing.

Table 4 Adverse Drug effect analysis through image processing

Medicine	problems	Methodology/ algorithms	Advantage/ Disadvantage
(Zhou et al., 2020)	Repetitive Behaviors identification in Autism child.	Randomized controlled trials, pharmacologic agents are applied.	needed further understanding, how we can help ameliorate behaviors

Medicine	problems	Methodology/ algorithms	Advantage/ Disadvantage
			in individuals with ASD
(Chaitra et al., 2020)	Negative Multicenter Study of Low Dose Fluoxetine on Repetitive Behaviors in Children and Adolescents with Autistic Disorder	Consolidated Standards for Reporting Trials (CONSORT) chart. ITT indicates intent-to-treat sample from Fluoxetine treated group	low dose of fluoxetine along with the decision to discontinue titration at a 25% reduction in symptoms or the appearance of the AE of activation
(Srikantha & Hasan Mohajeri, 2019)	The Possible Role of the Microbiota-Gut-Brain-Axis in Autism Spectrum Disorder	The correlation changes in short-chain fatty acids (SCFAs), indoles, and lipopolysaccharides (LPS) are identified.	The sequence of events leading to ASD, and to suggest unequivocal biomarkers and active therapeutic strategies
(Smith & Brown, 2014)	expectant Sodium valproate vulnerability and risk factors of ASD of childhood	public-based cohort investigation	compelling to increase the risk factor of ASD. parental mental health disease, and paroxysm.
(Erickson et al., 2011)	involvement in acamprosate focusing on social disability in youth with ASD	medical achievement of the first 6 youth with AD who arriving acallosal (low dosage 333 mg/day) for at least couple of week.	Better results in social relatedness in this pilot factual open-label trial.
(Frye et al., 2018)	inadequate trial children for Folinic acid develops verbal speech in children with ASD and it improves language impairment by a randomized double-blind placebo-controlled trial	Appling procedure for some medications to improve the ASD children using Folinic acid and Placebo.	As folinic acid may become increasingly used to treat ASD in the future, short-term and long-term adverse effects should be studied in more detail to ensure safety.
(Minshawi et al., 2016)	Appraisal of psychological and enthusiastic states computer vision of reality-based adaptability preparing for four children's with ASD	Gesture-controlled trial of DCS 50 mg given 30 min prior to weekly group social skills training was conducted at two sites.	Needs to investigate the social skills training protocol Impediments to the current examination and zones for future.

6. Traditional Over dosage and Under Dosage Level Prediction

Drugs consumed by the autism child has adverse drug effect on the body was verified and proved. The over-dosage of the drugs for autism leads to mortality without proper medications. Physician avoids the over-dosage or lower dosage of the drugs only based on the trial and error method since the child is unable to explain the feeling and effect of drugs.

7. Conclusion

In this review paper, the following methodologies were reviewed in autism detection such as machine learning algorithms in autism child image, artistic child thermal image-based diagnosis and neuropathic, Adverse Drug effect of autism children diagnose through the medical image, Adverse drug effect detect through image processing. Concurrent Medications of dosage level for an artistic child is challenging because of consuming over /lesser dosage of drugs causes side effects on antipsychotics. The overdosage of the drugs for autism leads to mortality is identified. Without medications treating autism leads to the repetitive behaviours in the child is proved. A physician can avoid the overdosage or lower dosage of the drugs only based on the trial and error method since the child is unable to explain the feeling and effect of drugs, the proper dosage of drugs and

overdosage of drugs in the child can be identified through the Drug Based Autism Child Repetitive Behavior Estimation (DARBE) method which is the continuous behavioural monitoring of the child and need to estimate the repetitive behaviours through thermal images obtained from various in the abdominal region of the body such as heartbeat or pulse rate, Mood assessment, heart rate variability, finger temperature, Skin temperature and estimate the severity of repetitive behaviour to suggest the dosage level of the drugs to the autism children.

Acknowledgement

We Authors like to thank Professor.Dr.N.R.Shanker and my guide Dr.V.Vijayaraghavan for the Valuable Support During the course of this research and providing the thermal images of autism children.

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