

Snoezelen Bubble Tube – A Therapy for the Mentally Challenged People

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Abstract -According to census 2001, it is estimated that over 21million people in India are suffering from one or the other kind of disability. The mentally challenged people are nearly 10.3% of the disabled people.As per the Census 2011, In India out of the 121 Cr population, 2.68 Cr persons are 'disabled' which is 2.21% of the total population. This is quite a huge percentage. The snoezelen therapy is now effectively being used for the development of the mentally challenged people.

The mentally challenged people cannot communicate with others comfortably. They suffer from behavioral disturbances. This often kills a mentally challenged person which leads him to resentment. They may get into depression when they are alone and often feel disturbed and cannot come out of this state by themselves. One way to get them out of their depression is to provide them some entertainment in the form of music or by providing some colors appear in front of them. The bubble tube also provides multisensory stimulation and cures the people who are offering from initial stages of dementia. The snoezelen therapy is now being used for curing the people suffering from autism and other developmental disorders such as dementia and brain injuries.

This concept is being used in many fields such as schools, hospitals and in many places. Ultimately the snoezelen bubble tube will be useful to provide entertainment to every person. The snoezelen bubble tube will be a very useful product and as this is developed taking economic factors into consideration, it is cost effective and is affordable to everyone.

Index terms- Snoezelen, Voice activation.

I. INTRODUCTION

A. Motivation:

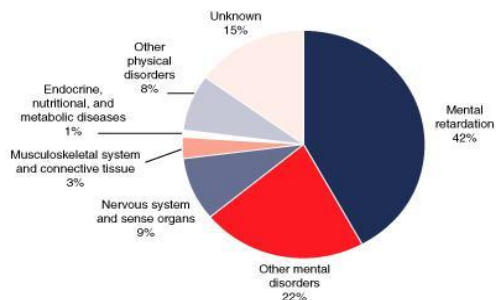
Depression is the main cause for a person's illness. When we consider a mentally challenged person, he will be often frustrated and behaves in an abnormal manner. Also the Percentage of the people having mental disorders is quite high. As mentally challenged people are often disturbed and are not interactive, they need some means to get concentrated and to be stabilized. Even the caretaker finds it difficult to control them and calm them from morning to evening. As a mentally challenged person can't express his feelings, he needs some help. It will be difficult to control them and they are not communicative in such situation.

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Figure 1: Statistics of differently abled people according to census 2001



The chart shown in Figure1 & Figure 2 represents the percentage of people having different disabilities like physical disorders, mental disorders, Nervous disorders and other disabilities distributed around the world.

Type of disability	Rural			Urban		
	P	M	F	P	M	F
Mental Retardation	1300	715	585	388	218	169
Mental Illness	2225	132	903	673	397	276

According to the census 2011 the number of cases either mental illness or mentally retardation is represented the table.

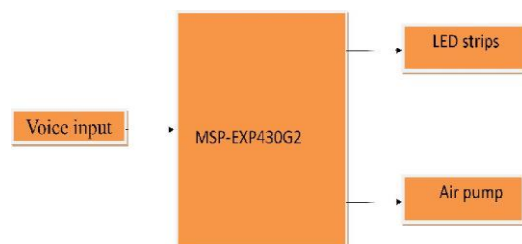


Figure 2: Statistics of differently abled people according to census 2011

There are some devices based on this therapy. But they are not voice-activated. They are operated with a 4-way switch. There are existing devices that can be addressed for this purpose. The device that is used at

present is not affordable by the common man which costs around thousands. It is also heavier and lacks portability.

B. Technical Background

SNOEZELEN is a multi-sensory environment that incorporates equipment and materials that offer a broad range of sensory experiences. Snoezelen is a therapy that creates some relaxation. This is used to cure developmental disorders such as autism. Some of the existing devices are color changing panel and Bubble tube with a 4-way switch.

C. Color changing panel:

In the color changing panel, the screen will automatically change its color once the panel is switched on. The user just sits in front of it and he observes the variation in colors. He interacts with it just by looking at it.

D. Bubble tube with a 4-way switch:

This consists of a 4-way switch in which each switch represents one particular color. The pressing of that particular switch makes the corresponding color LEDs glow. The user interacts here by switching the desired color



LEEDs.

Figure 3: Color panel



Figure 4: Tube with 4 way switch

E. Draw backs of the existing devices:

The color changing panel and the tube with a 4 way switch are some devices existing so far.

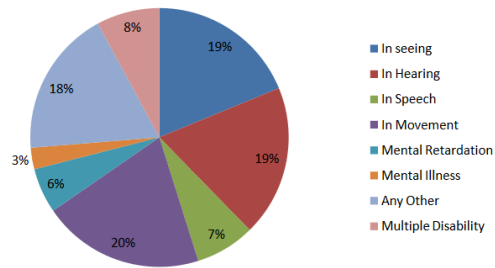
The tube with 4 way switch is not portable and also when the person clicks on a particular color switch, the corresponding colored LEDs glow. As the person has to look at the same color for long time he may feel monotonous after a short period of time. The color changing panel also lacks port ability and is also expensive.

F. Proposed Solution

The target of our project that we have developed, are the mentally challenged people. Basically children get enchanted by colors. For instance when a rainbow appear s in front of them they feel much excited and delighted. This excitement will be more in case of mentally challenged children.

Figure 5: System level diagram of Interactive Snoezelen bubble tube

Disabled population by type of Disability in India - Census, 2011



the project Interactive Snoezele n bubble tube, the voice is taken as input which is then fed to the microcontroller after it is amplified. This simultaneously drives the two segments-LED Strips and Air pump which

are necessary to produce bubbles inside the tube, to display the variation of colors simultaneously. As this works with voice as input, we should not incorporate the melody circuit.

According to the present economic conditions in the world, middle and lower middle class people occupy the highest percentage in population. The project is done considering them and is made cost-effective. Portability is one additional feature along with the voice-activation.

G. Organization of the Report

The rest of the report presents the following sections:

Section1 gives us a brief idea about the area we got motivated and the people who are benefited by the project with the advancements made in the project compared to the existing products. Section2 brings the internal structure with the blocks containing the main components of the mechanism.

Section3 gives the idea about how this is implemented both on hardware and software and the challenges faced while realizing the design. Section4 gives the results of both and software implementations. Section5 conclude and give the details of the tasks accomplished and the future extension of the project.

II. PROPOSED SOLUTION

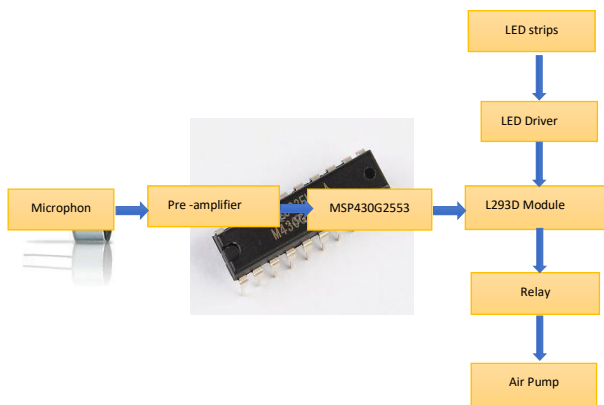
A. Block Diagram:

The microcontroller MS P430G2553 gets the input from a microphone whose output is sent to the pre-amplifier section. The maximum output obtained from the microphone when voice is give is around 100milli volts. Then the pre-amplifier section amplifies it to 2 or 3 volts according to the pitch of the voice. The maximum voltage that can be given to the microcontroller is 3.56 volts.

The output of the amplifier section is given to the controller which drives LED strips and air pump. A relay is used in between the air pump and the micro controller to

drive the air pump along with an L293D module. The air pump is used to produce the bubbles. Uln2003 acts as a driver for the LED strips which operates at 12 volts. Cost and portability are the additional features added along with the voice-activation which makes it affordable by the common man. It is provided with good electrical insulation.

Block diagram of Interactive snoezelen bubble tube:



Component Selection:

Microphone: A microphone is a transducer or a sensor that converts sound into an electrical signal. This is an input device which takes analog signals as input such as voice. As this project is done taking voice activation as key feature, this is taken as an input device.

MSP430G2553: This is a 20 pin IC and belongs to a mixed signal microcontroller family from Texas Instruments. It is built around a 16-bit CPU, the MSP430 is designed for low cost and specially low power consumption environment. This consists of two ports which are sufficient for the project and the Analog to Digital conversion can be done using this g2x53 only.

B.L293D module:

This module consists of 2 inputs and 2 outputs with 2 enables. This drives the output voltage and it is used to drive the LED driver and a relay here to drive LED Strips and air pump respectively.

C.Relay:

A relay is used as a switch. The input voltage to be given to switch on a relay is 3 to 5V. When the relay is switched on, the Air pump produces bubbles when placed in water.

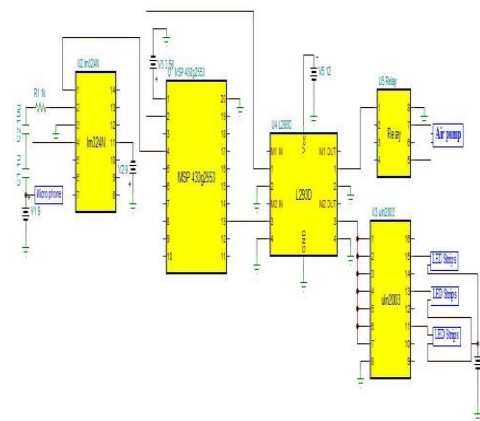
D.LED Strips:

The LED strips that are used here are flexible SMD led strips where SMD stands for surface mount devices. These are basically small and are light LED chips that are surrounded by epoxy resin. These are used to produce different patterns of colors.

III IMPLEMENTATION

A. Hardware Implementation

The input given to the bubble tube is voice. This is given through a microphone which is then sent to the lm324N which is used here to act as a pre-amplifier. Then it is sent to the controller, the voltage of which is sent to L293D to increase the voltage. The output of the module is given to the relay through a 5V regulator to avoid any



voltage disturbances. The two outputs of the module are sent to relay and uln2003 for air pump and LED Strips.

Figure 6: Schematic Diagram of Interactive Snoezelen Bubble Tube

The voice is given to a microphone whose output is sent to the 2nd pin of IC lm324N. The 3rd pin is made ground. The 4th pin and 11th pin are given to positive and negative 9v respectively. Now, the first stage of pre-amplifier section is built. As this is a quad-comparator, 4 similar kinds of amplifier stages can be built. The output is taken at the 1st pin.

The 1st pin of the lm324N is given to P1.2 which is the input of the microcontroller for A to D conversion. The remaining pins of port1 are taken as outputs. P2.5 is taken as ADC output and is given to one of the inputs of L293D, a motor driver. The other input of the motor driver is taken from P1.1. The two outputs of the drivers are for LED strips and the motor.

The output of the driver IC for which P2.5 is input is given to all the pins of LED driver and its 8th pin is grounded. The output of any one of the pins is connected to LED strips. The output of L293D for which P1.1 is the input is given to the supply pin of relay. The 8th pin is grounded and the common terminal is given to the air pump.

B.Pre-amplifier design:

The output of the pre-amplifier section is fed to the controller. The input voltage given to operate the controller is obtained by properly adjusting the potentiometer value. During this process when the input is very high, the ADC output of the controller used to become 0XFF and then come to halt and never show any variations in the output until it was restarted. The problem is overcome by adjusting the potentiometer value such that it is neither too high nor too low.

C.Voltage Insufficiency:

As the microcontroller is an ultra-low power controller, its output is too low. So, the output voltage was not sufficient enough to drive the air pump and the LED Strips. The appropriate voltage driver was chosen but there still exists some fault in the output. The strips didn't glow. Again the current driver was added to the circuit to give enough current which then lit the strips.



Figure 7: Final prototype of Interactive Snoezelen Bubble Tube

This is the final prototype and as we see, the LED strips are blinking and the air pump is evolving bubbles. All this happens when the voice is given as input to the microphone. It then gives some relaxed feeling to the person who interacts with it. The PCB implementation of the bubble tube is shown in the figure8 which gives the details of the connections of all the components.

D. Software Implementation:

The microcontroller consists of two ports. The port1 is initialized as input and the port2 is initialized as output. This is done by using the DIR command. The microphone checks for the input, which is the voice here. If the voice is given, the two processes start functioning. The relay drives the air pump after which the bubbles start evolving and the ADC output comes from port2 which is initialized as output. Then the LED strips start blinking according to the voice.

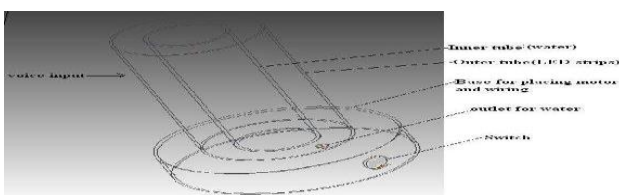


Figure 8: PCB implementation of Interactive Snoezelen Bubble Tube

III RESULTS

A.Pre-amplifier output:

The output of the microphone is sent to the pre-amplifier circuit. This input is then amplified to the required voltage by properly adjusting the gain with a variable potentiometer. The bread board implementation of the pre-amplifier circuit is as shown in figure9. The input and the 1-stage output of the pre-amplifier circuit are obtained as shown in the figure10 with the help of Analog discovery kit. The blue colored signal indicates the output of the microphone and input of the pre-amplifier circuit. The orange colored signal indicates the amplified output signal.

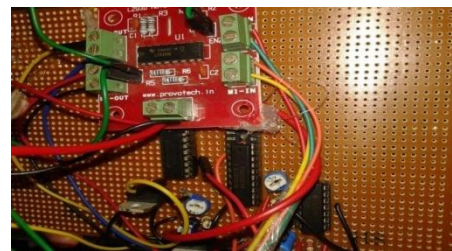


Figure 9: Flow chart of Interactive Snoezelen Bubble Tube

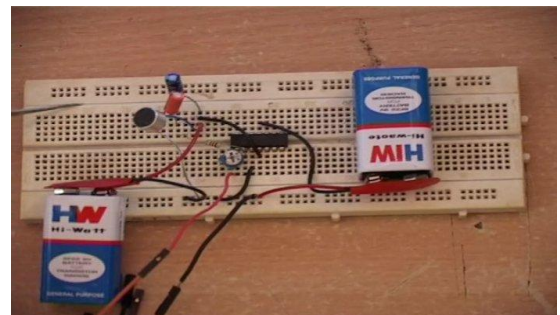


Figure 10: Bread board implementation of Power supply circuit

B.Outer case design in AUTO-CAD:

The bubble tube consists of two concentric glass tubes and these tubes are placed on the base part. The PCB and the air pump are also placed in the base part itself. On the base, two holes are made in which, one is for the microphone and the other is for the switch. The LED strips are attached to the inner side of the outer tube and the water is filled in the inner tube.

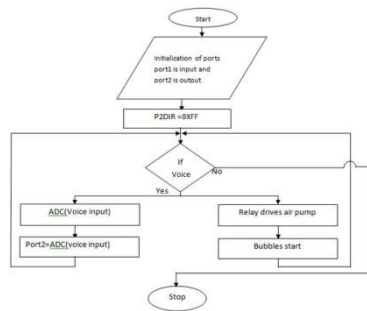


Figure 11: Outer case design of Interactive Snoezelen Bubble Tube

V. CONCLUSIONS

The target of the project is to vary the brightness of the LED Strips in accordance with the voice and to run the air pump. The goal is reached with the help of ADC.

In the world as per the present scenario, economic conditions play a major role. The middle class and lower middle class people are dominant in number. As, this was designed based upon a therapy, it was costly. Now, the Interactive snoezelen bubble tube is designed taking them into consideration and is made cost-effective. As this is a therapy, it will greatly have an impact on the person and he will feel that some control is there in his hands that improves his confidence levels. Complexity is one such issue. It is now made compact which makes it feasible for transportation. Safety is the other major concern. So, proper electrical insulation is provided to it in order to avoid hazards.

This project is technically improved by the addition of voice-activation. This can further be developed by making it touch activated. This makes him even more interactive and helps the person in such situation.

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