

Human-social interaction robots to improve shared attention in children with autism

Wykorzystanie interakcji człowiek-robot w celu poprawy rozproszonej uwagi u dzieci z autyzmem

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Abstract

The motivation behind the momentum research is use of robots explicitly human robots which has filled drastically in various domains, including treatment. In this examination, a humanoid robot was used to improve open consideration in children with mental imbalance. One of the troubles of this system is that contamination makes remarkable conditions for the patient that the presence of the guide and some other new thing isn't easily recognized. The subsequent test is to pick appropriate figuring and systems for following the head and understudy of the eye in youthful steers with mental awkwardness. One of the credits of which is obligatory and uncontrolled improvements of the head and eyes to the sides. The third issue is the treatment and investigation strategies. The treatment cycle and the arranged tests should not to reason extravagant instigation in the youth. The aim is to beat the referred to troubles, notwithstanding the high-block progressing understudy following count, without the use of business gear. Fleecy decision tree has been used to join clinical and planning information during therapy, ultimately the possibility of instinctive therapy for the improvement of restoratively withdrawn young people has been introduced.

Keywords: Social Assistant Robots; Autism; Pupil Detection; Human-Robot Interaction; Fuzzy Decision Making

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1. Introduction

Mental imbalance or autism is an issue that is influencing an ever increasing number of individuals. The common consideration is one of the fundamental boundaries of this infection and its improvement is straightforwardly identified with the general treatment of the illness, and not focusing on it greatly affects the movement of the sickness [1]. The rate of mental imbalance on the planet has developed altogether. In addition, some experts believe that 1 out of 10 individuals is brought into the world with autism [2]. Due to the lack of specific and definitive treatment of this disease, and the special characteristics of patients with it. For example rejection of treatment and inability to interact with the environment; the use of technologies such as computers and robotics is of particular importance, because different treatment scenarios can be planned and tested with their help and their effects. As a result, a suitable method can be provided for the treatment of cognitive diseases and used in the treatment of patients [3]. Kids with autism regularly experience issues perceiving the enthusiastic conditions of everyone around them. For example, an upbeat face or a terrifying face. In order to address this, specialists utilize flawless looking robots to show feelings to kids with autism can mirror them and react to them fittingly. This kind of treatment is the best treatment [4]. On the off chance that the robot can give an away from of the kid's conduct and show when he is

energized or focusing during the treatment, he will help the treatment cycle [5]. Helpful techniques utilized in this examination to treat the imparted consideration of individuals to chemical imbalance are PC games or game situation plan with social help robots. In this exploration, two situations have been planned. The principal situation is an augmented simulation and the subsequent situation is utilizing the Nao robot [6]. The outcomes show that notwithstanding improving the treatment cycle of patients, we had the option to precisely assess the utilization of advanced mechanics and augmented reality in association with medically introverted individuals and report the most fitting approach to treat this illness [7]. The augmented simulation game is with the end goal that in the wake of being played on a PC. In any case, it is shown on a screen by a video projector and the kid follows a fledgling which moves between the cells of a table, and simultaneously, the understudy of the eye by the inherent camera before the kid is followed continuously. Eventually, the aftereffects of the trial are introduced as outlines and with the assessment of the game, history can perform by the kid. The means of the game change to quicken the mending cycle [8]. The subsequent situation is finished utilizing NaO humanoid robot in a genuine climate and sensor. In the wake of beginning the situation, the robot focuses to a particular objective pointing at the kid and requests that he take a gander at it [9]. At the same time, the head and body turn data is separated by the sensor. All together

for the proposed answer for be intelligent (ie, the robot reacts as indicated by the kid's presentation), the fluffy choice tree is utilized [10]. In such manner, the measure of pivot of the youngster's head and body point comparative with the objective, just as the kid's clinical history, which is as of now inserted in a fluffy master framework. Additionally, it is utilized by the robot to choose the following choice [11]. Following quite a while of examination, Aldebaran Mechanical technology has dispatched a profoundly progressed social humanoid robot called NAO. This bipedal robot, which is 58 cm tall, is one of the pioneers of advanced mechanics with its legitimate plan and mix of programming and equipment. Highlights of the NAO robot incorporate full programming capacity, sensors, underlying PCs, controller ability and light and lovely body. This study investigates the effect of humanoid social robots as assistant therapists in the rehabilitation and education of children with autism as one of the first groups to use this technology.

2. Theoretical background

Massachusetts Institute of Technology specialists have built up a remarkable sort of AI that assists robots with surveying their kid's advantages while collaborating with every youngster's extraordinary information [12]. As indicated by considers, 60% of robots 'impression of kids' circumstances are predictable with the specialists' understandings [13]. The drawn out objective of this arrangement isn't to supplant these robots with restorative specialists [14]. However, they assist advisors with finishing key data in remedial correspondence by making normal and valuable connections between the robot and the mentally unbalanced kid [15]. Personalization is significant for treatment in light of the fact that every youngster with mental imbalance has interesting responses to correspondence [16]. The utilization of AI and man-made consciousness in the treatment of mental imbalance is troublesome. Since for the most part in computerized reasoning strategies, a great deal of comparative information is required for the preparation cycle [17]. Rudovic, top of the examination gathering, said that the utilization of ordinary neural organization strategies in a medically introverted patient had fizzled [18]. They utilized profound customized learning in different territories. Their discoveries improve the consequences of checking and anticipating the movement of Alzheimer's sickness [19].

3. Research Methodology

The present study was conducted using a descriptive method that gathered by library methodology, which was compiled by studying Human-social interaction robots with autism, related issues, articles and books which have mentioned in the reference. In a general division, Human-social interaction methods, features,

software's have been examined. The purpose of this study is to investigate the methods of Human-social interaction in order to help children who suffer autism. These methods include Virtual reality method and the use of NAO robots. The results of this study show that in addition to improving the treatment process of patients, we were able to accurately assess the use of robotics and virtual reality in interaction with autistic people and report the appropriate method for the treatment of this disease.

4. Results and discussion

4.1. Behavior Rating Inventory of Executive Function

A rundown of conduct rankings of chief capacities has been created to look at different parts of the elements of the front piece of the temple. This poll is planned in two structures: parent and instructor and is utilized for kids and teenagers of young men and young ladies matured 1-7 years. In the current investigation, the parent structure is utilized.

4.2. Performance Continuous Test

This test requires restraint of undesirable reactions and nonstop observing of target reactions [20]. The subject should focus for some time to a moderately basic arrangement of visual improvements on the PC screen and give a reaction key when the objective boost shows up [21].

4.3. AO robot

The specialists utilized the NAO humanoid robot in the examination. 60 cm tall robot that resembles saints and artists. NAO passes on various feelings by changing the shade of the eyes, moving the lips and changing the manner of speaking [22]. The greater part of the youngsters in most of examinations responded to the robot as a toy as well as a genuine individual. As indicated by Rudovic, advisors said a couple of moments of youngster contact could be a major test for them. Robots can catch a kid's eye. People express their feelings in an unexpected way, while the robot consistently acts similarly and the youngster can be prepared in an organized manner [23].

4.4. Individual focused AI

The MIT research group found that a sort of AI called profound learning is helpful for restorative robots. However, they can comprehend kids' conduct all the more normally. The profound learning framework utilizes a various leveled structure and numerous information layers to deal with crude information [24]. In spite of the fact that the example of profound learning has existed since the 1980s, the presence of registering power has as of late made this kind of man-made rea-

soning more down to earth. Profound learning is utilized in programmed discourse acknowledgment and item acknowledgment programs by getting a few highlights of face, body and sound. In addition, it can introduce theoretical ideas. For instance, on account of facial indications, which portion of the face is significant in deciding connection?

Profound learning permits the robot to separate information straightforwardly and without the requirement for people. The exploration group has gone above and beyond and made an individual system for showing every youngster the information gathered. Some specialists make recordings of the child's outward appearances, signals, head and body developments, and voice. They additionally gather information on pulse, internal heat level and skin sweat through a sensor on the child's wrist. A customized taking in organization from physiological information, video and sound, gives data on the conclusion and capacity of mentally unbalanced youngsters, their way of life and sex. Scientists can analyze the robot's gauge of a kid's conduct with that of five specialists dependent on kids' sound and video chronicles, and measure the youngster's degree of bliss, bitterness, energy and cooperation. This human-prepared, coded individual information is tried on undeveloped information and unadjusted models and fundamentally improving the social assessment of the kids examined. The scientists discovered fascinating data about kids' social contrasts [25].

4.5. The presented approach

Two scenarios have been considered to solve the problem. In the first scenario, the amount of shared attention of the child is evaluated by the virtual reality technique and real-time tracking of the pupil of the child's eye. In addition, by advancing the game in the later stages, it tries to increase the amount of shared attention. In the second scenario which is done using a humanoid robot, the child engages in physical and mental interaction with the robot, and while playing with it, the head-body position data is received and left to fuzzy decision making.

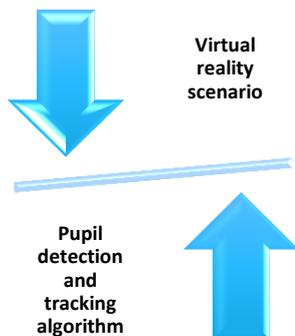


Figure 1: Two scenarios in the presented approach.

The decision tree selects different games with the aim of increasing shared attention and forces the robot to play with the child [26].

4.5.1. Virtual reality scenario

Virtual reality is a sort of innovation where a virtual environment is put before the client's eyes and interfaces with that environment through head and body developments. The principal situation of this examination in which the kid interfaces with the PC and utilizing Virtual reality innovation to create programming analysed [27].

4.5.2. Pupil detection and tracking algorithm

Methods for diagnosing the center of the eye have been proposed, which can be generally divided into the Table 1.

Table 1: Methods for diagnosing the center.

Method 1	Feature-based methods
Method 2	Model-based methods
Method 3	Combined methods

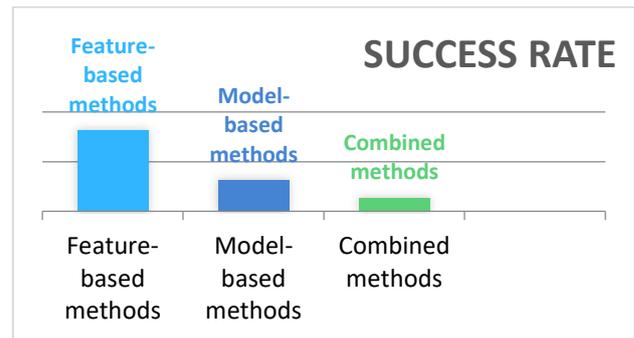


Figure 2: Success rate of diagnosing Methods.

Method 1

In order to situate the focal point of the eye, the focal point of a semi round example is where the biggest angle of the picture meets. Consequently, a numerical administrator that gets its greatest in the focal point of the circle logo is utilized. Handling strategies with the point of lessening the issues brought about by glasses and eye appearance in the eyebrows, just as fortifying the calculation introduced in an unexpected way. In the following formula, the displacement vector d_1 and the gradient vector g_1 do not have the same orientation, while on the right both orientations are the same. Geometrically, the center of a circular object can be obtained by analyzing the gradient vector. They also analyze the vector gradients. In addition, the specific properties of the vector field are formulated to describe the relationship between the probable center of the eye and all-gradient orientations of the vector. This is done with the aim of locating the center of the eye. In this formulation, the probabilistic center are shown with C_1 and the

gradient of vector shown with \mathbf{x}_1 . As a result, the normal displacement vector \mathbf{d}_1 must have a rotational gradient if we use the gradient vector field, we will be able to obtain this vector by calculating the internal multiplication between the displacement vectors as follow:

$$= \arg \max \left\{ \frac{1}{n} \sum_1 N(D_1^T G_1)^2 c^* \right. \\ \left. \mathbf{d}_i = \frac{(xi-c)}{xi-ci}, \quad \forall_i |g_i|^2 = 1 \right. \quad (1)$$

Method 2

In this method, in order to achieve equal weight for the position of all pixels, the displacement vector \mathbf{d}_i is scaled to one length, and to improve stability against linear changes in lighting and contrast, [28] gradient vectors must also be scaled to one length which is given as:

$$g_i = \frac{di(xi,yi)^2}{dxi,dxy} \quad (2)$$

Method 3

In this method, the BioID data set should be used to evaluate the proposed method. In addition to the changes that occur in light conditions, the position and position of the subjects also change. In this method, the position of the face is first recognized and based on that, the areas of the eyes are identified according to the proportions between the eyes and the size of the face that is as follow:

$$e \leq \left(\frac{1}{d}\right) \max(e_1, e_2) \quad (3)$$

However, e_1 and e_2 are Euclidean distances between the centers of the right and left eyes and d is the distance between the centers of the real eye.

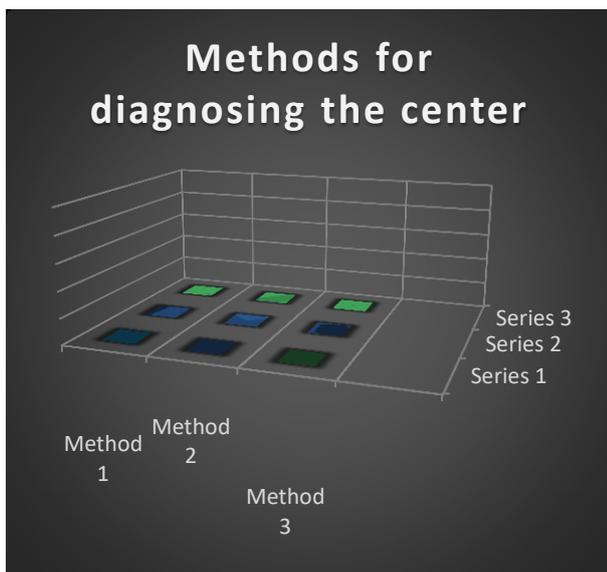


Figure 3: Methods for diagnosing the center.

4.6. Designing a game to perform a virtual reality scenario

This scenario is done by moving a bird randomly in the cells of a table. The child follows this bird with his eyes. In order to be able to check the exact movement of the pupil and the case. However, a contract analysis, the movement of the head must be restrained for which purpose the chin holder ophthalmology has been used. After the test begins, the server extracts the baby's pupil movement information through a network camera. In order to normalize the movement of the pupil and ensure its accuracy, the information is read 4 times per second and averaged between them to represent the final target.

4.7. Data collection

4.7.1. Human-robot collaboration situation

The situation intended for an individual to play with a robot has a few phases. Prior to beginning the test, the specialist advises the framework regarding the essential data required, for example, name, family name, and the degree of the last test used to set up the patient document. In this situation we will have three phases of the game, every one of which is isolated into three sections, the fluffy framework chooses the stages and their planning and sends it to the robot. To figure the mistake and get information from the situation execution measure, all execution steps in a game motor are reproduced, which are clarified underneath [29].

4.7.2. Solidarity game motor

Solidarity game motor is programming for making and creating computer games. One of the main highlights that are normally executed by game motors is the delivering motor for 3D and 2D designs, actual motor or crash recognition, sound, content.

4.8. Game plan Scenario of human collaboration with the robot

In this trial, a doll or any gadget that is appealing to kids is appended. In the principal stage, the robot goes to one of the dolls and subsequent to being under the doll, it holds its hands towards it. In the subsequent stage, the robot remains at a fixed point and focuses to one of the dolls with his hand and requests that the youngster focus on it. In the third step, the robot goes under one of the dolls and focuses to the contrary doll with his hands. Toward the start of the test, the robot begins playing from one of the stages as per the degree of the test. All through the test, the actualized calculation gets the visual sensor data and concentrates the situation of the youngster's head and body comparative with the subsequent position, and returns it to the worker. Subsequent to finishing three pieces of a phase, the measure of mistake is determined in each part. Contingent upon the test

level, the fluffy choice tree chooses the game stage, the framework can keep the game at a similar level, or relying upon the test yield, start a harder or simpler stage. Also, to have more precise data about the testing cycle, all the means acted in Unity programming have been mimicked. After the robot shows the objective to the youngster, the worker begins perusing data from the sensor for 2 seconds. It utilizes the got data to find and track the head. Besides, by utilizing a three-dimensional sensor, the skeleton of the body is first identified, at that point the head is eliminated lastly. The purpose of contact of the vector with the divider is set apart in yellow, the planned framework realizes that the cell is the objective and presentations it on the screen. The sample of the study will consist of a group of normal children and a group of children with autism in the age group of three to six years. In order to evaluate the comprehensiveness of the proposed solution, autistic children with different degrees of autism are selected. This test is also done with normal children to talk about system performance and scenarios. In addition, experiments are also designed to analyze the proposed algorithms, study scenarios and performance of individuals.

4.8.1. Experiment 1. Analyze the direction of the person and the position of the target

The target appears in one of the field cells every 2 seconds during the whole game time, and a diagram of its various positions is formed. Also after processing in each 10 seconds, a cell is displayed as the child has looked at the most, and a graph is drawn for it.

4.8.2. Experiment 2. Production of heat map

During the first scenario, each time the bird appears in one of the cells, in addition to recognizing the child's gaze and which cell it is staring at, the map of the child's gaze relative to the other cells is also used to perform analyses [30]. It is recorded more advanced. The heat map uses the color spectrum from black to white. The brighter the house, the more the child looks at the cell.

5. Conclusion

The utilization of robots to interface and treat boundaries, for example, shared consideration is a test that a significant number of the world's driving colleges have picked as their exploration field. In this examination, an endeavor has been made to step forward. To be helpful, social collaborator robots should be planned and worked by remedial necessities. Following quite a while of examination, Aldebaran Mechanical technology has dispatched a profoundly progressed social humanoid robot called NAO. This bipedal robot, which is 58 cm tall, is one of the pioneers of advanced mechanics with its legitimate plan and mix of programming and equipment. Highlights of the NAO robot incorporate full programming capacity, sensors, underlying PCs, con-

troller ability and light and lovely body. Given the foundation of the issue, there is a need to plan more mind-boggling robots than current robots. These robots can encourage the treatment cycle. Likewise, experts in the field of treatment should be engaged with the plan of calculations and robots. In this investigation, a two-route collaboration between the robot and the patient was set up utilizing the fluffy choice tree. In this communication, the improvement of the infection level is recognized by the robot and the robot settles on its choices considering that the patient has improved. This investigation explicitly centers on the treatment of patients' shared consideration. In such a manner, two calculations for constant eye and head discovery and location were created. After the improvement of these two calculations, situations were intended for testing. As the outcomes show, the tainted kids at first wouldn't speak with the robot, yet in the wake of making developments by the robot, they were pulled into it and consented to partake in the tests. When all is said in done, the utilization of social help robots, particularly those whose conduct can be constrained by kids, can significantly affect improving the social practices of youngsters with the mental imbalance and give a restorative answer for their correspondence issues.

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