# Menstrual Pain Soother Using T.E.N.S Method

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***Abstract-*** One method of stimulating the body's nerves is transcutaneous electrical nerve stimulation. However, this study is developing the system to address this issue by taking into account the TENS principle. The issue of stomach pain or, more specifically, menstrual pain experienced by the user while traveling or working. Menstruation causes discomfort for women. They find it awkward to alter preferences or settings straight from the device once they have attached it to their body. The goal of this study is to make it simple to use the device from a mobile application also user can control it through On-device Buttons. Here, this issue is resolved using the TENS method. Wi-Fi has made it simple to control the device from a phone. The suggested MCU can generate multiple pins.

**Keywords:** T.E.N.S., Dysmenorrhea, Menstrual Pain, Pain Relief, IoT Healthcare, Microcontroller, Non-invasive Therapy

## I. INTRODUCTION

Menstrual cramps, more commonly referred to as dysmenorrhea, plague a large percentage of the female population, causing discomfort that can interfere with everyday activities and quality of life. Defined as cramping of the lower abdomen, the pain is typically mild to severe and is commonly joined by secondary symptoms of nausea, fatigue, and mood disturbances. Although there are numerous forms of treatment available—ranging from over-the-counter analgesics to hormonal therapies and lifestyle changes—alternative methods are sought by many due to side effects or failure of standard methods. One such new method that is in the spotlight is the Transcutaneous Electrical Nerve Stimulation (T.E.N.S.) method. T.E.N.S. is a painless technique in which low-voltage electric currents are passed through electrodes to the skin. This technique has the purpose of relieving pain by stimulating sensory nerves and, at the same time, possibly blocking pain messages from being transmitted to the brain.

Moreover, T.E.N.S. could facilitate the release of endorphins, the body's own painkillers; further increasing its effectiveness in the control of discomfort. T.E.N.S. application for relief from menstrual pain has been of interest in both clinical and home environments, with research showing favorable results for most users. As a convenient and simple-to-use device, T.E.N.S. units provide a level of convenience that is well-suited to the requirements of that desiring effective pain control without the use of pharmaceuticals.

Moreover, the non-invasive nature of T.E.N.S. minimizes the risks associated with medication side effects, making it an appealing choice for many women. This report will delve into the mechanisms of action behind T.E.N.S., the evidence supporting its use for dysmenorrhea, and practical considerations for implementation. By exploring this alternative pain relief method, we aim to provide a comprehensive overview of how T.E.N.S. can serve as a valuable tool for those with menstrual pain, increasing their skill to control symptoms and enhance their general state of health.

Over the past few years, technology has further improved the usability and efficiency of T.E.N.S. devices, especially by integrating with Web page and Wi-fi connectivity. These technologies enable users to adjust intensity levels, change stimulation modes, and track session lengths from their smartphones—without having to physically interact with the device once it is installed. This hands-free convenience is particularly beneficial to those who suffer from pain at work or during travel, allowing for discreet and unbroken pain management during the day. Therefore, the integration of T.E.N.S. therapy with smart control functionality not only enhances user comfort but also marks a major stride towards personalized and accessible health care solutions in the field of women's well-being. The prevalence of dysmenorrhea among menstruating individuals is well-documented, with studies indicating that up to 90% of women experience some level of menstrual pain during their reproductive years. Traditional management strategies often include non-steroidal anti-inflammatory drugs (NSAIDs) and hormonal contraceptives; however, these approaches may not be suitable for all patients due to side effects or contraindications. Consequently, there is a growing interest in alternative therapies, particularly Transcutaneous Electrical Nerve Stimulation

(T.E.N.S.), as a non-invasive approach to controlling menstrual pain.

T.E.N.S. operates based on the gate control theory of pain, which suggests that non-painful stimuli can block the perception of painful signals. By delivering electrical impulses to the skin, T.E.N.S. stimulates large A-beta nerve fibers that can effectively “close the gate” to pain signals transmitted by smaller C fibers. In addition to blocking pain transmission, T.E.N.S. is believed to promote the release of endorphins, the body's natural painkillers, enhancing its pain-relieving effects. This mechanism has been supported by various studies, including Rosenfeld et al. (2018), which demonstrate a reduction in pain perception through both sensory nerve stimulation and endorphin release.

Several clinical trials have evaluated the effectiveness of T.E.N.S. in treating dysmenorrhea. For instance, a randomized controlled trial conducted by Kahn et al. (2020) reported a significant reduction in pain scores among women using T.E.N.S. compared to control groups. Similarly, a meta-analysis by Vickers et al. (2018) reviewed multiple studies and concluded that T.E.N.S. provides clinically meaningful pain relief for individuals suffering from dysmenorrhea. These findings highlight the importance of proper patient education on device usage and compliance to maximize therapeutic benefits.

Patient acceptance is a critical component in the success of T.E.N.S. therapy. According to a survey by Zhang et al. (2021), most women preferred T.E.N.S. over conventional pharmacological treatments due to its ease of use, lack of systemic side effects, and the ability to self-manage pain. Additionally, qualitative research by Smith et al. (2022) found that users value the independence and control T.E.N.S. offers, especially for managing chronic menstrual pain in daily life.

Despite its promising results, some limitations exist in current research on T.E.N.S. These include variations in electrode placement, stimulation parameters, and patient adherence, all of which can affect the consistency and reliability of treatment outcomes. Furthermore, while T.E.N.S. is generally considered safe, there are certain contraindications, such as use in individuals with pacemakers or specific dermatological conditions. As noted by Jones & Lee (2019), these factors underscore the need for standardized guidelines and careful patient screening to ensure safe and effective use.

## II. Objective

Menstrual pain, or dysmenorrhea, remains a significant but often under-discussed health issue. A large number of women experience moderate to severe menstrual cramps that interfere with their daily activities, including academic, professional, and social engagements. Despite the availability of various treatment options such as NSAIDs, hormonal therapy, and home remedies, many users report inadequate relief or unwanted side effects. Additionally, heating pads, although popular, are impractical for individuals who need mobility during menstruation.

There is a clear need for an alternative approach that is non-invasive, drug-free, portable, and user-friendly. Such a solution should ideally offer real-time control, minimal side effects, and the ability to personalize treatment intensity. The integration of modern technology, particularly IoT and embedded systems, can enable the development of such a solution. Therefore, this project proposes the design and implementation of a T.E.N.S.-based menstrual pain soother with smart control features, addressing the gaps left by conventional therapies and offering a more empowering and accessible solution for users.

The main objective of this project is to develop an intelligent, non-pharmacological pain relief system for dysmenorrhea using T.E.N.S. technology. To achieve this, the following goals are established:

1. **Design and Implementation**: Develop a wearable device based on T.E.N.S. principles using a microcontroller and appropriate electronic components that can safely generate therapeutic pulses.
2. **User-Controlled Interface**: Create a responsive web application that allows users to remotely control the intensity of the device, select modes, and monitor session status.
3. **Intensity Adjustment**: Incorporate five levels of electrical stimulation, adjustable according to the user's individual pain level and comfort.
4. **User Feedback Mechanism**: Collect feedback using standardized pain scales such as the Visual Analog Scale (VAS) and Numeric Rating Scale (NRS), as well as qualitative input through surveys.
5. **Supportive Features**: Integrate additional wellness features like an AI chatbot for assistance and a washroom locator for user convenience during menstruation.
6. **Evaluation and Testing**: Conduct experimental tests to assess the performance, safety, and effectiveness of the system through both hardware validation and real-world user trials.

The successful completion of these objectives will contribute to the field of women’s health technology and provide a scalable, accessible alternative for menstrual pain management.

## III. METHODOLOGY

**A. Hardware Implementation**: The hardware for the Menstrual Pain Soother is centered around the ATmega328P microcontroller, which is responsible for generating the electrical pulses used in T.E.N.S. therapy. Unlike software- based delay loops, the ATmega328P utilizes hardware timers—specifically Timer1 configured in Clear Timer on Compare Match (CTC) mode—to produce consistent and safe pulse frequencies and durations. These pulses are then used to drive the gate of an MOSFET, which acts as a high-speed electronic switch to deliver pulses to the electrode pads attached to the user's body.

The electrodes, commonly referred to as sticky pads, are positioned on the lower abdomen or back. The ESP-01 Wi-Fi module enables wireless communication with the web application. To power the ESP-01, which operates at 3.3V, a voltage regulator (LM1117) is used to ensure stable operation. An OLED display provides real-time feedback on intensity levels and operational status, while push buttons allow manual control.

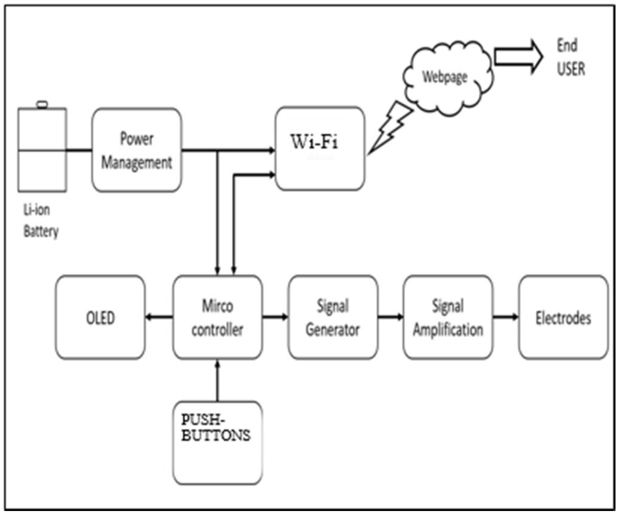
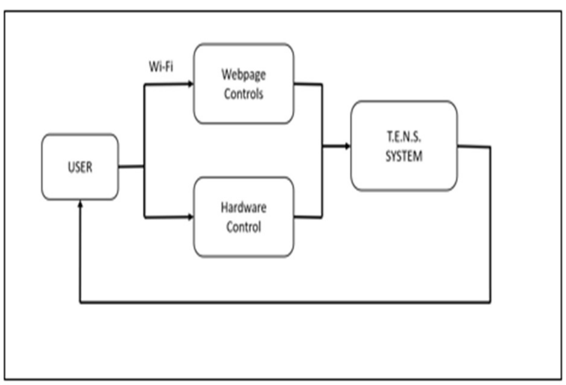



Fig 1: Circuit flow diagram of Menstrual pain Soother.

**B. Software Implementation**: The embedded code is written in C/C++. Timer is programmed to generate square wave pulses whose frequency and duty cycle are adjustable via external commands or button presses. The firmware handles intensity level changes, manages output




waveform generation, and communicates with the ESP-01 module through UART.

The web application frontend is built with Next.js and Tailwind CSS for efficient and responsive user interface design. The backend, developed in Node.js with Express.js, handles API requests and device control logic. Authentication is managed using Clerk Auth, ensuring secure user sessions and data protection. The AI chatbot, powered by natural language processing libraries, offers guidance and recommendations based on user input. The system also includes a Google Maps-integrated washroom locator for added user support.

**I. Dashboard**

Once logged in, users are welcomed by a custom dashboard that is the core point for all the functionalities. The dashboard shows the overview of the menstrual cycle of the user, the prediction of upcoming periods, symptom logs, and direct access to other features such as the AI chatbot, washroom finder, and health suggestions. The easy-to-use interface ensures users can move from one section to another effortlessly, which enhances the user experience.

**II. Periods Tracker**

The period tracker is an integral part, enabling users to record menstrual cycles, monitor symptoms, and obtain forecasts for future periods and ovulation windows.
By entering information including the beginning date of the last period, duration of bleeding, and cycle length, the program employs algorithms to predict future cycles.

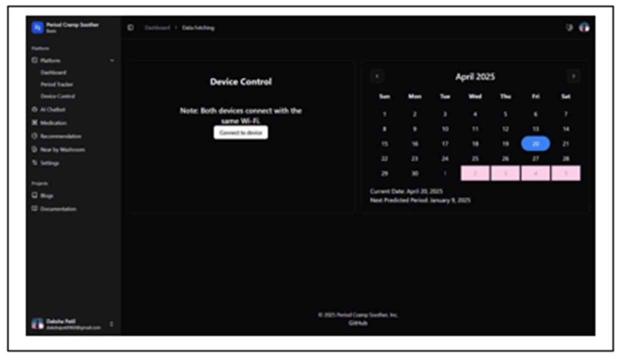


Fig 2: Dashboard, Device control and Period Tracker

**III. AI ChatBot Support**

A chatbot powered by AI is embedded to offer instant support and information about menstrual health to users. Users can chat with the chatbot to ask questions, record symptoms, or get advice on how to handle discomfort. The chatbot uses natural language processing to interpret user queries and give relevant, empathetic answers to improve user interaction and support. All components are hosted and deployed via Vercel, providing real-time interaction and automatic scaling for increased reliability. Testing environments were created to verify functional integrity across all modules before user deployment

Fig 4: System architecture of Menstrual pain Soother.

## IV. TESTING AND RESULTS

Testing was conducted at two levels: hardware functionality and software system reliability. On the hardware side, the ATmega328P was tested for precise signal generation using an oscilloscope. The timing of pulses, duty cycles, and switching of the IRF540N MOSFET were validated for safety and consistency. The voltage levels at electrode terminals were kept within safe limits. Each intensity level was evaluated to ensure the desired change in frequency and comfort level.

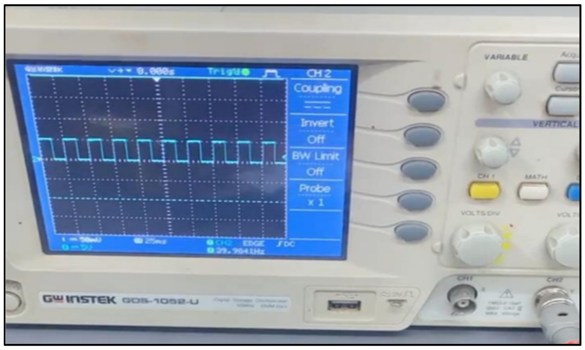



Fig 5: Testing.

The web-based interface was tested in multiple environments including local development and staging on Vercel. The API endpoints for controlling intensity levels were tested using Postman and verified against device responses. Real-time communication between the user dashboard and the ESP-01 module was successful with minimal latency.

User testing was carried out by distributing the device to a group of female participants who suffered from regular menstrual cramps. Participants rated their pain on the VAS and NRS scales before and after T.E.N.S. therapy. Most reported significant improvement in pain levels post-treatment. Feedback on usability, comfort, and effectiveness was overwhelmingly positive. Users appreciated the remote control, AI chatbot assistance, and the washroom locator, which added practical value to the solution. treatment options such as NSAIDs, hormonal therapy, and home remedies, many users report inadequate relief or unwanted side effects. Additionally, heating pads, although popular, are impractical for individuals who need mobility during menstruation.

There is a clear need for an alternative approach that is non-invasive, drug-free, portable, and user-friendly. Such a solution should ideally offer real-time control, minimal side effects, and the ability to personalize Therefore, this project proposes the design and implementation of a T.E.N.S.-based menstrual pain soother with smart control features, addressing the gaps left by conventional therapies and offering a more empowering and accessible solution for users. The circuit is designed and simulated using software. The signal controlling is achieved.

## V. CONCLUSION

This project successfully demonstrates a modern approach to managing menstrual pain using T.E.N.S. technology enhanced with IoT-based remote control and supportive software features. The system provides a non-invasive, user-friendly, and effective alternative to conventional pain relief methods. With five adjustable intensity levels and real-time feedback, the device empowers users to tailor the therapy to their comfort, resulting in improved satisfaction and pain management. The integration of an AI chatbot and geolocation services positions this device as a complete menstrual health solution rather than just a pain reliever. Its modular architecture allows for future upgrades and makes it suitable for deployment in both clinical and home environments. By addressing the shortcomings of current treatments and leveraging modern embedded systems, this T.E.N.S.-based device offers a significant step forward in personalized, digital healthcare for women. While the current implementation demonstrates functionality and effectiveness, several enhancements are planned for future iterations. To develop an Android/iOS app using Bluetooth (BLE) for offline, on-the-go control. rate sensors to offer dynamic pain relief profiles.

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