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RESEARCH ARTICLE

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ACCELEROMETER BASED CHARACTERIZATION AND DETECTION OF BEHAVIOR PATTERNS WITH AUTISM DISORDER AND INJURIOUS TO PREVENT SELF BEHAVIOR

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ABSTRACT

In this study, we automatically detect Behavioural patterns of patients suffering from autism disorder. Many stereotypical behavioural patterns may affect learning ability as a child and patterns such as self-injurious behaviours (SIB) can lead to critical damages or wounds as they tend to repeatedly harm one single location. Autism disorder involves part of the body such as flapping arms, body rocking and self-injurious behaviours such as punching their face, or hitting their legs. Our custom designed accelerometer based wearable sensors are placed at various locations of the body to detect stereotypical self-stimulatory behaviours (stereotypy) and self-injurious behaviours of patients with Autism Spectrum Disorder (ASD). A microphone can be used to record sounds so that we may understand the surrounding environment. Also a pulse rate sensor, body temperature sensor can be placed on the body of the patient to observe behaviour of the patient while under observation. Buzzer is used to indicate critical situation for the patient. The goal of this study is to detect these events and open possibility for design of intervention methods

INTRODUCTION

AUTISM spectrum disorder leads to cognitive impairment, including deficiencies in social interaction and communication. The Centers for Disease Control (CDC) show that 1 in 150 births are diagnosed with autism. The ratio is even higher for boys of which 1 in 94 is estimated to
be autistic. Autism is becoming the fastest growing (10-17% annual growth) development which is needs to be detected and cured with further treatment.

Symptoms of autism differ between individuals. They may also differ in a single individual over time. Research indicates that early diagnosis and intervention is critical for successful long term management. Clinicians often try different interventions simultaneously. Families face difficulties because the treatment varies from one therapist to another and families become worn out trying to find a treatment that works best for their children.

Research also indicates that it may be possible to prevent self-stimulatory behaviors associated with autism by helping children focus on specific activities at the right time. But, developing a solution that meets individual needs is also very difficult. Therefore, It is necessary to minimize these steps would benefit both families and therapists.

One aspect of the treatment is behavior correction, since many people with autism exhibit self-stimulatory repetitive behavioral patterns. Parents who have autistic children are very concerned about these behavioral patterns which set them apart from others. Along with long term treatments to cure autism they desperately seek immediate treatment to correct or modify behavioral patterns exhibited by their children.

In this paper, we explore method to meet their immediate needs by detecting repetitive patterns to indicate that patient is suffering from autism disorder or not. This data can be directly used by both clinicians and patients for developing behavior reversal programs and helping them to be more socially agreeable. By continuously checking action of the patient suffering from autism disorder we can conclude that if patient is suffering from autism disorder. Also for the safety of the patient we are observing other parameters such as temperature and pulse rate of the patient. This will indicate that patient is not suffering any discomfort due to the experiment. So, Body of the patient is kept under observation to detect the behavioral pattern.

II. DATA DESCRIPTION

Wireless accelerometer sensor with RF module is able to pickup movement information as they may be worn by users of the system. The sensor system can be worn on wrists, chest, waist and ankles and forehead. The sensor system can also be clipped onto shirts and hats to detect movement of the body or head. Most of the large motor functions can be detected but fine motor skills such as movement or use of fingers and toes cannot be detected. Our wearable sensor system is equipped with a 3-axis accelerometer, microcontroller and RF module for wireless communication with the computer. Using the on board microcontroller, sample and quantize the analog accelerometer output at high sampling rate (up to several kHz) is done. Sensor readings are exported from the sensor system to a PC in real time and no data is stored locally on the wearable system. For the behaviour detection purposes, high sampling rate is not required, therefore the accelerometer signal is sampled at 50 Hz rate and transmitted to base station and stored on the PC using the user interface.

III. BLOCK DIAGRAM

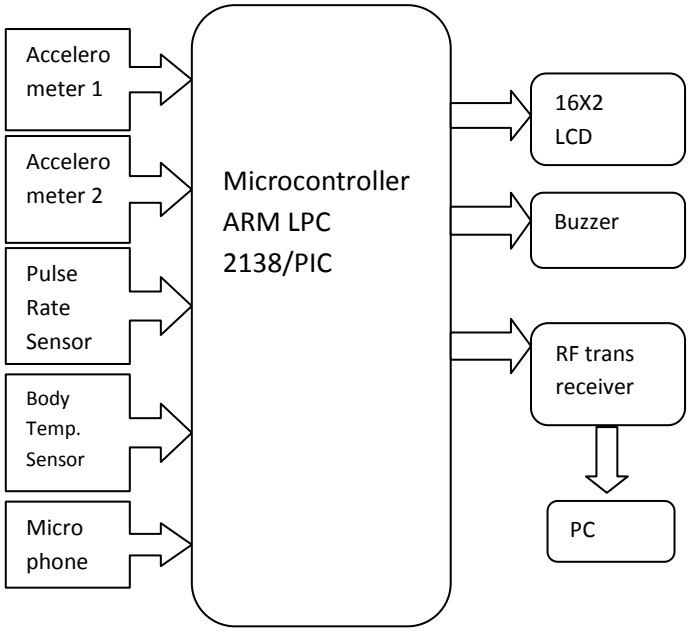


Fig.No.1 Block diagram

The system consists of accelerometer, pulse rate, body temperature sensor, LCD, buzzer and RF transmitter and receiver.

An accelerometer used is an electromechanical device that will measure acceleration forces. These forces may be static, like the constant force of gravity pulling at your feet, or they could be dynamic - caused by moving or vibrating the accelerometer. By measuring the amount of static acceleration due to gravity, you can find out the angle the device is tilted at with respect to the earth. By sensing the amount of dynamic acceleration, you can analyze the way the device is moving.

Accelerometers use the piezoelectric effect - they contain microscopic crystal structures that get stressed by accelerative forces, which cause a voltage to be generated. moves one of the structures, then the capacitance will change. Add some circuitry to convert from capacitance to voltage, and you will get an accelerometer.

The three axis accelerometer are basically used to identify the movements across the three axis i.e. x-axis, y-axis, z-axis. Accelerometer is an electronic device which is interfaced using I2C protocol and provides the reading after every 1msec.

Pulse rate sensor will continuously monitor the pulse rate of the person. Once the pulse rate goes below or gets faster than the fixed set point the buzzer will blow on.

Temperature Sensor will keep on monitoring the temperature of the body. Once the body temperature goes below or higher than the fixed set point the buzzer will blow on.

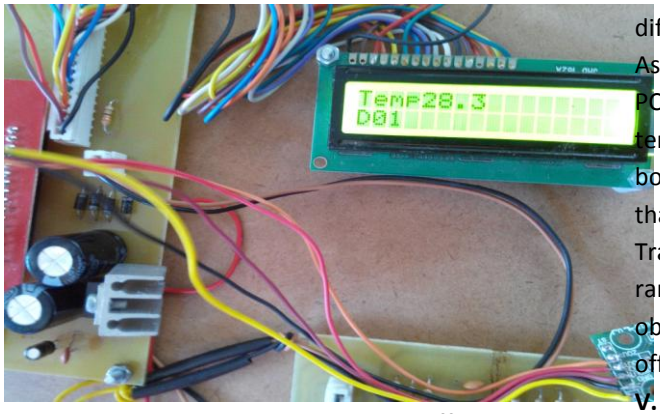
LCD is used in a project to visualize the output of the application. LCD can also used in a project to check the output of different modules interfaced with the microcontroller.

Buzzer is used in a system to indicate or to grab the attention regarding an emergency situation occurred.

RF trans-receiver is used for communication purpose. RF waves are electromagnetic waves which propagate at the speed of light, or 186,000 miles per second (300,000 km/s). The frequencies of RF waves, however, are slower than those of visible light, making RF waves invisible to the human eye.

The frequency of a wave is determined by its oscillations or cycles per second. One cycle is one hertz (Hz); 1,000 cycles is 1 kilohertz (KHz); 1 million cycles is 1 megahertz (MHz); and 1 billion cycles is 1 gigahertz (GHz). A station on the AM dial at 980, for example, broadcasts using a signal that oscillates 980,000 times per second, or has a frequency of 980 KHz. A station a little further down the dial at 710 broadcasts using a signal that oscillates 710,000 times a second, or has a frequency of 710 KHz. With a slice of the RF pie licensed to each broadcaster, the RF range can be neatly divided and utilized by multiple parties.

V. ANALYSIS OF SYSTEM:

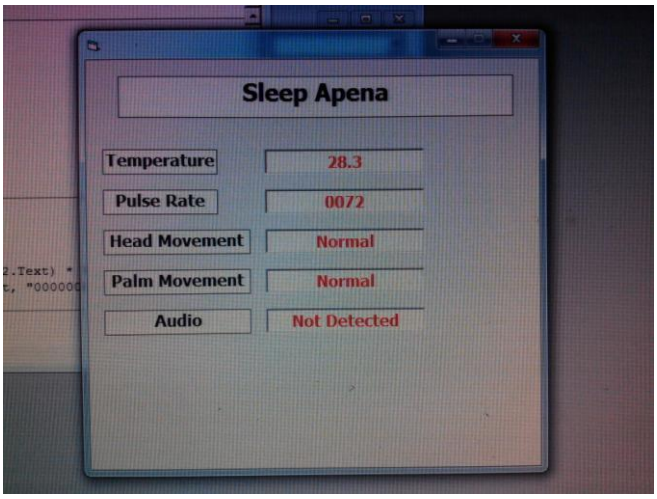


For this particular study, we collected different types of accelerometer sensor data from patient labelled as S1. Recorded data include several self stimulatory patterns and many other daily activities.

As shown in figure different accelerometer data can be observed. Different body parts movement can be seen or detected automatically. For further use, data from microphone can also used. In the analysis, accelerometer is placed on the body parts where patient is suspected to be affected. Then patient is requested to keep the affective part steady. If patient is affected by autism disorder then after some time movement in that particular part can be seen.

As patient is moving affected body part it is detected by accelerometer. Sampled signal is transmitted to microcontroller.

As per program in the microcontroller, it will change the count to one in the PC through Visual Basic software. Now each time if patient moves part it will get recorded in the database.



If patient moves its part more than certain value then buzzer will glow and LCD will show that patient is affected by autism disorder. Count to be measured is set by doctor as it is different for different patients.

As shown in figure, all data which is transmitted to PC can be observed on the screen such as temperature, pulse rate and moving parts of the body. This is for therapist to get information about tha patient who is under observation.

Transmission is done by using RF module which has range of 100-150 meters. So that therapist can observe results related to patient while sitting in his office.

V. CONCLUSION AND FUTURE WORK

In this paper, we presented new algorithm to continuously recognize the activities of autistic children that exhibit repetitive behaviours using wearable wireless accelerometer sensor system.

The system was used to detect hand/arm and body motions.

The proposed algorithm shows results which shows repetitive behaviour effectively.

We have also shown that the system is able to learn and quickly read patterns which may be critical and need attention. The system's ability to detect the behaviour of patient and to monitor different health related issues. It will to provide unbiased quantitative data and could be used with a treatment or intervention for behavio ur reversal therapy.

We have observed that excitement or stressful situations caused stereotypy or SIB. The next challenge would be enabling the system to predict the events before occurrence.

REFERENCES

[1]. T. Westeyn, K. Vadas, X. Bian, T. Starner and G. Abowd, "Recognizing Mimicked Autistic Self-Stimulatory Behaviors Using HMMs. Proceedings of the 2005 9th IEEE Int'l Symposium on Wearable Computers, 2005.

[2]. M. Madsen, R. el Kaliouby, M. Goodwin, R. W. Picard, "Technology for just-in-time in-situ learning of facial affect for persons diagnosed with an autism spectrum disorder", Proc. of the 10th ACM Conf. on Computers and Accessibility, Halifax, Canada, Oct. 13 -15, 2008.

[3]. C.-H. Min, A. H. Tewfik, Y. Kim, and R. Menard, "Optimal sensor location for body sensor network to detect self-stimulatory behaviors of children with autism spectrum disorder", 31st Annual Int'l Conf. of the IEEE EMBS, Minneapolis, MN, USA, Sep. 2-6, 2009, pp. 3489 – 3492.

[4]. C.-H. Min and A. H. Tewfik, "Novel Pattern Detection in Children with Autism Spectrum Disorder Using Iterative Subspace Identification", ICASSP 2010, Dallas, TX, USA, Mar. 15-19, 2010, pp.2266-2269.

[5]. J. R. Deller, J. H. L. Hansen, and J. G. Proakis, "Discrete Time Processing of Speech Signals", Wiley Interscience, pp. 471-484, 1999.

[6]. Center for Disease Control, http://www.cdc.gov/bcbddd/autism

[7]. Autism Society of America, http://www.autism-society.org