HUMAN-ROBOT INTERACTIONS FOR CHILDREN WITH AUTISM SPECTRUM DISORDER (ASD) RESPONSE-TO-NAME PROTOCOL

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ABSTRACT

Incidence of children with autism spectrum disorder (ASD) has increased with an average rate of 1% worldwide. Clinical ASD screening, especially for children screening is a laborious and skilled task, there is however no objective and effective method automating ASD children screening. Analyzing children ASD characteristics in predefined motion behavior protocols is attempted to provide automatic solutions to children ASD screening. A novel protocol, Response to Name (RTN), is proposed in this paper for ASD clinical validation and diagnosis. The RTN method is jointly designed with clinical partners, novel gaze estimation is developed for validating ASD characteristic behavior. The experiment is conducted using a robot with gaze estimation embed in it. The response of the children with autism is carried out in different scenarios and score are evaluated for each rounds and the recovery of child from autism is estimated.

I INTRODUCTION

A serious developmental disorder that impairs the ability to communicate and interact.Autism spectrum disorder impacts the nervous system and affects the overall cognitive, emotional, social and physical health of the affected individual.The range and severity of symptoms can vary widely. Common symptoms include difficulty with communication, difficulty with social interactions, obsessive interests and repetitive behavior.Early recognition, as well as behavioral, educational and family therapies may reduce symptoms and support development and learning.Due to the large population, the number of children with ASD is especially large. The burden of screening is very high, including the time and personnel costs. Computer vision could simplify and standardize the screening process, which requires less training and experience. There is no single method for the diagnosis of ASD, and it is necessary to make comprehensive interactions and judgments according to the pathological manifestations of the subjects. The screening is done by integrating a robot which is able to estimate the eye gaze and predicting the autism level in children by using Response to name protocol. The RTN task focuses on a child's ability to respond after being called by name.The experiment is carried out keeping three rounds of robot interaction with the child and analyzing the behavior. In the first the robot will be in front of child and it will pronounce the name of the child. After that, the eye gaze of child is detected. If the child response to the voice and makes eye contact with robot then score is evaluated as one. If the child doesn't response means then the score will be evaluated as zero. This process will continue with robot in different direction and all the analyses and score estimation will be uploaded in the server using IOT. Using this system the children with autism spectrum disorder are evaluated.

II LITERATURE REVIEW

A gaze sensing method using visual saliency maps that does not need explicit personal calibration is designed. The goal is to create a gaze estimator using only the eye images captured from a person watching a video clip. The saliency maps of the video frames are treated as the probability distributions of the gaze points. A mapping between the eye images

to the gaze points is estimated using Gaussian process regression. In addition, a feedback loop from the gaze estimator is used to refine the gaze probability maps to improve the accuracy of the gaze estimation. The experimental results show that the proposed method works well with different people and video clips and achieves a 3.5-degree accuracy, which is sufficient for estimating a user's attention on a display.

A Delft Assessment Instrument for Strabismus in Young children (DAISY) is a device designed to measure angles of strabismus in young children fast and accurately. DAISY allows for unrestrained head movements by the mean of a triple camera vision system that simultaneously estimates the head rotation and the eye pose. The device combines two different methods to record bilateral eye position: corneal reflections (Purkinje images) and pupillary images. The system reached sufficient accuracy to be applied for the measurement of angles of strabismus, almost independent from the head pose.

A driver face recognition problem under the intelligent traffic monitoring systems is addressed as severe illumination variation face recognition with single sample problem. Firstly, in the point of view of numerical value sign, the current illumination invariant unit is derived from the subtraction of two pixels in the face local region, which may be positive or negative, we propose a generalized illumination robust (GIR) model based on positive and negative illumination invariant units to tackle severe illumination variations. Then, the GIR model can be used to generate several GIR images based on the local edge-region or the local block-region, which results in the edge-region based GIR (EGIR) image or the block-region based GIR (BGIR) image. The experimental results indicate that the proposed methods are efficient to tackle severe illumination variations.

III METHODOLOGY

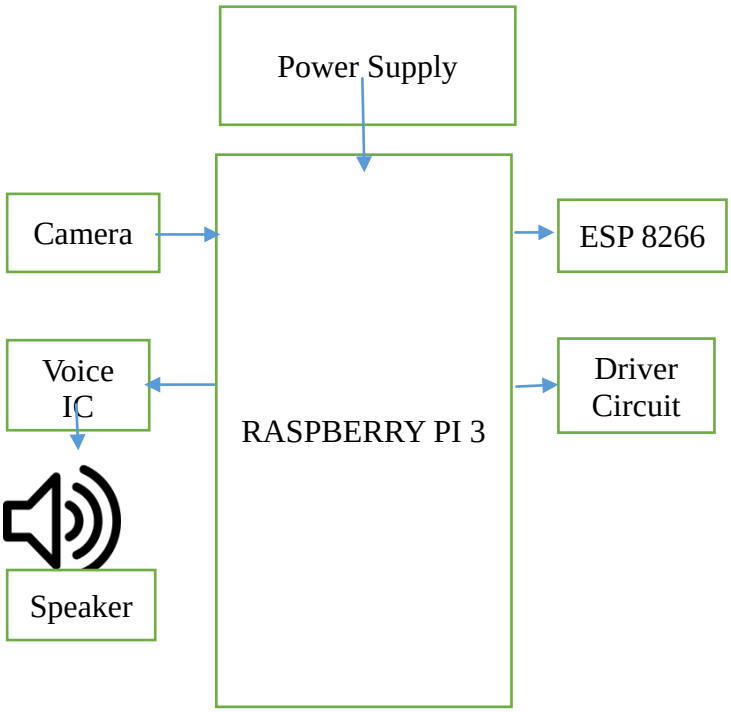

Fig 1: Block diagram of proposed method

The proposed system has a power supply comprising a 12v battery, which is used to supply power to the raspberry pi 3, to which a supply of 5v power would be adequate. Thus the 12v is converted into 5v by the use of a voltage regulator which is placed in the power supply circuit using a TIP41 power transistor, which can provide a maximum of 4A in spec. However, in real time application, it can only provide a maximum of 2A. The transistor's body is TO-220 due to which it can easily be used as a heatsink of any size.The 7805 power regulator is faster than other models, because of its body being similar to that of TIP41 powertransistor, excluding the Zener diode and bias resistor.

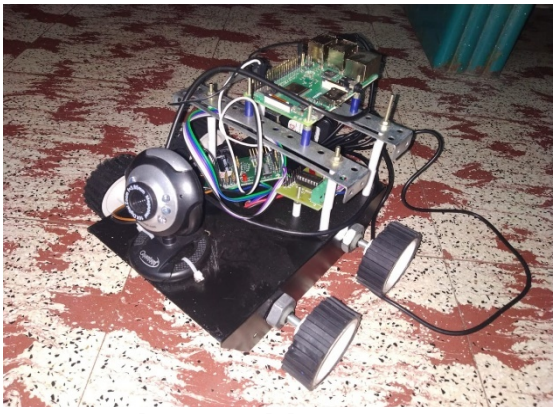

Fig 2: Hardware model

The robot can be controlled/moved by using the IOT mobile application, which runs with the aid of esp8266 IOT module.The motor driver, model L293D can control the motor functions of the robot. The esp8266 Wi-Fi module has the ability to communicate with a web server and also receive commands from the user. The speaker helps producing the sound capable of drawing the child's attention, which is already stored in the raspberry pi. When the face is detected by the system, it captures the image of the face, which is sent via mail to an authorized personnel.

A mobile application serves as the forefront of user interaction with the system. The response time of the child is recorded each time and this information is sent to the authorized personnel. The application is connected to the web server 24/7, enabling it to constantly upload data every few seconds. The application also enables tracking the live location of the robot at any given instant to determine where the test was taken.

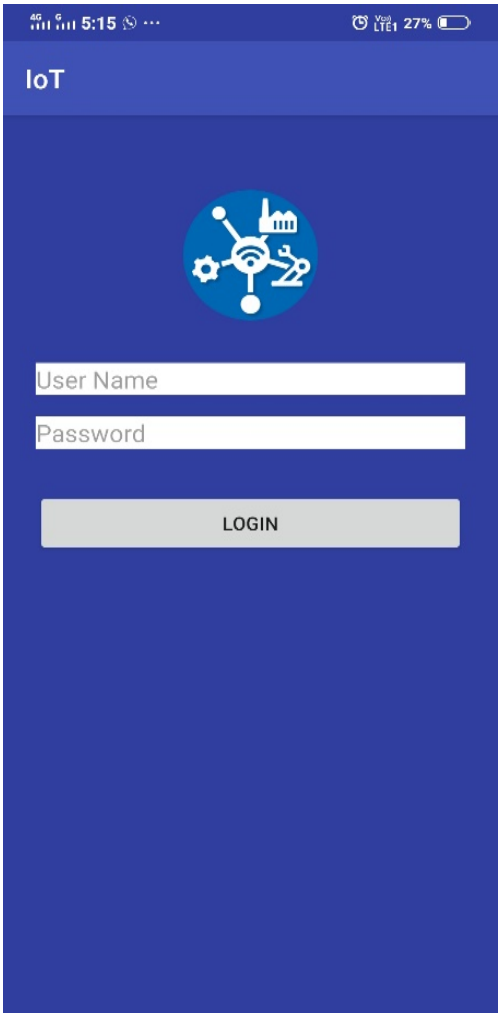

Fig 3: The first page of the application, which allows the user to register with a username and password of his/her choice.

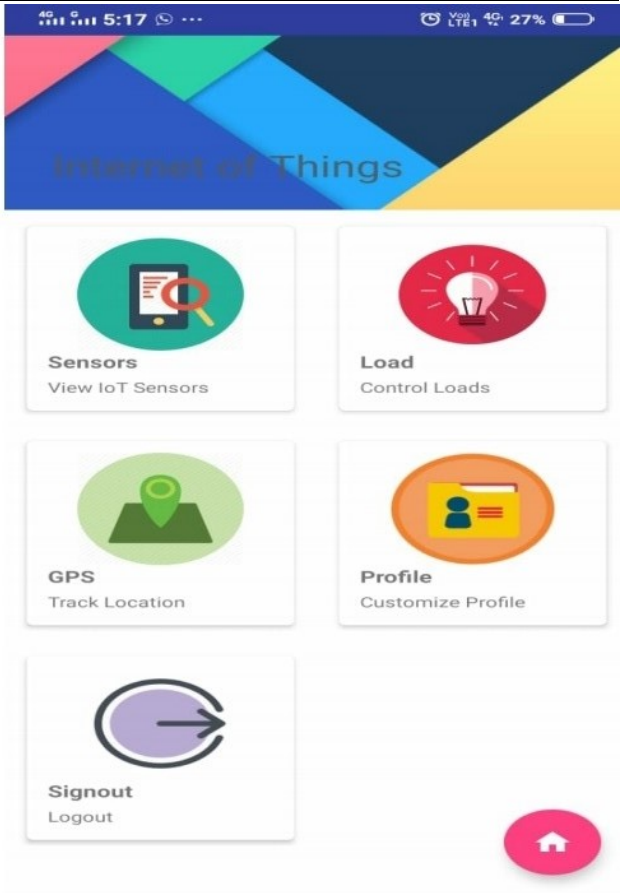

Fig 4: Various features in the application.

Fig 5: Buttons in application which are used to control the robot.

IV RESULTS AND ANALYSIS

The child is subjected to the test by the robot from multiple positions and the response time is recorded for each position. Based on the data collected, the authorised personnel would be able to detect the level of autism present and the appropriate treatment duration that would be required on the path to recovery.

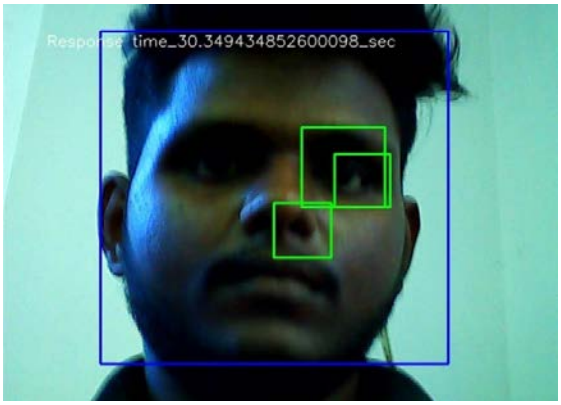

Fig 6: Captured image of face which is sent across via mail

Fig 7: Recorded various response times

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