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Automatic Ear-Level Sound Generator for Tinnitus

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ABSTRACT: This paper describes different treatment and controlling methodologies used for tinnitus management. In the 21st century, the prevalence of tinnitus is increasing, impacting approximately one in five people. It is a very complicated condition that significantly affects quality of life. Despite the availability of hundreds of tinnitus treatment options, none are very successful. In light of this, there has been a steady increase in studies on tinnitus treatments in the recent past. In this survey paper, we describe and compare many techniques used for tinnitus management

KEYWORDS: Sound frequency masking, Bluetooth connectivity, Sound therapy, Customizable treatment, Dual modes

I. INTRODUCTION

Tinnitus is the perception of sound in the absence of external auditory stimulation. Numerous tinnitus patients describe symptoms such as frustration, annoyance, irritability, anxiety, sadness, hearing issues, Hyperacusis, insomnia, and concentration difficulties. It is anticipated that tinnitus will continue to rise in the 21st century due to the fast-paced lifestyle, demographic shifts, and increased occupational and recreational noise exposure. Numerous attempts have been made to treat or even cure tinnitus, yet no treatment or intervention provides a completely satisfactory solution. There are specific treatment options for certain subtypes of tinnitus. CBT alone or in conjunction with trans cranial magnetic stimulation (TMS) can effectively reduce tinnitus. In addition, the American Clinical Practice Guidelines for Tinnitus continue to recommend hearing aids, health counselling and education, cognitive behavioural therapy, and auricular therapy as the primary treatment strategies. The Guideline does not recommend drugs, diet, or neuromodulation techniques due to the lack of medical evidence supporting the use of drugs and neuromodulation.

II. RELATED WORK

The current landscape of tinnitus management primarily relies on subjective therapeutic interventions, with limited automated and accessible solutions. Some tinnitus patients use white noise machines or wearable devices that produce background sounds to mask the ringing or buzzing sensation. However, these devices often lack the capability to adapt to the dynamic nature of tinnitus. Behavioural therapies, such as CBT, are commonly employed to help individuals cope with the psychological impact of tinnitus. While effective for some, these approaches require regular sessions and may not address the immediate, on-demand relief needs of patients. Medications, such as anti-anxiety drugs or antidepressants, are sometimes prescribed to manage tinnitus-related stress and discomfort. However, their efficacy varies, and side effects may limit their suitability for some individuals. For patients with both hearing loss and tinnitus, hearing aids are often recommended to amplify external sounds. While they may alleviate the symptoms to some extent, they do not provide a targeted and customizable solution for tinnitus alone. Various mobile applications offer sound therapy options, allowing users to listen to different sounds or music to mask tinnitus. However, these apps may lack real-time adaptability and integration with the patient's immediate environment.

III. METHODOLOGY

The proposed system is an innovative and accessible solution for tinnitus management, introducing the "Automatic Ear-Level Sound Generator for Tinnitus" using Arduino technology. The system aims to provide both automatic and manual modes for on-demand relief and personalized interventions. In the proposed system we integrated both the technical and therapy based treatment, which will be more convenient for the patients to customise it based on their

interest. The proposed system is more sensitive to capture the behaviour of the surrounding nature, the condenser microphone is the component which senses the deep silent behaviour of the surrounding. We also included the two modes to the device to provide more convenient practice to the patients, to display the mode and other information we introduced a LCD display to it. The proposed system provides more real time accuracy to the device and the treatment.

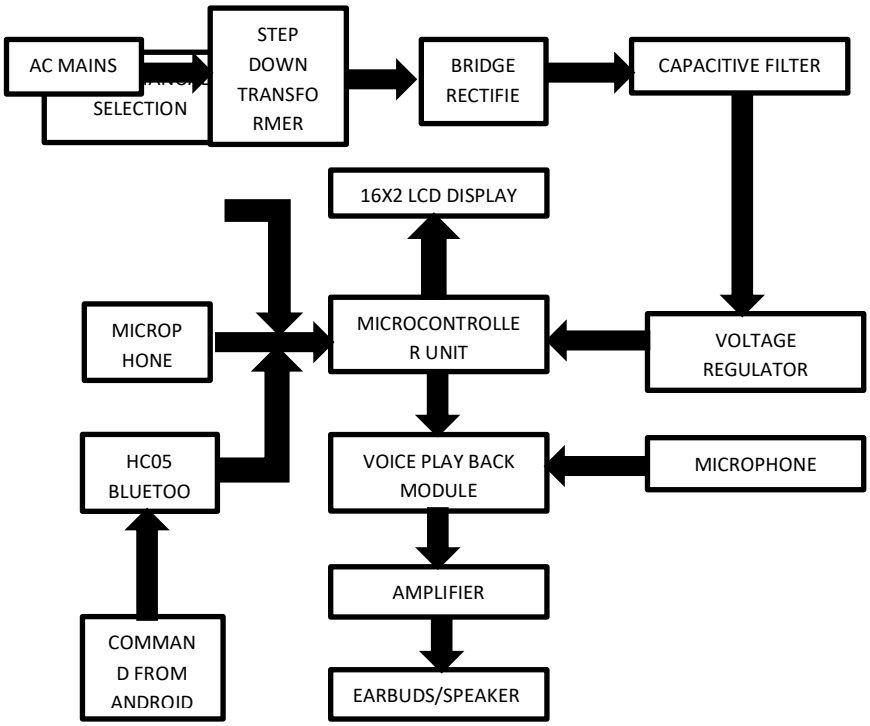

Fig.1 Block diagram of proposed system.

COMPONENTS

ARDUINO UNO:

Arduino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog Inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP Header and a reset button. It contains everything needed to support the Microcontroller; simply connect it to a computer with a USB cable or power it With an AC-to-DC adapter. Arduino Uno has a number of facilities for Communicating with a computer, another Arduino board, or other microcontrollers.

16 X 2 LCD:

This is an LCD Display designed for E-blocks. It is 16 characters, 2-line alphanumeric LCD display connected to a single 9-way D-type connector. This allows the device to be connected to most E-Block I/O ports. The LCD display requires data in a serial format, which is detailed in the user guide below. The display also requires a 5V power supply. Please take care not to exceed 5V, as this will cause damage to the device. The 5V is best generated from the E blocks Multi Programmer or a 5V fixed regulated power supply. The 16 x 2 intelligent alphanumeric dot matrix displays is capable of displaying 224 different characters and symbols. A full list of the characters and symbols is printed on pages 7/8 (note these symbols can vary between brand of LCD used). This booklet provides all the technical specifications for connecting the unit, which requires a single power supply (+5V).

POWER SUPPLY (7805 IC Voltage Regulator):

A regulated power supply is very much essential for several electronic devices due to the semiconductor material employed in them have a fixed rate of current as well as voltage. The device may get damaged if there is any deviation from the fixed rate. The AC power supply gets converted into constant DC by this circuit. By the help of a voltage regulator DC, unregulated output will be fixed to a constant voltage. The circuit is made up of linear voltage regulator 7805 along with capacitors and resistors with bridge rectifier made up from diodes. From giving an unchanging voltage supply to building confident that output reaches uninterrupted to the appliance, the diodes along with capacitors handle elevated efficient signal conveyed. ICs regulator is mainly used in the circuit to maintain the exact voltage which is followed by the power supply. A regulator is mainly employed with the capacitor connected in parallel to the input terminal and the output terminal of the IC regulator. For the checking of gigantic alterations in the input as well as in the output filter, capacitors are used. While the bypass capacitors are used to check the small period spikes on the input and output level. Bypass capacitors are mainly of small values that are used to bypass the small period pulses straight into the Earth.

TRANSFORMER:

A transformer is an electrical device that transfers electrical energy between two or more circuits through electromagnetic induction. Electromagnetic induction produces an electromotive force within a conductor which is exposed to time varying magnetic fields. Transformers are used to increase or decrease the alternating voltages in electric power applications. It is a step down transformer in which the secondary winding is more than primary winding. Due to these windings it can able to step down the voltage. A Transformer changes electricity from high to low voltage or low to high voltage using two properties of electricity.

BLUETOOTH MODULE:

The HC05 Bluetooth Module can be used in a Master or Slave configuration, making it a great solution for wireless communication. You can use it simply for a serial port replacement to establish connection between MCU and GPS, PC to your embedded project. The HC05 Bluetooth Module has 6 pins Vcc, GND, TX, RX, Key, and LED. It comes preprogramed as a slave, so there is no need to connect the Key pin, unless you need it change it to Master Mode. The major difference between Master and Slave modes is that, in Slave mode the Bluetooth module cannot initiate a connection, it can however accept incoming connections. After the connection is established the Bluetooth module can transmit and receive data regardless of the mode it is running in. If you are using a phone to connect to the Bluetooth module, you can simply use it in the Slave mode. The default data transmission rate is 9600kbps. The range for Bluetooth communication is usually 30m or less. The module has a factory set pin of "1234" which is used while pairing the module to a phone. The HC-05 module can build a connection to other modules.

E.g. a Robot being a master and connecting to slave Bluetooth module. Or in slave mode to make a wireless bridge to a notebook.

VOICE PLAYBACK MODULE:

The single voice playback (ISD18B20), which is a single-chip, single- message record/playback device. Recordings are stored into on-chip non- volatile memory, providing zero-power message storage. With the embedded Flash memory employed, data retention up to 100 years and typical 100,000 erase/record cycles can be reached. Time for recording is 8-20 seconds. Loop, jog playback and single-pass playback features are present in this module. This module having high quality voice recording and high fidelity replay. It can be used as a speaker module and can be controlled through microcontroller MCU.

ISD1820 VOICE RECORDER:

Voice Record Module is based on ISD1820, which a multiple-message record/playback device. It can offer true single-chip voice recording, no-volatile storage, and playback capability for 8 to 20 seconds. The sample is 3.2k and the total 20s for the Recorder. This module use is very easy which you could direct control by push button on board or by Microcontroller such as Arduino, STM32, Chip Kit etc. Frome these, you can easy control record, playback and repeat and so on.

MICROPHONE SENSOR MODULE:

Typical Use Cases of Condenser Microphones. Most commonly, condenser microphones are used in the studio where their superior frequency and transient response, as well as their lower self-noise, are great for capturing clean, high-fidelity recordings that are true to the sound source.

IV. EXPIRIMENTAL RESULTS

A real-time model of an automatic ear level sound generator for tinnitus is obtained.In automatic mode, the arduino continuously monitors the surrounding noise through the condensor microphone to identify prolonged period of deep silence and generate a buzzing sound to mask the tinnitus noise inside the ear.In manual mode, it allows user-controlled treatment through Bluetooth connectivity to an external android application by which patients can customize their treatment using commands send via Bluetooth. Additionally the user can enable various applications of music therapy, sound therapy or other personalized interventions using earbud speakers.

V. CONCLUSION

In summary, the development of the Automatic Ear-Level Sound Generator for Tinnitus using Arduino technology represents a significant stride in the field of tinnitus management. This innovative system combines automated detection of tinnitus absence with user-customizable interventions, offering a dynamic and versatile solution to address the challenges faced by individuals affected by tinnitus.

The proposed system, with its cost-effective Arduino-based design, aims to bridge these gaps, offering a user-friendly and adaptable tool for individuals seeking relief from tinnitus symptoms. Moreover, the emphasis on open-source collaboration and documentation promotes transparency, sharing of knowledge, and potential advancements in tinnitus management technology. By fostering collaboration among developers and researchers, the proposed system has the potential to evolve and adapt based on collective insights and innovations.

In conclusion, the Automatic Ear-Level Sound Generator for Tinnitus is poised to make a meaningful impact on the lives of tinnitus patients. Its applications range from home-based management to contributing valuable data for tinnitus research. This project not only addresses the immediate needs of those affected by tinnitus but also lays the groundwork for future advancements in the field, emphasizing the importance of accessible and user-centric solutions for tinnitus management.

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