International Journal Dental and Medical Sciences Research
Volume 5, Issue 5, Sep-Oct 2023 pp 94-104 www.ijdmsrjournal.com ISSN: 2582-6018

Design and Implementation of Electroceutical for the Treatment of Herpes Zoster in Primates and Post-Zoster Neuralgia

Whi-Young Kim
Department of Digital Healthcare, Pusan Healthcare University, 16, 55th-gil, Sari-ro, Saha-gu, Busan, Korea, 49318

Date of Submission: 05-09-2023 Date of Acceptance: 15-09-2023

ABSTRACT: After complete recovery from chickenpox, the varicella-zoster virus remains latent in the dorsal root ganglia and cranial nerve ganglia. Reactivation can occur after a period of latency, during which the dormant virus can occasionally become active. However, it is suppressed by cell-mediated immunity. When cellular immunity is compromised, the virus can replicate within the neurons of the ganglia, leading to neuronal destruction and the development of pain by causing rash and blister formation.

Additionally, sympathetic nerves are stimulated, causing contraction and dilation of arterioles and microvessels. Sympathetic signals transmitted through the spinal cord influence the activity of sympathetic nerves in skin blood vessels and fibres, thus increasing blood flow.

Consequently, this process can reduce cellular necrosis, enhance cellular activity such as enzyme activation through ion movement across the cellular membrane, induce depolarization and changes in membrane potential, facilitate growth factor secretion, calcium ion transport, chondrocyte synthesis, and more. Ultimately, this approach holds potential for pain management. A single-loop treatment coil is proposed for effective management of both shingles and post-herpetic neuralgia (PHN), providing a promising therapeutic strategy for addressing the lesions and pain associated with herpes zoster."

KEYWORDS: dorsal root ganglion, cell mediated immunity, herpes zoster, post-herpetic neuralgia (PHN)

I. INTRODUCTION(11 BOLD)

[1].Neural damage or tissue inflammation are chemically and anatomically linked processes. Abnormal activation of alpha-adrenergic receptors in primary sensory nerve cells, or the formation of connections between centrifugal sympathetic nerve fibers and primary sensory nerve cells during the regeneration process, are examples of how the sympathetic nervous system contributes to pain[1].

Treatment strategies for shingles involve addressing skin lesions, controlling pain, and preventing progression to post-herpetic neuralgia (PHN) in the acute phase. Pain control plays a crucial role by regulating acute-phase pain and suppressing central sensitization to prevent the development of PHN. Conventional treatments often include early administration of antiviral agents, preferably within 50 hours of onset, and the simultaneous use of steroids to suppress inflammation and nerve damage. While this combination can alleviate acute pain, it may not effectively prevent the occurrence of post-herpetic neuralgia[2].

Shingles is a disease caused by the reactivation of the varicella-zoster virus (VZV). It manifests as vesicular lesions along sensory nerves, with characteristic rash patterns and blisters following the distribution of sensory ganglia, including those in the thoracic spinal nerves, the fifth cranial nerve, and the seventh cranial nerve[3]. Shingles and post-herpetic neuralgia are characterized by severe pain and various motor impairments. Patients experience allodynia during the acute phase, and the likelihood of developing post-herpetic neuralgia increases with longer periods between shingles outbreak and nerve blockade. Post-herpetic neuralgia is accompanied by intense burning pain, intermittent shooting pain, neuralgia, and allodynia. Chronic inflammatory cells are found in the dorsal root ganglion (DRG) and peripheral nerves following the occurrence of post-herpetic neuralgia.

In this study, the application of magnetic pulses triggers ion activation within muscles, nerve cells, and microvasculature, leading to improved blood circulation and a shift from acidic to alkaline body fluids. Additionally, sympathetic nerves are stimulated, causing arterioles and microvessels to contract and dilate. Sympathetic signals transmitted through the spinal cord influence the activity of sympathetic nerves in skin blood vessels and fibers, thereby enhancing blood flow[4]. This method reduces cellular necrosis, enhances cellular activity,

International Journal Dental and Medical Sciences Research
Volume 5, Issue 5, Sep-Oct 2023 pp 94-104 www.ijdmsrjournal.com ISSN: 2582-6018

influences membrane potential changes and ion movement through cellular membranes, facilitates growth factor secretion, calcium ion transport, chondrocyte synthesis, and more. Ultimately, it holds the potential for pain management. A single-loop treatment coil is proposed for effective management of both shingles and post-herpetic neuralgia (PHN), providing a promising therapeutic strategy for addressing the lesions and pain associated with herpes zoster."

II. MATERIALS AND METHODS

In this study, the system is composed of a capacitor to store the necessary energy for stimulation and a coil to generate a strong magnetic field. When a short and intense current is applied to the stimulation coil, a pulsed magnetic field is formed. The time-varying magnetic field induces electric currents within human tissues, stimulating nerves. This principle allows for the generation of stimulation intensities of around several teslas with pulse widths in the hundreds of microseconds range. The system configuration includes the ability to attach and detach the therapeutic stimulation coil to the nerve stimulation device, and an LED is added to indicate anomalies in the affected area[5].

An EMG sensor module is also optionally included, consisting of an energy harvester and an analog EMG front-end. It is designed to be lightweight and compact for portability and mobility, and can be interfaced with a cell phone to enable real-time monitoring of the user's condition. This facilitates communication and coordination with medical facilities, enabling prompt intervention in case of severe symptoms. Overall, this system serves as an animal-targeted treatment device for shingles and pain relief. It is designed to provide convenience and mobility, allowing for easy attachment of additional stimulation coils based on performance and capacity needs[9].

III. SYSTEM COMPOSITION AND PRINCIPAL

Figure 1 illustrates the overall configuration of the animal-targeted shingles and pain relief device proposed in this study. Symbol 1 represents an adapter for using commercial power sources, symbol 2 signifies the embedded charging capability, while symbol 3 indicates the portable battery for use on the go. Symbol 4 represents the charging port managed by the microprocessor, and symbol 5 signifies the voltage monitoring function within the microprocessor[6].

The speaker for producing sound is depicted by symbol 6, and the core component, the microprocessor, is denoted by symbol 7. Symbol 8 represents the optional electromyography (EMG) measurement sensor, through which data is input and processed by the microprocessor. Symbol 15 represents the drive control unit, and symbols 10, 12, 13, and 14 represent TRIAC, IGBT, various sensor drivers, and SCR driver, respectively[7].

Symbol 16 stands for the wired communication port, and symbol 17 represents the wireless communication port. Display view is symbolized by 18, power button by 19, sensor button by 20, and the operation/start-stop button by 21. Symbol 22 detects incoming phase in AC, symbol 23 represents the voltage regulator controller, and symbol 24 depicts the ZCS Resonant inverter[8].

Symbol 25 represents a display window visible on the exterior of the neural stimulation device. Fullwave Cockcroft Walton circuit is symbolized by 26, the keypad for input through the display window is symbol 27, and symbol 28 charges the voltage from symbol 26. Symbol 29 discharges the power semiconductor, while symbols 33, 36, and 35 represent low-power discharge units and charging and discharging units for regulated voltage, respectively.

Symbol 34 denotes the high-frequency therapeutic stimulation coil. Symbol 30 represents real-time clock, symbol 31 represents data memory area, and symbol 32 contains the program memory that operates the device.

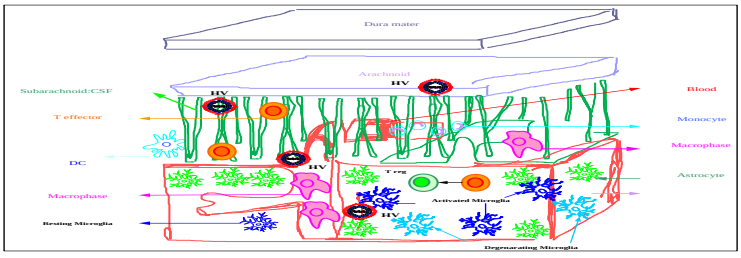


Figure 1 showcases the comprehensive configuration of the proposed animal-targeted shingles and pain relief device

International Journal Dental and Medical Sciences Research
Volume 5, Issue 5, Sep-Oct 2023 pp 94-104 www.ijdmsrjournal.com ISSN: 2582-6018

In Figure 2, symbol 1 represents a lens, symbol 2 stands for a CCD-CMOS sensor, and symbol 3 represents the signal processing of the CCD-CMOS sensor. Symbol 4 indicates a conventional illumination LED, while symbol 5 represents a driver for near-infrared LEDs with wavelengths ranging from 700 to 1,100nm. Symbol 6 stands for the camera interface, and symbol 7 represents the application processor.

A gyroscope sensor with functionality for position correction is symbolized by 8, while an accelerometer controlling the speed of position and posture correction is symbol 9. An AC adapter is denoted by symbol 10, wireless power by symbol 11, and the battery for wireless arthroscopy by symbol 12. Symbol 13 represents the battery charger, and symbol 14 stands for a small Bluetooth transmitter for auxiliary data transmission. LCD control circuit is symbol 15, while symbol 19 denotes a small Bluetooth receiver for auxiliary data transmission. The power management system is symbol 18, and symbol 20 represents a monitor. The configuration is complemented by the presence of a cell phone, symbolized by 21.

The most suitable method for transmitting high-quality sensed images is Ultra-Wideband (UWB) communication technology. UWB communication operates in a wide frequency band, making it capable of transmitting a large amount of data at once, which is ideal for transmitting high-resolution data. Furthermore, by simply adding camera functionality, the skin surface can be used to examine and diagnose shingles[10].

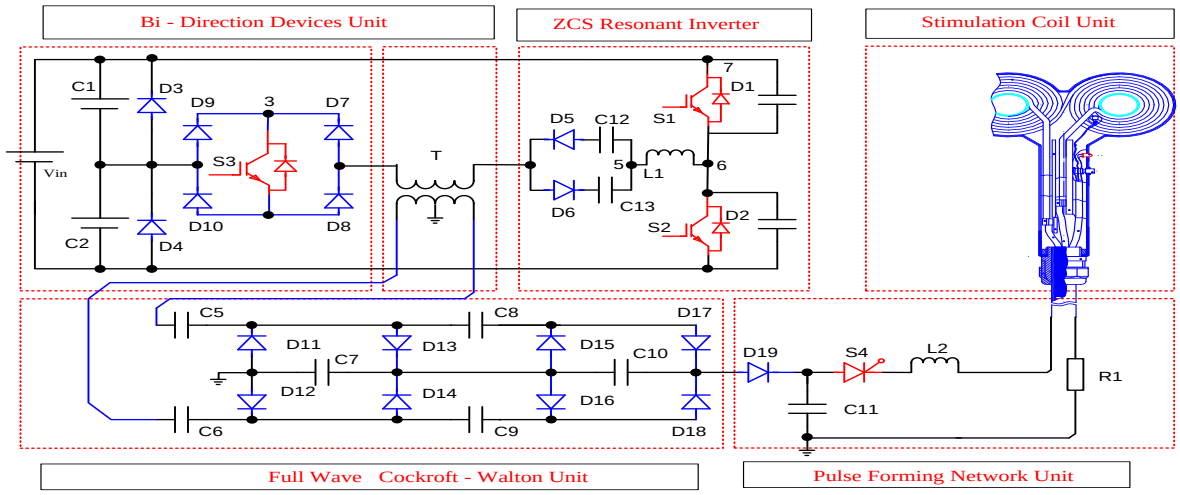


Figure 2 illustrates the enhancement of camera functionality for the examination and diagnosis of shingles on the skin surface

"Figure 3 represents a conceptual diagram of the disease caused by the varicella-zoster virus (VZV), the core of this study. Symbol ① represents the herpes virus, while symbol ② indicates herpes zoster, a condition caused by the varicella-zoster virus. Symbol 4 represents the dorsal root ganglion responsible for the affected skin segment, where the virus becomes reactivated due to factors like weakened immunity, physical trauma, or malignancy, leading to the occurrence of acute pain and vesicular rash along sensory nerves. Symbol ③ illustrates the stimulation process that results in improved blood circulation, conversion of acidic body fluids to alkaline, and sympathetic nerve stimulation, causing arterioles and microvessels to contract and dilate. This stimulation, transmitted through the spinal cord, affects blood vessel constriction and relaxation in skin sympathetic nerves, leading to increased blood flow in capillaries and vessels.

Symbol 5 represents the treatment coil, while symbol 6 signifies the function of the treatment pulse device. Symbol ④ illustrates the discharge through the stimulation coil, which stops the expression of the shingles virus and relieves pain. Symbol ⑦ indicates acute inflammation, cellular infiltration, edema, and hemorrhage in the same third nerve, spinal ganglion, peripheral sensory nerves, and posterior regions of the olfactory nerve, associated with severe conditions such as nerve necrosis, inflammation, and degeneration.

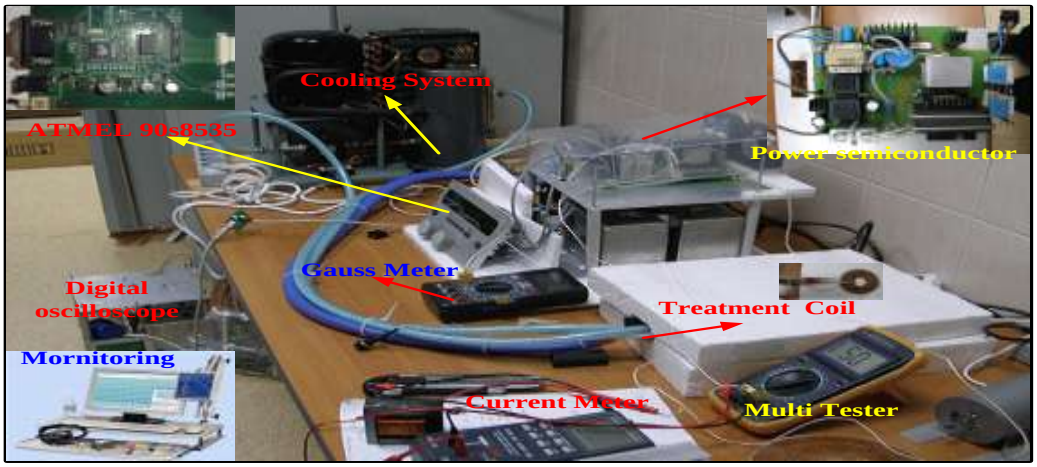
Symbol ⑧ represents the herpes virus that lies dormant in the dorsal root ganglion and is reactivated by triggering factors, causing acute pain and vesicular rash along sensory nerves. The varicella-zoster virus (VZV) in symbol ⑨ belongs

International Journal Dental and Medical Sciences Research
Volume 5, Issue 5, Sep-Oct 2023 pp 94-104 www.ijdmsrjournal.com ISSN: 2582-6018

to the same subfamily as herpes simplex virus (HSV) 1 and 2. The genome is divided into unique long (UL) and unique short (US) regions, and genome replication is stimulated by various repeat regions.

In symbol 10, the VZV genome (first row) includes the terminal repeat long (TRL), terminal repeat short (TRS), internal repeat long (IRL), and internal repeat short (IRS) with unique long (UL) and unique short (US) regions. Gene locations for VZV (second row) and HSV (third row) are numbered, with homologous genes marked by circles for VZV or symbol ⑦ for HSV. The HSV genome includes UL and US regions along with TRL, TRS, IRL, and IRS repeats.

The practical application of the shingles and post-herpetic neuralgia treatment device for VZV and HSV patients is depicted in symbol 12, where vesicles appeared on the left side of the waist and tailbone area. VZV DNA was detected in both affected regions. Symbol 11 illustrates vesicles that emerged behind the right ear and in the throat and tonsils. VZV DNA was found in the vesicles and patient's saliva."



"Fig. 3 Conceptual diagram of the disease caused by the varicella-zoster virus (VZV), which leads to herpes zoster (shingles)."

IV. PRACTAL ANALYSIS AND IMPLEMENT

The research introduces a novel inverter power circuit (symbol 3), building on the experimental methods conducted prior to proposing this concept. Symbol 1 represents the motor current compensation circuit, which is introduced to suppress output harmonic components in a single-phase inverter under conditions of DC power voltage and switching frequency. The power circuit of a PWM inverter is appropriately transformed into a half-bridge power circuit (symbol 2) to achieve an output voltage that includes zero, positive DC power voltage, negative DC power voltage, as well as half of positive and negative DC power voltage.

In this approach, when demanding currents above the rated current, the control mode changes to maintain a constant current mode to control the output voltage. For frequencies below the rated current, a multiplier stack mechanism is employed to drive switching power devices at the load, inducing voltage drop and reducing ripple. A voltage doubler is implemented to further minimize ripple by doubling the charging cycles per second, effectively mitigating voltage drop and ripple factors.

Symbol 2 includes the introduction of a resonant half-bridge inverter with current resonance and a Cockcroft-Walton circuit, forming a two-stage voltage multiplier driven by a high-voltage DC-DC converter. The reduction of switching losses and the smaller size and parasitic capacitance of the transformer stages make this configuration efficient.

To summarize, symbol 3 represents the start current compensation circuit, while symbol 4 is the high-frequency boosting transformer, and symbol 5 is the Cockcroft-Walton circuit, collectively forming a high-voltage multi-flyer. The ZCS series resonant inverter (symbol 7) reduces losses caused by tail current during IGBT turn-off, utilizing 2 IGBTs, a leakage inductor, blocking capacitor, and charging capacitor. The switching loss is essentially zero. The switch devices (S1, S2, C1, and C2) enforce current to follow a sine wave, suitable for high-speed repetitive operation.

Symbols 6, 7, and 8 represent a blocking diode, high-frequency power component SCR for discharge, and low-frequency power component SCR for discharge, respectively. Symbols 9 and 10

International Journal Dental and Medical Sciences Research
Volume 5, Issue 5, Sep-Oct 2023 pp 94-104 www.ijdmsrjournal.com ISSN: 2582-6018

depict the treatment coils for 2-LOOP and 1-LOOP types of animal herpes zoster and pain treatment devices. Symbols 11-15 represent various components related to magnetic field, coil current, stimulation coil, induced current, and stimulation point.

Symbols 16-21 denote internal circuit operations, and symbol 22 illustrates the current flowing through the primary of the transformer and the voltage of the charging capacitor, displaying the operation of ZCS and its effect in mitigating switching losses. The application of soft-switching technology not only reduces switching loss but also minimizes conducted electromagnetic interference (EMI), making it essential from an EMI standpoint.

Symbols 25 and 26 show the voltage and current waveforms of IGBT, while symbols 27 and 28 depict the primary current waveform of the transformer. The proposed one-loop treatment coil offers an effective treatment approach for both herpes zoster lesions and post-herpetic neuralgia (PHN) lesions with the dual-loop treatment coil.

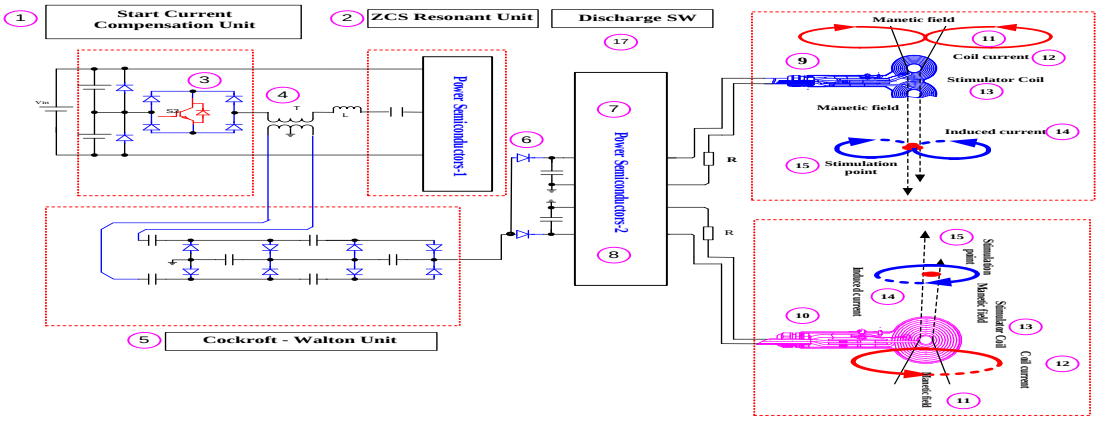


Figure 4: Introducing the Start Current Compensation Circuit for Single-Phase Inverter under DC Power Supply Voltage and Switching Frequency Conditions This figure illustrates the configuration of a single-phase inverter with the introduction of the start current compensation circuit. It showcases the operation under DC power supply voltage and switching frequency conditions.

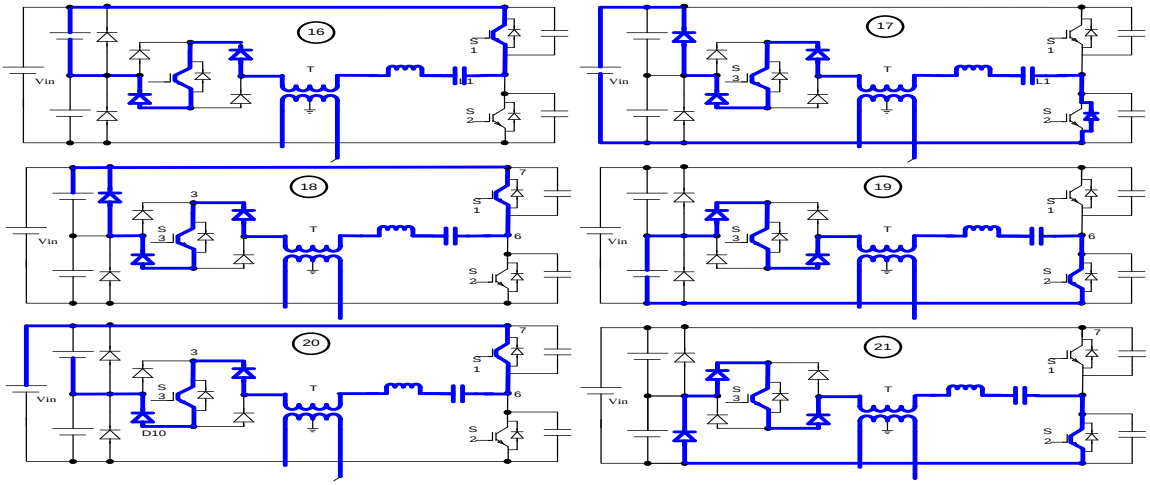


Figure 5: Flowchart of Introducing the Start Current Compensation Circuit for Single-Phase Inverter under DC Power Supply Voltage and Switching Frequency Conditions This figure depicts the operational flow of a single-phase inverter with the start current compensation circuit. It presents the sequence of system operation under DC power supply voltage and switching frequency conditions.

International Journal Dental and Medical Sciences Research
Volume 5, Issue 5, Sep-Oct 2023 pp 94-104 www.ijdmsrjournal.com ISSN: 2582-6018

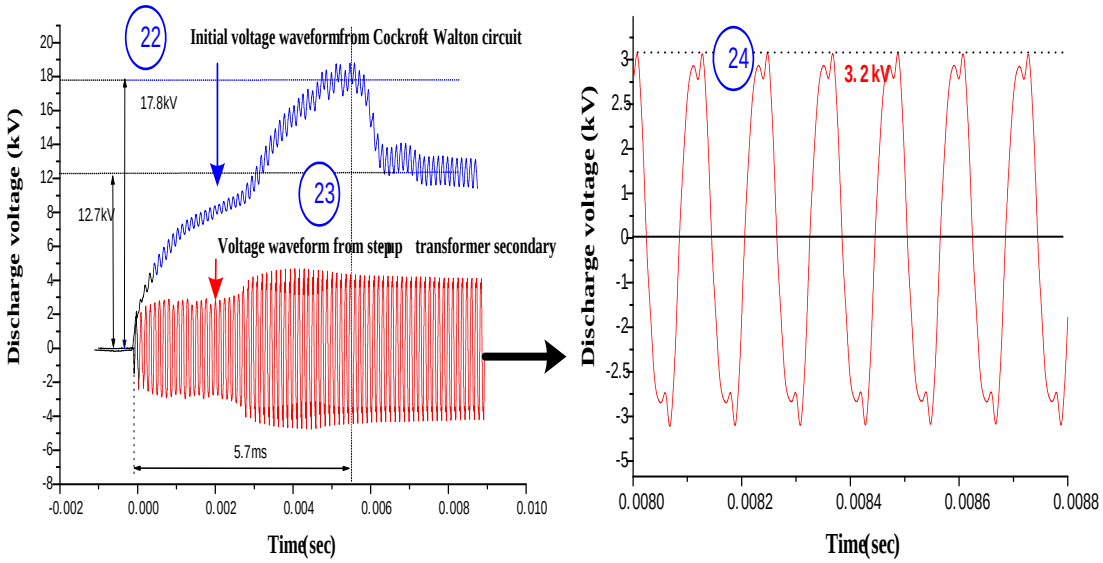


Figure 6: Experimentally Obtained Waveforms of Single-Phase Inverter with Introduced Start Current Compensation Circuit under DC Power Supply Voltage and Switching Frequency Conditions This figure displays experimentally obtained waveforms of a single-phase inverter with the introduced start current compensation circuit. It showcases how the output waveforms change under DC power supply voltage and switching frequency conditions.

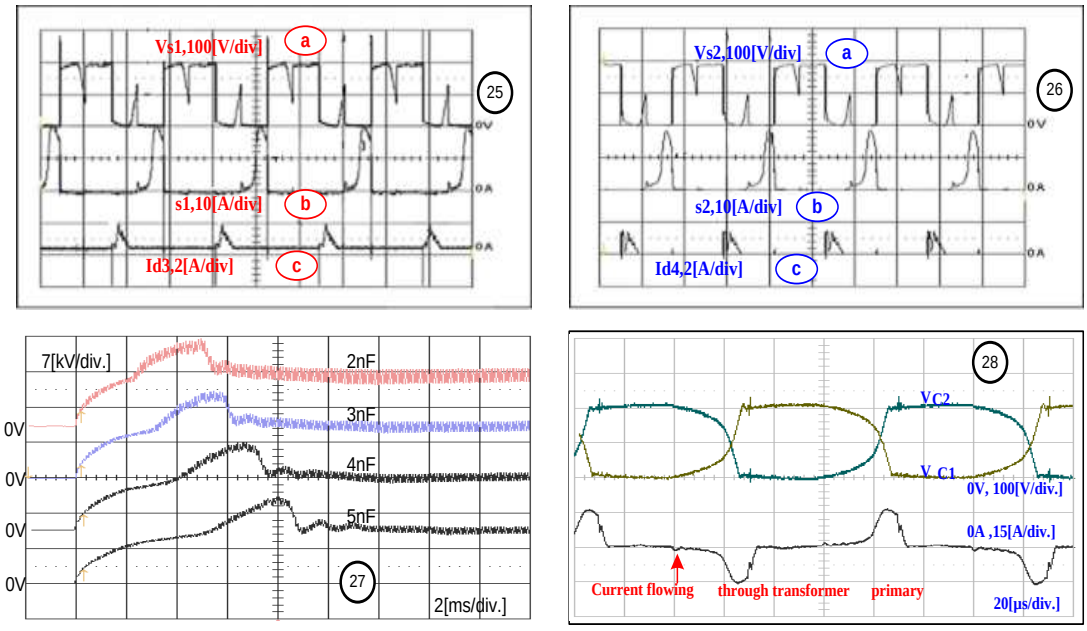


Figure 7: Experimental Waveform Values of Single-Phase Inverter under DC Power Supply Voltage and Switching Frequency Conditions This figure provides detailed values of experimental waveforms for a single-phase inverter operating under DC power supply voltage and switching frequency conditions. It presents the voltage and current waveform values obtained from experiments, which can be used for analysis and evaluation.

International Journal Dental and Medical Sciences Research
Volume 5, Issue 5, Sep-Oct 2023 pp 94-104 www.ijdmsrjournal.com ISSN: 2582-6018

V. DISCUSSIONS

Figures 8, 9, and 10 are designed for communication, control, and contact with relevant parties via mobile phones for treatment purposes. Firstly, utilizing CCD-CMOS sensors, skin, and electromyography (EMG) sensors with Bluetooth communication technology, this approach addresses emergency situations such as varicella-zoster virus (VZV) infection and pain treatment. It enables rapid treatment management through cell phones. The method introduced in Symbol 1 for animal patients reduces economic, physical, and psychological burdens. The accumulated database information sent to Symbol 2 supports patient consultation, treatment, and coordination with medical facilities.

The sensors and cell phones track treatment progress and location, utilizing the database to collect biological information and data via cell phones and sensors. This enables participation and collaborative services among doctors, specialists, and caregivers, facilitating upload, feedback response, disease research, and implementation of a patient management system application.

The proposed device in this invention offers a system unaffected by location and time, providing various monitoring capabilities. Through location settings and wireless communication networks, access to the server in Symbol 3 is established. When leaving the designated area, the cell phone registered with the caregiver in Symbol 4 transmits lesion status and location information to the server, utilizing CCD-CMOS sensors, skin, EMG sensors, etc., in Symbol 7. Bluetooth detection switches to the appropriate activity for emergency situations, and GPS and voice recognition can be added to the cell phone for additional monitoring in potential situations.

Symbol 8 represents a GUI (graphic user interface) method for disease tracking and diagnosis. In the event of abnormal lesions, a data system is established for urgent treatment. Upon entering an ID and password into the cell phone, the user's information is stored in the database. Urlparse is used to access external organization websites, and phone number access technology connects caregivers and medical facilities. Symbol 6 represents a therapeutic coil for animal varicella-zoster virus and pain treatment, illustrating its communication method with the cell phone.

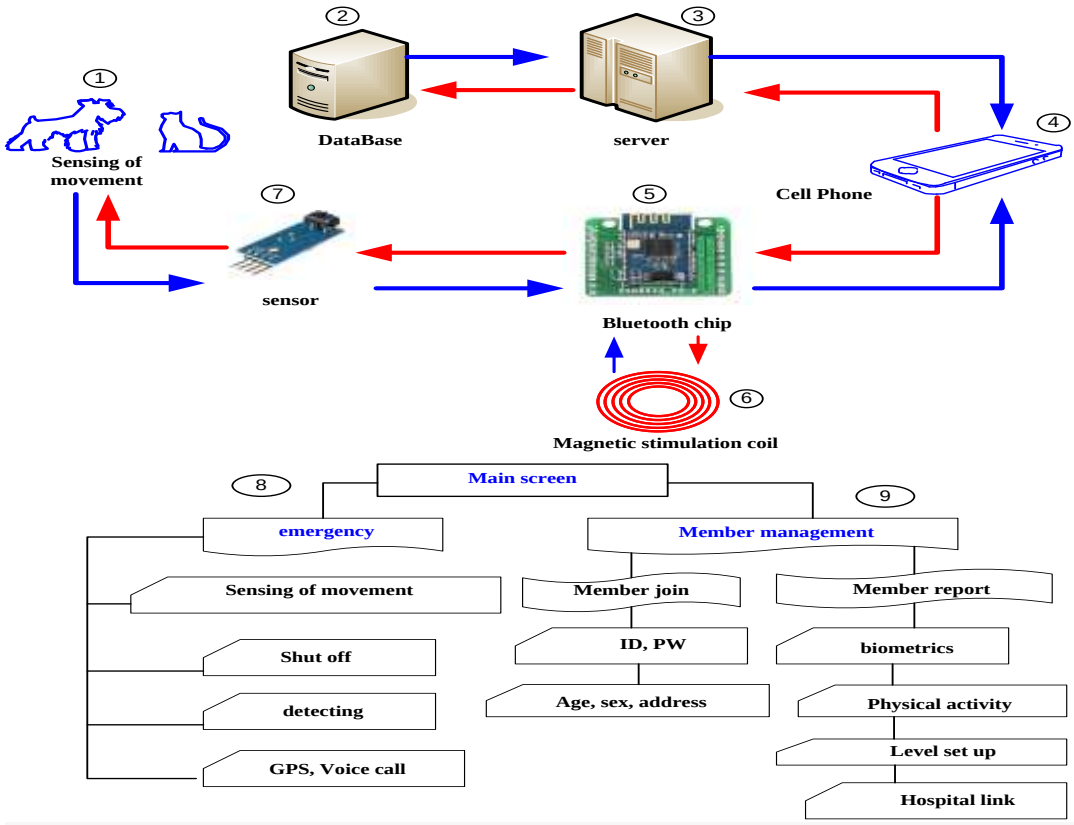


Figure 8 illustrates the utilization of CCD-CMOS sensors, skin, electromyography (EMG) sensors, and Bluetooth communication technology for responding to emergency situations such as varicella-zoster virus (VZV) infection and pain treatment, all through a cell phone.

The operational environment involves the integration of CCD-CMOS sensors (Symbol 2), skin, and electromyography (EMG) sensors (Symbol 4) with a microprocessor (Symbol 1), such as MSP430 or AVR series. For this invention, ATmega 128 was employed, utilizing 8 ports (A-G) excluding G port, which uses 5 bits. The ATmega128's signals are communicated through open-source broadcast and URL usage, linking to a website. In challenging emergency situations, ACT_CALL is utilized to place emergency calls. The principle of operation involves skin and behavior anomalies causing LED activation, and inactivity resulting in LED illumination. When a hazard is detected by sensor (Symbol 9), a Bluetooth-based signal is transmitted to the cell phone application (Symbol 8) for recognition. Detected alerts, warnings, and sensor data are communicated to relevant parties through web and phone applications, enabling bidirectional communication via remote control.

Bluetooth is employed to handle sensor data when it arrives at the USART I/O register, triggering a reception interrupt. The received message is stored in the RX. Both transmitted and received signals between the cell phone, sensors, and control module are managed through the ATmega128's digital signal conversion. Symbol 3 (Vcc) receives 5V and draws 30-50mA, connected to ATmega128. Pins 7 and 8 are used for transmission and reception purposes. Status serves as an On/Off pin. When an ADC value is read from RX after a received analog-to-digital conversion of sensor module signals, it triggers LED illumination. In cases of anomaly detection (Symbol 10), the alarm code and Bluetooth signal are transmitted. Code (Symbol 11) is initiated after sensor anomaly detection, with the sensor module utilizing the timer from the stored source code in ATmega128. The Bluetooth module sends an emergency code to the cell phone application. Symbol 12 signifies transmitting an emergency alert code via the application. Symbol 13 indicates an anomaly in the sensor and notifies through the application, ensuring the operation and cessation of the Symbol 5 and 7 devices for animal varicella-zoster virus and pain treatment.

Upon receiving the Bluetooth signal, the application transitions to an Activity, where the interface is designed and a server socket is created. Connection requests lead to Bluetooth searches, followed by pairing verification and connection with the core client. If socket creation fails, the listening socket is closed, and threads are terminated. Input and Output streams are configured using UUID protocols, establishing an environment for Bluetooth communication. The application is designed using Java and XML on the Android platform. The OS of the cell phone is Android, developed using Eclipse and JDK, with the 2.3.3 Gingerbread version. The development environment includes Jetty server and Elasticsearch database system, employing Elastic Search as a search engine and SQLite as an embedded database within Android.

The application structure comprises 5 services, including CCD sensors, EMG, motion detection, GPS, and emergency calls, organized into 8 activities (Symbol 14). The HostActivity handles server implementation, and UserManagement handles login and member information storage. To avoid extensive settings, the Tomcat server was replaced with the Jetty embedded server using Java. To ensure application operation, permissions are specified in the Manifest.xml file, without which the cell phone application won't function.

VI. EXPERIMENT RESULTS

In the process of creating the database (Symbol 9), you create login and registration buttons. You create EditText fields for information such as ID, password, age, address, living situation, daily life, ecological information, etc. Then, you use the setOnClickListener method to handle the validation of the entered ID and password information.

Symbol 2 represents the code for creating the database (DB base) and structuring the tables. The code creates a table named "User_info," automatically increments the user ID, adds a text-type key value, and stores and retrieves table values and key values from Sqlite_test.

Symbol 3 involves the code for updating the created table with user inputs. The code receives user inputs and stores them in the database file after converting them into a string format.

The mobile application's implementation results (Symbol 4) are designed to collect and share lifestyle and health management information with relevant individuals and caregivers. This information is used as external evaluation indicators for cognition, neurology, BPSD (Behavioral and Psychological Symptoms of Dementia), daily living activities, and functional abilities. It supports receiving information from external guidelines and continuously monitoring disease progression. In case of emergencies, it enables safe handling. The collected data can support diagnosis and treatment management, allowing verification of diagnosis for shingles and post-herpetic neuralgia.

Symbol 5 represents the implemented screen where symptoms and functional abilities occurring in daily life are regularly input by family members or caregivers. The results of observations are used to evaluate activities, mental state, eating, excretion, bathing, clothing, cleanliness, etc., using a level scale (1 to 5). The observed inputs are used to assess activities such as eating activities, food intake, speed, and independence. External

International Journal Dental and Medical Sciences Research
Volume 5, Issue 5, Sep-Oct 2023 pp 94-104 www.ijdmsrjournal.com ISSN: 2582-6018

indicators are then used for diagnosis evaluation, and the results of this evaluation are considered for level determination. The screen provides information about alternative interventions such as therapy, medication, corrective support, and facility program support based on short- and long-term goals.

Symbol 6 represents a screen for linked treatment support. Based on the management support function and level judgment results from observations, this screen connects patient information to nearby animal hospitals or specialized medical facilities for smooth treatment, especially when home treatment is difficult. It suggests appropriate interventions and linked treatments based on behavioral and psychological symptoms (BPSD) and doctor's diagnosis.

Symbol 7 indicates that through communication between the cell phone and the device, diagnosis and treatment can be set and performed according to the situation for early treatment.

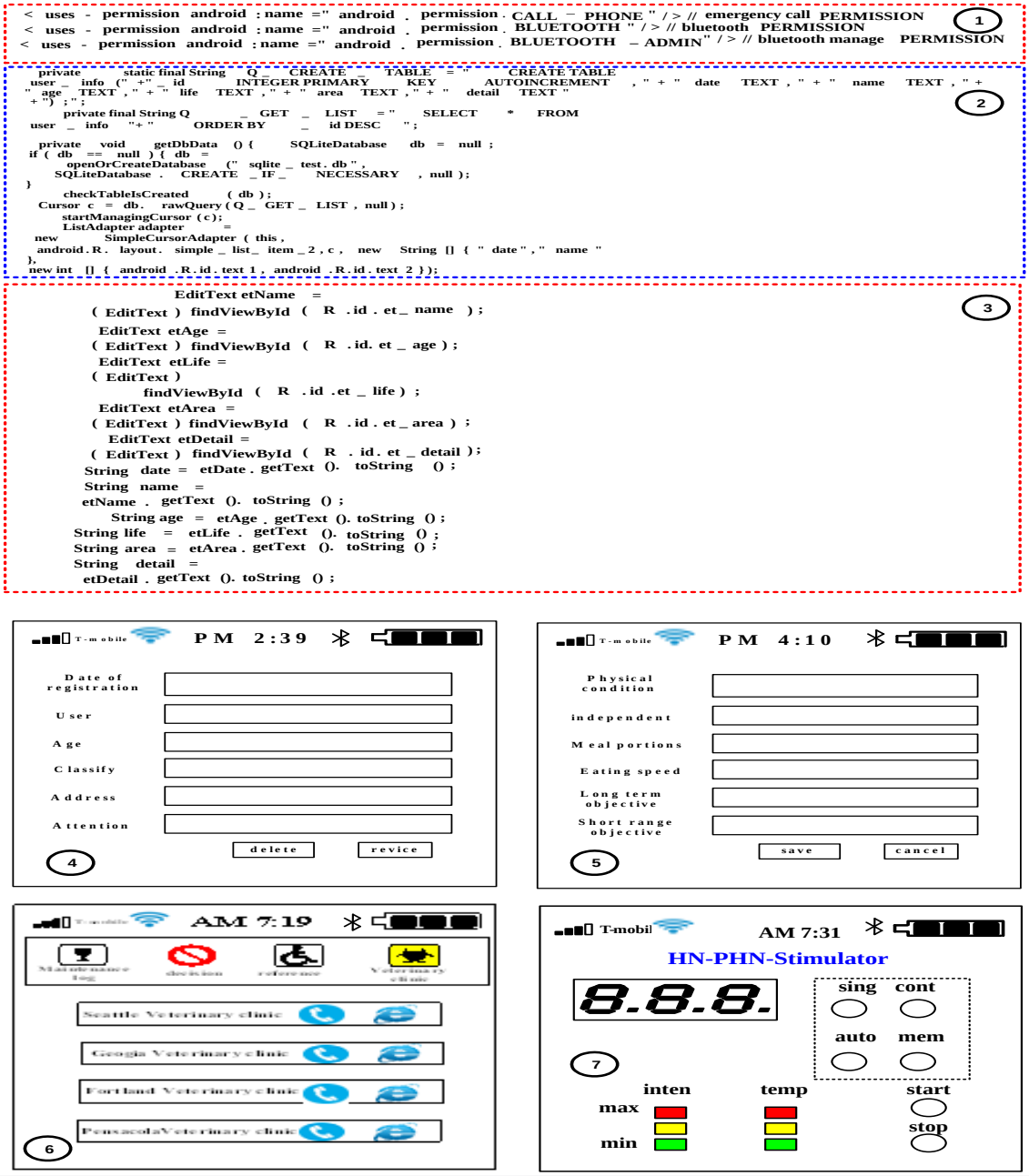


Fig .9 depicts the creation of the login button and registration button, along with the various EditText fields for capturing information such as ID, password, age, address, living situation, daily life, ecological information, etc.

International Journal Dental and Medical Sciences Research
Volume 5, Issue 5, Sep-Oct 2023 pp 94-104 www.ijdmsrjournal.com ISSN: 2582-6018

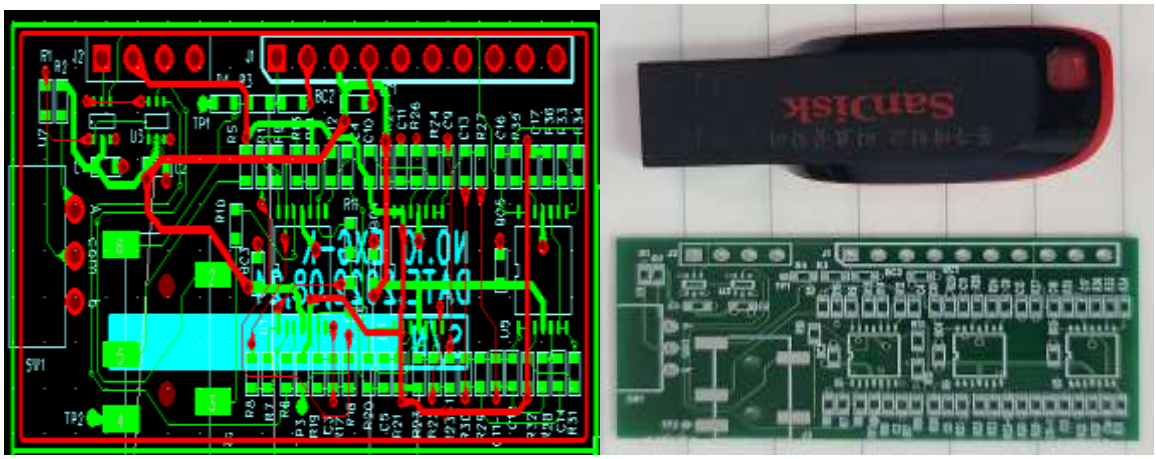


Figure.10 shows a prototype implemented with electronic medicine..

VII. CONCLUSION

In this study, an active therapeutic approach is attempted for the rehabilitation of exercise-induced pain and initial management of pain after herpes zoster. The principle involves applying a magnetic field to the body, inducing eddy currents at a level that can stimulate muscles and nerve cells. This approach can effectively treat pain in areas where conventional methods might not yield satisfactory results and can be widely applied for various pain treatments.

The technique has benefits including improving blood circulation, promoting healing, reducing pain, and enhancing cellular activities. Human leukemic cells are observed to undergo apoptosis in a magnetic field, indicating potential healing effects. The ion movements through the cell membrane increase cellular activities such as enzyme activation and secretion of growth factors. Changes in membrane polarization, membrane potential, ion transport, and synthesis of cartilage cells are also observed.

Ion activation not only promotes blood circulation but also penetrates deep into tissues, stimulating nerves, muscles, and skeletal tissues. This can effectively treat diseases, eliminate the sources of pain, and convert acidic bodily fluids into alkaline fluids.

Capillaries not only carry blood flow but also play an active role in adjusting blood circulation based on tissue metabolic demands. The degree of contraction and relaxation of arterioles and capillaries is influenced by metabolic activities and sympathetic nerves. By stimulating the sympathetic nervous system, arterioles and capillaries can be directly influenced in their contraction and relaxation. Furthermore, signals from the spinal cord to the brain affect the activities of skin sympathetic nerves, influencing the vascular contraction and expansion fibers.

Hence, by stimulating the sympathetic nerves, both the direct constriction and relaxation of arterioles and capillaries and the indirect influence on skin sympathetic nerves through spinal cord signals can lead to an increase in blood volume within capillaries and blood vessels.

Acknowledgement

"It was supported as an industry-academia joint technology development project of the 2023 LINC3.0 project."

REFERENCES

[1]. Walsh V, Pascual-Leone A. Transcranial magnetic stimulation: a neurochronometrics of mind. Cambridge, MA: MIT Press; 2005.

[2]. Sun-Seob Choi, Sun-Min Lee, Jun-HyoungKim,"Chopper application for magnetic stimulation," Journal of Magnetics, Vol,15. No.4 December 2010, pp.213-220.

[3]. Sun-Seob Choi, " Treatment pulse application for Magnetic Stimulation ", journal of Biomedicine and Biotechnology, Vol. 2011, article ID 278062, 6page,doi: 10.1153/2011/278062.

[4]. Whi-Young Kim, "Transcranial magnetic stimulation with applied multistep direct current grafting", Biomedical Engineering: Applications, Basis and Communications, Vol. 24.No.5, April 2013.

[5]. E. Wassermann, Oxford Handbook of Transcranial MagneticStimulation (2007).

[6]. S.-S. Choi, Journal of Biomedicine and Biotechnology278062 (2011).

[7]. Mark S. George, Transcranial magnetic stimulation inclinical psychiatry, American Psychiatric Publishing Inc.(2007).
[8]. V. Walsh and A. Pascual-Leone, Transcranial magneticstimulation: a neurochronometrics of mind. Cambridge,MA: MIT Press (2005).
[9]. M. Sommer, N. Lang, F. Tergau, and W. Paulus, Neuroreport13, 809 (2002).
[10]. Nicole A. Lazar, The Statiscal Analysis of FunctionalMRI Data. Springer, Berlin (2008).
[11]. Richard, S. J. Frackowiak, John T. Ashburner, WilliamD. Penny, and Semir Zeki, Human brain function, 2nded., Academic Press, San Diego (2003).
[12]. R. S. J. Frackowiak, K. J. Friston, and C. Frith, Humanbrain function, 2nd ed., Academic Press, San Diego,(2003).
[13]. A. T. Barker, C. W. Garnham, and I. L. Freeston, Electroencephalogr.Clin. Neurophysiol. Suppl. 43, 227(1991).