



DEVICE FOR EARLY AUTISM SPECTRUM DISORDER DIAGNOSIS

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Abstract: Autism Spectrum Disorder is a multi-parametric disorder affecting people and specially children. It is important to detect autistic children as soon as possible to conduct adequate treatment. In this paper we develop a skin conductance device capable of measuring the galvanic skin conductance and help diagnosing autistic children from the first weeks after their born. As skin conductance is directly affected by the emotional arousal. With the development of cloud services it is important that advances in technology help physicians in diagnosing autistic people.

INTRODUCTION:

Autism is a complex disorder of mental development that includes limited interactions or communications in social phobia, language development deficiency and repetitive behavior. It is important to detect autistic children as soon as possible to conduct a treatment and help integrating them in society. The involuntary autonomic nervous system (ANS) feeds the heart, smooth muscles, the exocrine glands (sweat glands) and some endocrine glands. This system is composed of sympathetic "fight-or-flight" and parasympathetic "rest-and digest" divisions. During emergency or stress situations, the sympathetic nervous system (SNS) is activated in order to initiate the reactions which prepare the body for fight or flight. The parasympathetic nervous system (PSNS) governs the tranquility and restful situations and controls growth and maintenance activities. Children with ADHD showed a low sympathetic activity and high parasympathetic activity. In contrast, children with ASD showed a high sympathetic activity and low Parasympathetic activity. Physiological measurements of the ANS include electrodermal activity (EDA) and heart rate (HR). The skin conductance is more desirable than the heart rate, since we are trying to assess a pure emotional response that is initiated in the central nervous system. Its measurement is according to variations in the electrical conductance of the skin and it has an acceptable correlation with the ANS's activity that indicates the arousal state accompanied with stress. SNS controls the sweat glands, so when the person is subject to stress or fear, a greater electrical conductance is noticed in measuring the galvanic skin conductance (GSR). In this paper, we develop a device. The device will continuously measure the GSR and display it to the physician in order to help diagnose the child as ASD, ADHD, or balanced. The physician will use his smart phone as the display. A wireless Bluetooth communication is established between the device and the smartphone. The physician will use an android application to monitor and control the system.

EXISTING GSR STUDIES AND DEVICES

Many studies concerning devices capable of measuring the GSR are developed. Barry D. Smith et al. studied the GSR to assess the effect of Overhabituation and dishabituation responses.

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They realized tests on extraverts and introverts group where each individual was assigned to various doses of caffeine. High dosage of caffeine leads to a straight increment in the level of tones in extravert but doesn't affect enormously the skin conductance at rest for the introverts. Barry D. Smith et al. studied two external factors: stimulus intensity and relevance that influence the psychophysiological and arousal response. The test was realized on a group of people that was watching a presentation of a sequence of sexual and violent stimuli of variable intensities. The level of sensation seeking affects the magnitude of the skin conductance according to the modality and the intensity of stimuli. Affective company developed a bracelet capable of measuring the Electrodermal Activity. The device can also measure the temperature with an accuracy of 2°C. The device can also send the measurements via Bluetooth to a computer or store them on its memory. Technology Company developed an 8 channels encoder capable of reading multiple modalities to automate physiological processes (EMG, EKG, ECG...) and collecting data in real time. Each process has a specific sensor that will be connected to the encoder using pin cables, in this way these signals are transmitted to the encoder. The GSR sensors have an accuracy of 2 µS.

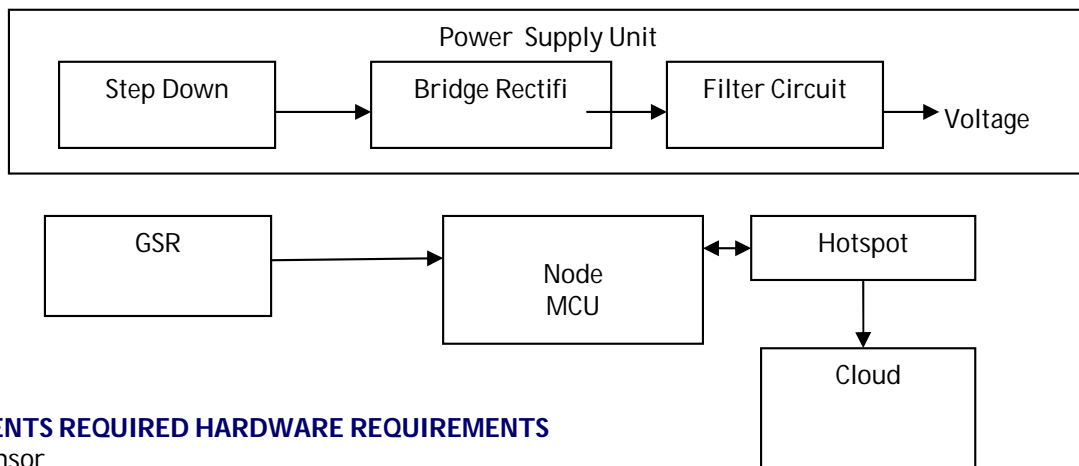
EXISTING SYSTEM

Many studies concerning devices capable of measuring the GSR are developed. We present in this section few of them. Barry D. Smith et al. studied the GSR to assess the effect of over habituation and dishabituation responses. They realized tests on extraverts and introverts group where each individual was assigned to various doses of caffeine and then requested to listen to several tones until the occurrence of criterion electro dermal habituation. High dosage of caffeine leads to a straight increment in the level of tones in extravert but doesn't affect enormously the skin conductance at rest for the introverts. Barry D. Smith et al. studied two external factors: stimulus intensity and relevance that influence the psycho physiological and arousal response. The test was realized on a group of people that was watching a presentation of a sequence of sexual and violent stimuli of variable intensities. The level of sensation seeking affects the magnitude of the skin conductance according to the modality and the intensity of stimuli. Affective company developed a bracelet capable of measuring the Electrodermal Activity. The device can also measure the temperature with an accuracy of 2°C. The device can also send the measurements via Bluetooth to a computer or store them on its memory.

PROPOSED SYSTEM

In this project we presented a new tool for physicians to detect ASD children. This tool is based on the electro dermal activity that characterizes each disorder. We have developed a device capable of measuring the GSR of children and stream then wirelessly to the Smartphone of the physician. Based on the levels of the GSR, diagnosis and treatment can be established.

BLOCK DIAGRAM

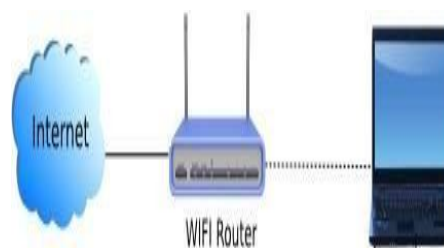


COMPONENTS REQUIRED HARDWARE REQUIREMENTS

- GSR sensor
- NodeMCU
- Hotspot (Wi-Fi)
- PC
- Power supply unit

SOFTWARE REQUIREMENTS

- Arduino IDE
- Embedded C
- Java



MOBILE APPLICATION AND RESULTS

Android choice

We have chosen to develop an Android application for different reasons. First, the open architecture source of android allows unlimited options of customization; so there would be several interfaces options unlike iPhones that have a single interface. Second, android applications are less expensive than those of iPhones and most of them are for free. Besides that, android is more flexible than Apple, as it enables easily the usage of multimedia files. For the mentioned reasons, we decided to promote the mobile application using android studio program. Our application has the following specifications:

- Each physician has his own record
- The Electronic Patient Record is saved for each child Each child can have multiple visits
- Results of each visit are recorded and displayed via a graph
- The application can show previous and current results for comparison
- The user can send results via email to create a database

After login the physician can choose to create a new patient profile or to do a new visit for an old patient. If a new patient profile is chosen the following information must be filled: a reference number for the patient, Name and Surname, blood type, Mobile phone, Date of birth, Nationality, Mouhafaza, Caza, City, and Gender. The physician is also asked to indicate the suspected disorder of the patient (ADHD, ASD, Balanced, others). The previous entries has been chosen for creating a rich database on which future works can be extended to correlate region, date of birth or other information with disorders Before the realization of the skin conductance test, the physician has to enter some environmental parameters of the room like the noise level, the temperature and the humidity When the test starts, a Bluetooth communication is established between the Smartphone and the bluno board. The bluno continuously sends the value of the GSR to the Smartphone. The physician next applies a stressor to the patient and analyses the change in GSR. For patients with ASD, a high increase in GSR is noted. For balanced patients, low change in GSR is noted. For ADHD patients, very low change in GSR is noted. At the end of the visit the physician sends an email to our database. The email contains all information about the patient and the test values. Only the patient name is omitted and the patient is referred with a reference number to comply with the ethics. The email attachment is an excel file containing all information.

CONCLUSION

In this paper we presented a new tool for physicians to detect ASD children. This tool is based on the electrodermal activity that characterizes each disorder. We have developed a device capable of measuring the GSR of children and stream then wirelessly to the Smartphone of the physician. Based on the levels of the GSR, diagnosis and treatment can be established. As future works we intend to develop our device to become low cost, low weight, more accurate, and to automatically measure the temperature relative humidity and noise. In addition a web based application must be developed to allow all Smartphones to be used with the device. Once a good database is created, analysis and automatic diagnosis can be performed.

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