GlobSol

Ushering Humans Into A Brave New World

Introducing: Emote Sensor

Our company, GlobSol is developing a wearable monitoring device

EMOTE-SENSOR

to help **AUTISTIC CHILDREN COMMUNICATE THEIR EMOTIONS** better to the world and **ENHANCE THE QUALITY OF THEIR LEARNING** ,using vital body parameter data collection and analysis through Emotional mapping.

Introduction

What is Autism?

Autism is a complex developmental disability that typically appears during the first three years of life. The result of a neurological disorder that affects the functioning of the brain, autism impacts the normal development of the brain leading to reduction in various degrees in the areas of social interaction and communication skills. Children and adults with autism typically have difficulties in verbal and non-verbal communication, social interactions, and leisure or play activities

What are the problems faced by an Autistic Child?

1) Imagine every emotion you try to express, be it anger, frustration, sadness or happiness- all these emotions that you try to express go completely un-understood by the people around and that is precisely the world of an autistic child.

Emotional expression gives a certain depth to the human communication. It forms a vital part of the interaction between two humans as well as contributes a great deal towards the individual's acceptance into the society. We learn the basic emotional conditioning in our early years between the ages 5-10. We are unconsciously receptive to the emotional advances of our parents as well as the world around us, and we learn to identify and label our emotions as time passes.

But an autistic child is not 'wired' like the rest of us. The child's emotional conditioning is fraught with difficulties and loneliness. Autism is a neurological disorder which impairs the social interactions and communications, the symptoms being lack of emotional reactions, avoidance of physical contact, violent mood swings, often engage in repetitive behaviour and sometimes self-harm. If not caught early, Autism may pose a serious emotional blow to the child and may lead to complete dependence on the care-giver as well as total alienation from the society. If the disorder is ignored without therapy, the neurons make permanent connections and the autistic child would be mentally disabled for life.

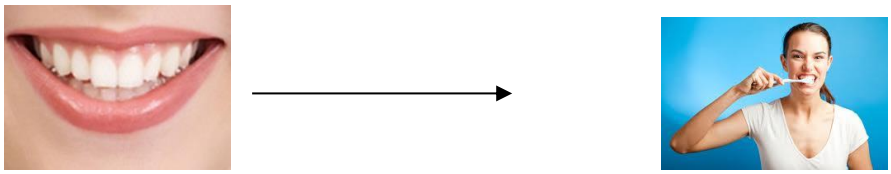
Autistic children have a problem with emoting unlike other average children. In our society, reading the facial expression tends to be an unconscious part of

communication and as these children lack that, they suffer from loneliness and alienation.

It is considered a taboo consulting a psychiatrist in today's society of most cultures. So even if this neurological disorder is caught early they fail to monitor the child's activity constantly and provide adequate therapy, which otherwise can improve the child's self-dependence and positive self-image**.**

The parents of autistic children are usually distraught at the fact that despite all their efforts to reach out to their child, they are unable to comprehend his complex, erratic emotions. There is a *need* to bridge this emotional gap that separates the poor parents from their own children.

2) The education of Autistic Children is based on the concept of conditioning, where the child is subjected to visuals repeated over a period of time since normal format of education has proved to be ineffective on them. For instance, if the child has to be taught how to brush his teeth, the sequence of pictures would include:



This form of education has been in use despite certain drawbacks. The major concern with educating an autistic child is that one does not get a feedback from the child on whether it's learning or not as the visible reaction to comprehension and non-comprehension of the taught lesson is usually the same and this a major hindrance as the whole point of education is lost if the child does not learn. Until the child is given the task of say, brushing his teeth, one cannot know what the child has learnt.

Another concern is that since the child does not show any visible reaction to the education imparted, there is the possibility that certain visual aids might adversely affect him. This is in cases where the visual aids causes an adverse effect not strong enough to bring about a violent reaction, but are mild in nature and would cause permanent negative conditioning of the child. Such adverse effects *need* to be identified and stopped for the proper upbringing of the child.

At a normal school, we would see that various students would excel in different areas based on their interest and understanding. Not all children would excel at everything. But they are made to adapt to the curriculum provided as they have the ability to do so. But every autistic child has his own needs and having a strict education system that forces them to adapt to it does not form a conducive atmosphere for the sensitive child. We need an education system that adapts to the need of *every individual* child that can identify the strengths and weaknesses of the ward in question.

Also, one important factor is that the student to teacher ratio in an Autistic school is usually 1:1. This ratio has to be maintained as every child has individual needs and have to be taken care of in order to make the child feel safe and comfortable.

Market Scenario and Analysis:

Identified Prevalence of Autism Spectrum Disorders
ADDM Network 2000-2008
Combining Data from All Sites

Surveillance Year	Birth Year	Number of ADDM Sites Reporting	Prevalence per 1,000 Children (Range)	This is about 1 in X children...
2000	1992	6	6.7 (4.5-9.9)	1 in 150
2002	1994	14	6.6 (3.3-10.6)	1 in 150
2004	1996	8	8.0 (4.6-9.8)	1 in 125
2006	1998	11	9.0 (4.2-12.1)	1 in 110
2008	2000	14	11.3 (4.8-21.2)	1 in 88

The above table shows the number of children suffering from Autism in the world. As the above table shows, there has been a steady growth of reported cases of Autistic kids in the world, across the last decade. As of 2008, there are about 1.136%(1 in 88) of the children in the world facing the difficulties of this disorder. According to the 2008 census, the numbers of children in the world are 1.9 Billion and $1/88^{th}$ of that comes to 21.5 Million individual people between the age group of 1-17. The population of the island continent Australia is around 22 Million. Thus, if ALL the autistic kids from the world were to come together, then they'd fill up an ENTIRE continent, the fifth largest country in the world- Australia. That is the current situation. The number of people who are suffering from this disorder is a staggering number and leaving them behind because of a mental disorder is not only wrong, but inhuman.

In India, there is a dearth of data on the number of Autistic people. This is primarily due to the social stigma associated with the disorder, thus pushing the parents not to reveal the autistic condition of the child, forcing the child to try

and lead a normal life. This worsens the state of the child and causes of irreversible damage. This product aims at providing that data about which we will talk a little later.

Studies show that individuals with an ASD had average medical expenditures that exceeded those without an ASD by $4,110–$6,200 per year. On average, medical expenditures for individuals with an ASD were 4.1–6.2 times greater than for those without an ASD. Differences in median expenditures ranged from $2,240 to $3,360 per year with median expenditures 8.4–9.5 times greater.

In 2005, the average annual medical costs for Medicaid-enrolled children with an ASD were $10,709 per child, which was about six times higher than costs for children without an ASD ($1,812).

There is a need for an inexpensive solution to this problem. Our device caters to people from all the socio-economic classes and backgrounds due to its low price.

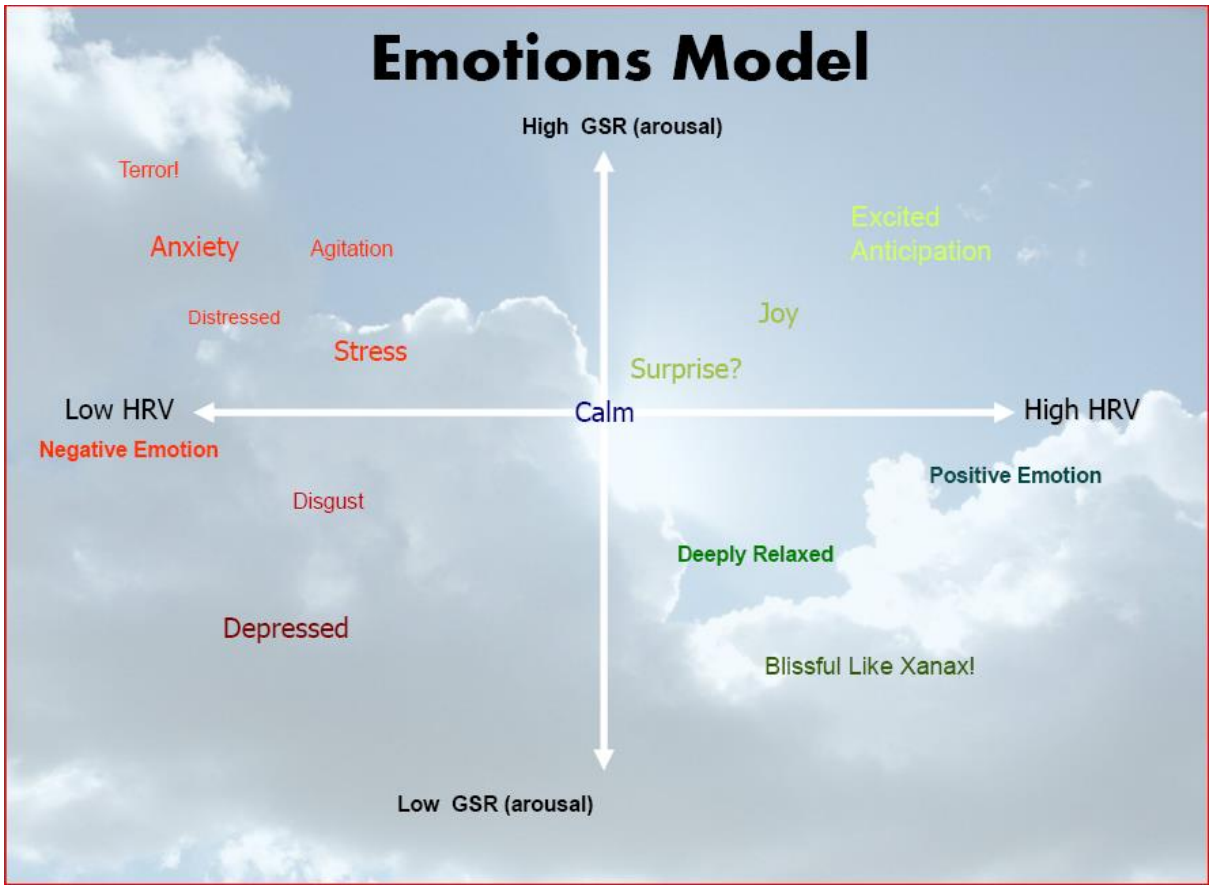
There is a need for an interface between the Autistic people and the rest of the world. And thus, we have our product- **Emote Sensor.**

The Product

The Device:

We have designed a wearable sensor wristband with an array of sensors, namely skin conductance sensor, temperature sensor and pulse meter. The device records the vital body parameters (pulse rate, body temperature, skin conductance) of the autistic child wearing it,maps them onto an emotional scale and through a biofeedback mechanism gives an insight into the autistic child's emotional behaviour .The readings are processed with a backend in the Android phone and the alert signals are sent onto the same device which are in the hands of the caretaker.According to a lot of the research study on Physiological basis of humans ,the polyvagal theory states '**EVERY PSYCHOLOGICAL REACTION HAS A PHYSIOLOGICAL BASIS TO IT'.**Our device taps right into this. Since the Autistic child cannot express its emotions ,we gauge them from the child's vital parameters and thus helping the child communicate its emotions to the world.

Skin conductance is effectively a direct measure of the conductivity of the autistic child's skin, which is affected by the secretions of the sweat glands, which is inturn directly connected with the brains physiological reactions to various emotions. This is a primary check of the erratic stressful emotions that hit the child. The secondary measure of emotions is done using the pulse measurements that are made. The tertiary check is done using the child's body temperature. Stressful emotions are known to have a non-periodic and erratic pattern where as positive emotions have a periodic pattern. Thus the algorithm that we have developed helps identify the triggered erratic spikes and differentiate between positive and negative emotions of the child wearing it . Collectively this data can be used to alert the caretaker of the autistic child's stressful or painful emotions and hopefully, just hopefully they could intervene and save the child from entering into an emotional escalation .



The Emotions Model(outcome of the thesis by MIT Media labs researchers) is a vital tool in mapping of emotions.The coordinates corresponding to:

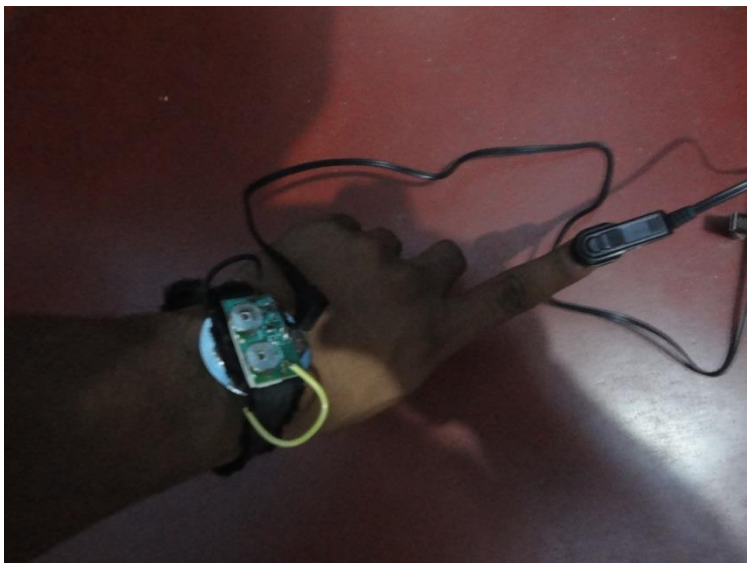
X-axis->Heart Rate Value(HRV) and Y-axis->Galvanic Skin Response(GSR).

Functionality of the device:

The device maps the lifestyle of the autistic child over a period of time, constructing a basic biological picture of the child through his vital stats. The data is collected continuously from these sensors and directed on to a micro-controller, which processes it and forwards it through Bluetooth to an android platform device.. The data flow and processing is as shown:

To judge their emotions better and to gain a significant insight into their minds, we have designed our device such that an Autistic child's needs are not ignored. Our device basically serves as an emotional barometer.

All the sensors along with the microcontroller ,bluetooth module and battery are mounted onto a flex PCB which is in turn embedded onto a watch like wearable band which is designed with an insulation layer of fr4 material (dermatologically safe) ,curved contact points with optimal surface area and with strap facilities (universal size-length of strap can be varied based on thickness of hand). The emotions which the autistic child fails to express, now can be tapped using the physiological changes in the child's body and made aware of to the caretaker via the android device (phone).



The hardware is now in place.But to have efficient functioning of the device we need a software interface.For this purpose we have developed two Android Apps-the Basic App and the Cloud Server App.

The Android App:

The Basic App performs basic tasks like calibration of the device (will be discussed in detail later) and sending in an alarm to the Android Device. Live data of body stats of the autistic child will be displayed on the Android device. Minimal cloud space will be occupied by this version to store average data values at a lower sampling rate. On the cloud, an approximating algorithm (such as a neural net) samples the incoming data at an accurate rate and approximates it. The result of the approximation is forwarded back to the phone. Based on the data crunched by the approximating machine, the resultant emotional state is inferred.

Analysis and reports which form a key role in biofeedback therapy and prognosis measurements will not be available.

The Cloud Server App is an upgradation of the Basic App.This version of the app will continuously store the data onto the cloud at a higher sampling rate and is used for progressive analysis. In this version of the App analysis of the collected data is done and a report is made available to the caretaker.
A larger cloud space is allocated for comparison and progress analysis of the child. The data over a certain period of time is recorded and forwarded to a therapist or the counselor responsible for overseeing the child's development.
There is a special feature of "Therapy ON" mode which will help analysis of the emotional behaviour of the child during therapy- pharmaceutical and psychological. The graphs representing the data in this mode will be represented in a differentiable colour to facilitate in prognosis.
For instance if the child wearing a band is undergoing therapy at 11 am uptill 1 pm.Then the graphs until 11 am will have one colour code, during therapy will have a different colour and post therapy will have another colour wjen the THERAPY ON mode is used. This would help get a feedback on the effectiveness of the therapy provided to the child in question.

Analysis and reports which form a key role in biofeedback therapy and prognosis measurements will be made available in this version of the app.

The wearable armband device along with the Android app constitutes our product.

Parents/caregivers can use this device to gauge the intensity of their child's emotional reactions, teachers could use this device to help the children learn better and they prove to be an invaluable tool in therapy sessions.

This data which is stored over the cloud can be used by a therapist for continuous monitoring of the autistic child's emotional behaviour and be used effectively in therapy. Our product helps to track the emotional escalation that precedes an outburst, allowing parents, teachers and doctors to identify better interventions, faster.
The data analysis reports can be useful in structuring therapies and customising learning methodologies for a child.The grasping ability of the child can be inspected through the data collected thus providing an efficient feedback mechanism.

Enhancing Quality of learning:

As mentioned earlier the Autistic children require a customised method of learning.If an average child was unable to follow anything in a classroom scenario, they would express their uneasiness. But the same is not the case with the Autistic child.To cater to their academic needs, Our device enhances their learning experience by giving the teacher an insight into the childs mind via the parameters that the device interprets. For instance if the child has not followed something, it is more likely to reflect onto the sensor data and show erratic

patterns.Similarly if the child has enjoyed a concept it will show positive(periodic) influence on the data.

This Biofeedback mechanism is a vital tool in also identifying the childs strengths and weaknesses based on the analysis made by the device . By measuring cognitive workload and emotional engagement in classroom settings, Emote sensor identifies the methods that best match each learner. Thus we are envisaging an education system that adapts to the need of *every individual* child that can identify the strengths and weaknesses of the ward in question.

Social Impact:

As mentioned above, Autism is a serious problem which cannot be ignored. Our product provides a necessary interface between the autistic child and the world. The device is serves like an emotional barometer to the child. It helps the parent monitor the child's emotional outbursts, erratic mood swings and sometimes even worse neurological conditions like epilepsy, which is quite common in autistic children. Our device calibrates the emotions of the autistic child, which would be an invaluable tool in therapy sessions as well as education for autistic children.

The main social impact we are looking at is the acceptance of Autistic people into the society. Our device helps the child condition his emotions through a bio-feedback mechanism. And if the conditioning is done early, the child may grow up into an independent, self sustaining and normally functioning adult.

Our **USP** being that we have personalised customization and calibration of the device to the autistic child who will be using it. According to the polyvagal theory, every psychological reaction has a physiological basis. But we know that every human is different, in the sense the body parameters (pulse, sweating rate, temperature) of one human being differ from another. This introduces a certain disparity as to how accurately our device measures the child's emotional outbursts and calibrates the child's emotions. We solve this with a unique, innovative technique which is called as calibration.

In calibration, Our device ‘observes’ the child over a certain period of time, tracking all the vital parameters and feeding them into an approximating engine. An approximating engine is one which uses the approximating algorithms such as neural nets and sets a reference point. Our device tracks the child’s parameters over a certain period, observes the high’s and low’s as well as the normal phases of the child and sets a reference. Using the reference, the child’s emotions are calibrated.

Our device adapts to the child, hence making the readings more personal and accurate. As our device learns the emotional patterns of the child, in any severe case where the child is prone to self injury, our device notices the pattern and alerts the care-taker about the child’s condition.