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"TACTUATOR" – A Tactile Stimulation based wearable for dyslexic

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Abstract— ***Reading is an intricate process involving several concurrent processes to occur in the brain. Many children are born with disabilities such as dyslexia. Dyslexia is specific learning disability in children. Developmental dyslexia is a common type of reading disorder in children that results from specific cognitive deficits in the phonological components of the language. The TACTUATOR is a tactile stimulation device that uses vibration motors for expressing each letter for the child to recognize the difference. Here vibrational cues are given to the fingers of the left hand from an input device. The TACTUATOR is a wearable device that the child can use while in movement also. It is known that the technological advancements are increasing at a faster pace. But the utilization of technologies in various sectors is very low. It is known that children with these disabilities are increasing in our country. So we propose a system where the children with dyslexia are able to learn and comprehend the text through vibrations. The system enables a tactile stimulation technique for an efficient understanding.***

Keywords- **Dyslexia; Vibrational patterns; Tactile stimulation**

I. INTRODUCTION

- Dyslexia as a disorder in which a child does not develop the skills of reading, writing, spellings that are expected in their age. The intellectual performance is reduced, despite of having regular access to schooling like other children.
- Dyslexia is believed to be caused by both genetic and environmental factors. It often occurs in people Dyslexia is believed to be caused by both with attention deficit hyperactivity disorder (ADHD) and are associated with difficulties in identifying numbers.
- It may also begin in adulthood as a result of some head injury or traumatic brain conditions.
- Dyslexia is diagnosed through a series of tests of memory, spellings, vision, speech therapy and some advanced ways in improving their reading skills. Sometimes insufficient teaching can also cause dyslexia.

The following are the sections elucidated. Section II describes about the existing methods that are involved in helping a dyslexic to improve their reading skills by speech therapy and audio discrimination with the help of Audio Discrimination. Section III explains the results and methods involved in helping the child read through vibrations present in the existing system. Section IV explains the drawbacks of the systems and the future enhancements that can be made to this system.

II. EXISTING SYSTEM

There are several theories, based on a variety of research perspectives, trying to explain the underlying causes of the developmental dyslexia. The Rapid Auditory processing theory explains the causes of this disability. This method specifies the primary deficit lying in the various sounds of the phoneme that are made up using the phonetics in the English language.

Interventions that the rapid auditory processing can be useful for children with dyslexia can be typically show the inordinate difficulty with the phonemes.

The phonological research has shown that children with dyslexia have a difficulty in also distinguishing the similar phonemes. Auditory discrimination refers to the ability to distinguish similar sounds.

The disorder is a learning disability that affects fluency and accuracy of reading also named to be a neurobiological disorder. Some disadvantages of this method are the child needs to take some time in

understanding the phonetics of some similarly spelt and pronounced words. As this method involves a whole hardware setup, the child has to sit in one particular place and read and comprehend the words in a particular text given. As this method is a speech therapy and involves auditory discrimination one must be very keen in listening to the phonetical sounds and comprehend the text. This might take quite a long time for the child to understand and overcome his/ her disability.

III.PROPOSED SYSTEM

Developmental dyslexia slow down the auditory discrimination in children. It hence poses as a major problem when it comes to their reading capability. In the existing systems efforts have been taken to increase the auditory discrimination by using hand gestures. In the proposed system, instead of focusing on the auditory discrimination, the process of reading is made simpler by the TACTUATOR (Fig 6).The system consists of a transmitter section where specific commands are sent to the user through vibrations. The vibrations are sent to the user through hand gloves (Fig 5) that is fitted with the vibration motors. The text is sent through a UART that is connected to the PIC16F877A microcontroller interfacing the gloves. Whenever a data is transmitted to the user, it is received by the gloves and the specific motor is driven accordingly. Now the user can identify the text sent to them and interpret it through the vibrations from the vibrators (Fig 3). The user can also transmit a message to the PC. This is done by interfacing a keypad (Fig 4) through the controller. When a text needs to be read, it can be sent as a text, received and interpreted by the child as a specific set of vibrations.

The microcontroller used here is PIC (Fig 1), Peripheral Interface the name given by microchip technologies to its single chip microcontrollers. The PIC micros have grown to become the most widely used microcontrollers in the bit microcontroller segment.

Programmable code protection, Power-saving Sleep mode, In-Circuit Debug, via two pins 10-bit, 8-channel A/D Converter, Brown-Out Reset, Analog Comparator module are a few special microcontroller features that can be used.

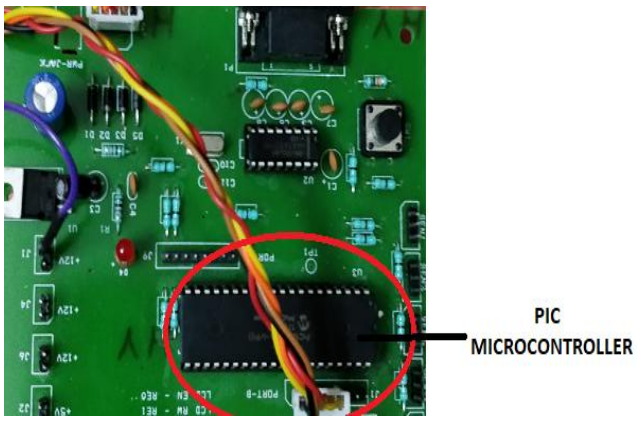
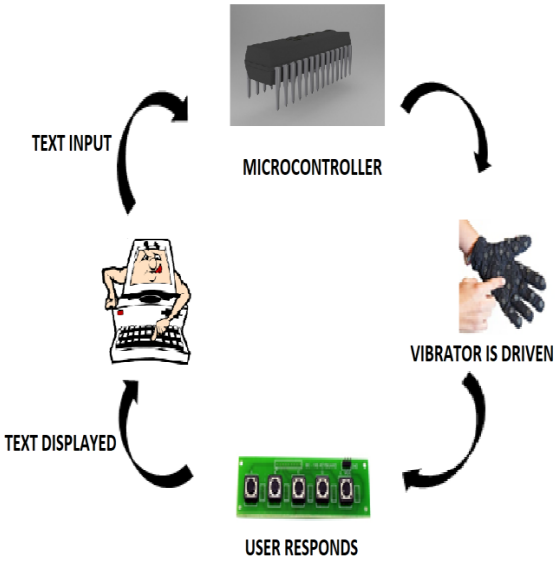


Fig 1: MICROCONTROLLER

The transformer that is used in this model is a static electrical device which transfers energy by inductive coupling between its winding circuits. A varying current in the primary winding creates a varying magnetic flux in the transformer's core thus varying the magnetic flux through the secondary winding. This varying magnetic flux induces a varying electromotive force (EMF), or voltage, in the secondary winding.

Fig2: **BLOCK DIAGRAM**



Here is a 5V power supply circuit using LM 7805 IC. LM7805 is a famous positive voltage regulator IC comes in three terminal provides fixed 5V DC output. This IC has many built in features like internal current limiting, thermal shut down, operating area protection etc. The IC will become hot during the operation so it is essential to use a good heat sink.

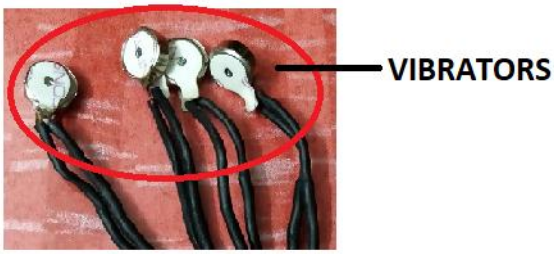


Fig 3: VIBRATORS

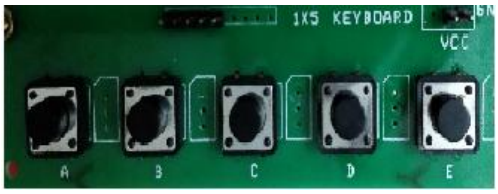


Fig 4: KEYPAD

Fig 5: HAND GLOVES



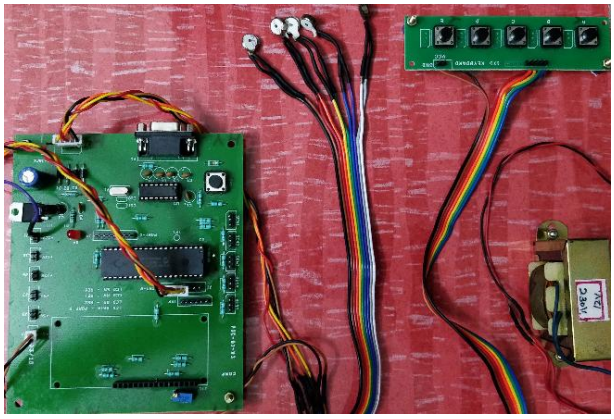


Fig 6: TACTUATOR

The CPU accesses both rows and columns through ports; therefore, with two 8-bit ports, an 8*8 matrix of keys can be connected to a microprocessor. When a key is pressed, a row and a column make a connection; otherwise, there is no connection between row and column. This way the microprocessor transmits the signals.

IV.ARRANGEMENT OF VIBRATORS

The vibrators are arranged in such a way that all alphabets in the English language can be accommodated. The 26 alphabets are arranged in the order of their increasing frequency of usage. This was derived from the Linotype keypad layout. In this arrangement, the vowels and the letters t, n are placed on the thumb. The letters s/h ,r/d ,l are placed on the index finger using 3 motors by vibrating s and h on the same motor showing difference by the duration of vibration. Similarly, the middle finger is fitted with c/m, f/w and y/p. Going in the descending order of frequency of usage of alphabets, w/b, g/k, q/j on the ring finger. x and z being the least used are placed on the little finger. This arrangement makes the child learn easily and differentiate between the various alphabets and make their reading process more easier and helps overcome their disabilities. By this arrangement of the alphabets the child is able to differentiate between the similarly pronounced words and make his reading better and similar to that of the normal children who does not suffer from this disability. The following Fig:7, depicts the arrangements of the vibrators.

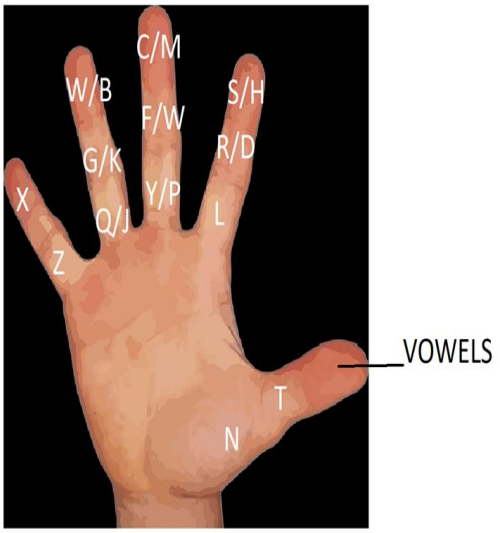


Fig 7: ARRANGEMENT OF MOTORS

V. CONCLUSION AND FUTURE ENHANCEMENTS

The dyslexia is still not characterized and understood by the society. There are no specificities as being done for the other disabilities. The goal of this research was designing and implementing a tactile stimulation device to increase auditory discrimination in children with developmental dyslexia who are slower than average in developing auditory discrimination. Comparing the actuator and the Tactile Arm Wrap, it can be concluded that there are two main ideas for tactual transmission of speech. The first one is using a few actuators with various stimulations, and the second one is using multiple actuators with identical stimulations for creating the vibrational paths.

In future instead of giving the input through a PC an android application can be developed such that the input can be given through the application. Using this the entire device is portable. Another enhancement is that the language of the input can be changed depending upon the user's language and the input can be stored in cloud such that the user need not give the input again and again.

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