# VISVESVARAYA TECHNOLOGICAL UNIVERSITY

# BELAGAVI-590018

**A Project Report**
**on**

# "Design and Development of IoT-Enabled Smart Head Massager Device"

Submitted in partial fulfillment of the requirements for the award of the degree of

**Bachelor of Engineering**
**in**
**Information Science and Engineering**

**Submitted by**


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(An Autonomous Institution Approved by AICTE, affiliated to VTU, Belagavi-590018)
**Venkatagiri Kote, Devanahalli, Bengaluru-562110**


**2023-2024**

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# CERTIFICATE

This is to certify that the project work entitled **"Design and Development of IoT- Enabled Smart Head Massager Device"** was carried out by Miss. **Ankitha G S (1NC20IS003), Mr. Bharath G(1NC20IS006), Miss. Dikshita Chilukuri(1NC20IS008), Miss. Jeeva H R (1NC20IS014)**, bonafide student of VIII$^{th}$ semester, Nagarjuna College of Engineering and Technology, Bengaluru, in partial fulfillment for the award of Bachelor of Engineering in **Information Science and Engineering** department of the Visvesvaraya Technological University (VTU), Belagavi during the year 2023-2024. It is certified that all corrections/suggestions indicated for Internal Assessment have been incorporated in the report deposited in the departmental library. The project report has been approved as it satisfies the academic requirements concerning the project work prescribed for the said degree.

| Signature of the Guide | Signature of the HOD | Signature of the Principal |
|---|---|---|
| Dr. Ramesh M. Kagalkar | Dr. Sanjeevakumar M. Hatture | Dr. B. V. Ravishankar |
| Professor | Professor & HOD | Principal |

Examiners

| Name of the Examiner | Signature with date |
|---|---|
| 1. …………………. | ………………….. |
| 2. …………………. | ………………….. |

# DECLARATION

We, the students of the VIII$^{th}$ semester of the Information Science and Engineering department, Nagarjuna College of Engineering and Technology, Bengaluru, declare that the work entitled "**Design and Development of IoT Enabled Smart Head Massager Device**" has been completed under the guidance of **Dr. Ramesh M. Kagalkar**, Professor in the Department of Information Science and Engineering, Nagarjuna College of Engineering and Technology, Bengaluru. This dissertation work is submitted to Visvesvaraya Technological University (VTU) in partial fulfillment of the requirements for the award of Degree of Bachelor of Engineering in Information Science and Engineering (ISE) during the academic year 2023-2024. Further, the matter embodied in the project report has not been submitted previously by anybody for the award of any degree or diploma to any university.

**Place:** Nagarjuna College of Engineering and Technology

**Date:** 08/06/2024

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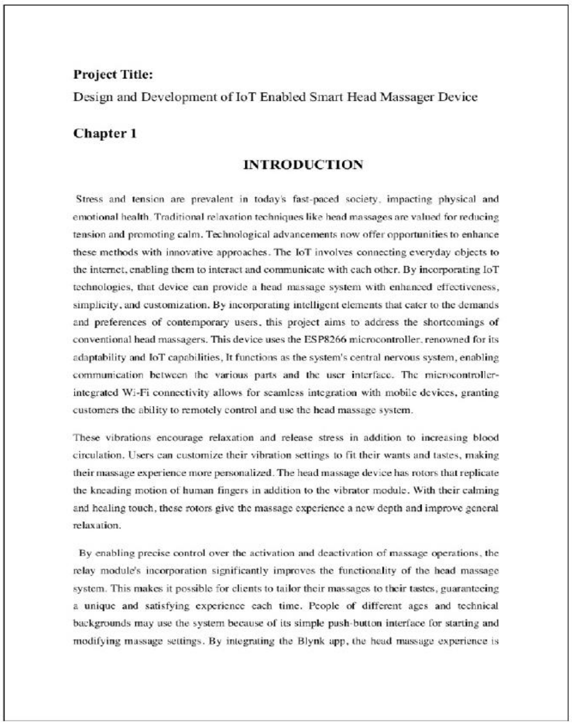

**Project Title:**

Design and Development of IoT Enabled Smart Head Massager Device

**Chapter 1**

**INTRODUCTION**

Stress and tension are prevalent in today's fast-paced society, impacting physical and emotional health. Traditional relaxation techniques like head massages are valued for reducing tension and promoting calm. Technological advancements now offer opportunities to enhance these methods with innovative approaches. The IoT involves connecting everyday objects to the internet, enabling them to interact and communicate with each other. By incorporating IoT technologies, that device can provide a head massage system with enhanced effectiveness, simplicity, and customization. By incorporating intelligent elements that cater to the demands and preferences of contemporary users, this project aims to address the shortcomings of conventional head massagers. This device uses the ESP8266 microcontroller, renowned for its adaptability and IoT capabilities, It functions as the system's central nervous system, enabling communication between the various parts and the user interface. The microcontroller-integrated Wi-Fi connectivity allows for seamless integration with mobile devices, granting customers the ability to remotely control and use the head massage system.

These vibrations encourage relaxation and release stress in addition to increasing blood circulation. Users can customize their vibration settings to fit their wants and tastes, making their massage experience more personalized. The head massage device has rotors that replicate the kneading motion of human fingers in addition to the vibrator module. With their calming and healing touch, these rotors give the massage experience a new depth and improve general relaxation.

By enabling precise control over the activation and deactivation of massage operations, the relay module's incorporation significantly improves the functionality of the head massage system. This makes it possible for clients to tailor their massages to their tastes, guaranteeing a unique and satisfying experience each time. People of different ages and technical backgrounds may use the system because of its simple push-button interface for starting and modifying massage settings. By integrating the Blynk app, the head massage experience is

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# ABSTRACT

The project comprises developing an advanced head massager that uses IoT technologies to improve user experience and functionality. Looking like a helmet, this device has several carefully crafted parts that work together to provide a complete relaxation experience. The ESP32 microcontroller, a flexible and potent gadget at its heart, is in charge of coordinating the device's functions. Acting as the brains of the system, this microcontroller takes commands from the graphical user interface and uses those instructions to direct the actions of other hardware parts. Two of these parts are essential to the massage's administration: a relay and a DC motor. By acting as a switch, the relay controls how much electricity is sent to the DC motor. The computer controls the motor's speed and strength by varying the relay's state, giving consumers the ability to customize their massage experience. A vibrator module is included to enhance the massage's therapeutic effects in addition to the motor's operations. The vibrator, which is controlled in concert with the motor, adds more stimulation and amplifies the device's ability to promote relaxation and relieve tension. The device effortlessly interfaces with the Blynk IoT platform to enable user engagement and customization. Users can adjust massage parameters, including intensity, duration, and vibration patterns, remotely with the help of a specialized smartphone app. Users may easily and conveniently customize their relaxing experience with this user-friendly UI. All things considered, the smart head massager helmet is an amalgam of cutting-edge technology and innovative wellness design. It provides users with an elegant yet approachable rejuvenation and relaxation solution by utilizing the power of IoT. Users can depend on this gadget to provide a customized and immersive massage experience, whether they are looking to relieve stress or are just treating themselves.

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# Chapter 1

## INTRODUCTION

Stress and tension are common place in today's fast-paced society, having an impact on people's physical and emotional health. Traditional relaxation techniques, like head massages, have long been prized for their capacity to reduce tension and encourage calm. But thanks to technological improvements, there's more and more possibility to improve these traditional methods with cutting-edge approaches. The goal of the design and development of IoT-based smart head massage devices is to transform how people experience and enjoy head massages by utilizing the potential of IoT technology. The IoT is a concept that entails linking common objects to the internet so they may interact and communicate with one another. That device can offer a head massage system a new degree of effectiveness, simplicity, and customization by incorporating IoT technologies. Through the incorporation of intelligent elements that meet the demands and preferences of contemporary users, this project aims to address the shortcomings of conventional head massagers.

This device uses the ESP8266 microcontroller, which is well-known for its adaptability and IoT capabilities, which are essential. The functions as the system's central nervous system, enabling communication between the many parts and the user interface. The microcontroller-integrated Wi-Fi connectivity facilitates a smooth integration with mobile devices, granting customers the ability to remotely control and use the head massage system. The vibrator module is a crucial part of the IoT-enabled device. It is positioned inside the device in a strategic way to provide targeted vibrations to particular pressure spots on the scalp. These vibrations encourage relaxation and release stress in addition to increasing blood circulation. Users can customize their vibration settings to fit their wants and tastes, making their massage experience more personalized. The head massage device has rotors that replicate the kneading motion of human fingers in addition to the vibrator module. With their calming and healing touch, these rotors give the massage experience a new depth and improve general relaxation.

By enabling precise control over the activation and deactivation of massage operations, the relay module's incorporation significantly improves the functionality of the head massage system. This makes it possible for clients to tailor their massages to their tastes, guaranteeing a unique and satisfying experience each time. People of different ages and technical backgrounds may use the system because of its simple push-button interface for starting and modifying massage settings. By integrating the Blynk app, the head massage experience is elevated to new levels of accessibility and convenience with the introduction of sophisticated features like remote control and real-time monitoring. Users may easily change massage settings, monitor consumption trends, and get notifications with the Blynk app all from the convenience of their hands. The smooth amalgamation of hardware and software highlights the revolutionary capacity of IoT technology for individual leisure and well-being.

The IoT-enabled device improves mental health in addition to physical health. Research has indicated that consistent massage therapy might lessen tension, anxiety, and depressive symptoms by encouraging the body's endorphins which are naturally occurring mood enhancers to be released. This system encourages users to take charge of their relaxing routines by integrating intelligent elements like remote control functionality and customizable massage settings. These features let users feel empowered and autonomous.

The implemented device's capacity for flexibility and scalability is another important feature. Future additions of features or components can be seamlessly included in the head massage system because of its modular architecture. Because of its adaptability, the system may change to accommodate the demands and preferences of its users, which keeps it competitive and relevant in the quickly developing field of IoT technology. It creates new avenues for innovation and cooperation in the health and wellness sector. Manufacturers, researchers, and healthcare experts can collaborate to investigate novel applications and therapies that leverage the power of connectivity to improve well-being by utilizing IoT technologies.

In the development of conventional relaxation procedures, the proposed device is a noteworthy advancement. Through the integration of IoT technology's customization and convenience with the therapeutic advantages of head massage, this concept provides a contemporary approach to people looking to relieve stress and anxiety. The device has a user-friendly interface, sophisticated functions, and growth potential, and is positioned to have a significant influence on users' lives by encouraging rest, renewal, and general well-being in today's hectic world.

## 1.1 Motivation

The implemented device may be spurred by several factors:

1. **Relaxation and Stress Reduction:**
    - High levels of stress, tension, and anxiety are frequently associated with modern lifestyles, and these conditions can result in several physical and mental health problems.
    - Massages to the head are believed to induce relaxation, enhance blood flow, and release tense muscles in the shoulders, neck, and scalp.
    - The advantages of head massages can be easily and conveniently accessed by people in the comfort of their own homes or places of business with the help of a device massaging equipment.

2. **Enhanced Quality of Sleep:**
    - Tension and stress can exacerbate insomnia and othis sleep disorders, which can be harmful to one's general health and productivity.
    - Frequent head massages have been demonstrated to aid in relaxation induction, which can enhance general well-being and increase the quality of sleep.
    - A gadget with IoT capabilities can be configured to deliver personalized massage sessions or mild vibrations based on personal sleeping habits or inclinations.

3. **Pain Reduction and Management of Migraines:**
    - Common ailments like tension headaches and migraines can have a big influence on productivity and quality of life.
    - Head massages can lessen headache and migraine frequency and intensity by releasing muscular tension and increasing blood flow.
    - Targeted massage techniques and customizable intensity levels can be applied to particular pain points or trigger locations using a smart device.

4. **Accessibility and Convenience:**
    - Conventional manual head massages can be costly, time-consuming, and need going to a spa or professional masseuse.

- Without having to make appointments or leave the comforts of one's home or workplace, an IoT-enabled head massaging device provides the ease of getting a massage whenever and wherever it is needed.

5. **Customisation and Data-Based Understanding:**
   - Users can tailor massage settings to suit their unique requirements and preferences thanks to IoT connectivity.
   - Utilisation patterns, pressure levels, and user input are among the data that the device can gathers and analyze to make customized suggestions or advancements over time.
6. **Combining with Ecosystems of Smart Homes:**
   The device can be included in current smart home ecosystems as the technology for smart homes advances, providing voice control, automation, and smooth interaction with these linked gadgets or programs.
7. **Market Potential and Business Opportunities:**
   The market for wellness and self-care is expanding quickly due to growing recognition of the significance of both physical and mental well-being. An inventive and user-friendly IoT-enabled head massaging device can take advantage of this market by offering a distinctive and worthwhile product for customers looking for practical and efficient pain relief and relaxation solutions.

By taking into account these driving forces, the creation of an IoT-enabled device can help enhance general well-being, relieve stress and anxiety, encourage improved sleep, and provide users with a handy and customized self-care option.

## 1.2 Problem Statement

The primary goal of this project is to develop an advanced IoT-enabled head massager that enhances connectivity and functionality to offer a superior relaxation experience. The device will feature multiple massage modes, each designed to target different parts of the head and provide varied massage styles tailored for relaxation, tension alleviation, and rejuvenation. Leveraging IoT capabilities, the massager will allow users to control settings via a mobile app (Blynk app), enabling customization of massage patterns and intensity to suit individual preferences. This smart device aims to make head massages more accessible and customizable, overcoming the limitations of traditional relaxation methods and integrating seamlessly with modern technology for continuous improvement and user-driven customization. Also, with Wi-Fi accessibility, they can easily set up and use smartphones, tablets, and other compatible devices by connecting them via Wi-Fi.

## 1.3 Objectives of the Device

The objectives of the device focus on enhancing user experience and well-being through:

- **Enhanced Relaxation**: Utilizing various massage techniques to reduce stress.
- **Customization and Personalization**: Allowing users to tailor their experiences based on individual preferences.
- **Ease of Use**: Ensuring the device is user-friendly and maintenance-free.
- **Smart Features Integration**: Incorporating advanced technological features for a comprehensive wellness experience.
- **Convenience and Portability**: Designing the device to be portable for on-the-go usage.
- **Health Benefits**: Incorporating features that promote physical health benefits like improved blood circulation.
- **Quality and Durability**: Ensuring long-lasting performance through high-quality components.
- **Safety and Security**: Prioritizing user safety and compliance with safety standards.
- **User Satisfaction**: Focusing on delivering a satisfying and beneficial user experience.

## Summary:

This chapter introduces the innovative IoT-based head massage system designed to modernize and enhance traditional relaxation techniques. Through smart technology integration, the device offers personalized and convenient solutions for stress relief and health improvement, marking a significant advancement in relaxation technology. It's aimed at enhancing traditional head massages through IoT technology. This system integrates an ESP8266 microcontroller for connectivity and control, utilizing components like vibrator modules and rotors for targeted and effective massages. The Blynk app integration enables advanced features such as remote control and real-time monitoring. The project is motivated by the need for accessible relaxation, enhanced sleep quality, and pain management. Objectives focus on user customization, ease of use, and integration with smart home ecosystems.

# Chapter 2

# LITERATURE SURVEY

## 2.1 Outline of Background Work

Literature surveys play a pivotal role in the research process, serving as a comprehensive base that not only informs researchers but also shapes the trajectory of their investigations. This section covers three pivotal studies that significantly contribute to the field of robotic massage therapy, emphasizing the unique aspects and shortcomings of current technologies. Additionally, it reviews existing market products to provide a comparative context for the proposed innovation.

The identified research paperwork is elaborated as follows,

In [1] The foundation of human-robot interactions is tactile interaction. The difference between human-robot and human-virtual agent contact is the robot's physical presence. This study looks into whether receiving a massage from someone else is more enjoyable than providing oneself, and whether administering a massage using a basic robot is noticeably worse. It also explores if the participant's sentiments regarding robots are altered by their hands-on interaction with one. The findings demonstrate how much more enjoyable it is to have a massage from a human masseuse as opposed to a robot or by oneself. On the other hand, under the robot condition, the subjects showed noticeably greater happy facial expressions. The participant's experience with the robot did not materially alter their opinions about robotics.

This research indicates that the area of robotic massage therapy holds great potential for facilitating human-robot connection. The study makes it possible to compare firsthand the pleasure of having one's head massaged by a robot and by a human massage. This offers insightful information about how humans perceive tactile stimuli during human-robot interaction. Through the analysis of participants' facial expressions, pleasure by providing a comprehensive knowledge of their emotional responses to the various massage situations. This research works on the lack of visual or tactile feedback loop of the Robot and the lack of adjustment to the characteristics of each person. Only focused on head massages and not on muscle massages commonly associated with tension relief.

This research paper reviews as below,

- **Study Insight**: The paper explores the nuances of tactile interactions in human-robot interfaces, particularly in the context of massage therapy. It investigates the emotional and physical satisfaction derived from massages delivered by humans versus robots.
- **Key Findings**: Massages performed by humans were found to be more pleasurable compared to those administered by robots or self-performed massages. Interestingly, interactions with robots led to noticeably happier facial expressions despite lower pleasure ratings, suggesting a complex emotional engagement.
- **Limitations**: The robot used lacked a feedback loop for visual and tactile responses and could not adjust to individual user characteristics. It was solely focused on head massages, neglecting broader applications such as muscle massages for tension relief.

This paper [2] Both physical and emotional relaxation can be obtained from common head care practices including shampooing and scalp massages. This head care robot is being developed based on robot hand technology. Using the bio-signals of accelerated plethysmography (SDNN, HF/TP, LF/HF), heart rate (HR), blood pressure, salivary amylase (SAA), and peripheral skin temperature (PST), the quantitatively assessed its relaxation impact in this work. It particularly verified notable distinctions between the planned robot's technique and their suggested head care robots in five indexes: HF/TP, LF/HF, HR, SAA, and PST. The values of the sympathetic nervous system's indices LF/HF, HR, and SAA significantly declined, indicating a decrease in sympathetic nervous system activity.

However, the rise in the values of the parasympathetic nervous system's HF/TP and PST indices was accompanied by an increase in parasympathetic nervous system activity. After only five minutes of operation, this designed head care robot offered a good level of relaxation. In this work, authors have listed a few advantages, such as, Significant differences were observed in five indexes: heart rate variability (HF/TP, LF/HF), heart rate, salivary amylase activity, and peripheral skin temperature. Activity of the SNS decreased and Activity of the PNS increased. This research work is a machine robot chair that has to be installed in a place & is not portable, it is mainly seen in Spa treatments & not everyone can afford it.

This research paper reviews as below,

- **Study Insight**: This research evaluates the relaxation effects of a head care robot using various biometric indicators.

- **Quantitative Assessment**: Significant improvements were noted in heart rate variability, sympathetic nervous system activity (marked by decreases in heart rate and salivary amylase), and parasympathetic nervous system activity (noted by increases in peripheral skin temperature).
- **Limitations**: Despite its efficacy, the robot's design restricts it to stationary use (e.g., spa settings), limiting accessibility and affordability for general consumers.

The authors [3] address that there are currently a lot of massage therapy gadgets available on the market, but none of them are truly worth the cost, thus they are unable to provide the prompt relief that is required. It will showcase the entire production, control, and design process for the product through a series of simulations that include the following: a Vibrational/Modal Frequency Response to analyze the stability during operation; a Fatigue Test to determine the maximum stress the design can withstand for a good life; a Thermal Analysis to assess the heat dissipation from the electronics; and finally, a Linear Static Stress Analysis to determine the strength of the design that can produce the right amount of force. SOLID WORKS software will be used to generate the computer-aided design, and ANSYS will be used to optimize the finite element simulations.

In this work authors have listed a few advantages and disadvantages respectively, A perfect massage anywhere without an annoying wire for two hours when recharged completely, it mainly focuses on only two points on the head, it is unable to maintain the rpm and few knurling sounds are being heard from the device, Heavy to use.

This research paper reviews as below,

- **Study Insight**: This paper critiques the effectiveness of existing massage devices and proposes a new design evaluated through a series of simulations to test durability, force appropriateness, and heat dissipation.
- **Advantages**: The proposed device is portable and wireless, offering a convenient massage experience.
- **Limitations**: The device focuses only on specific head points and struggles with maintaining consistent RPMs; some units emit undesirable noises.

## Market Survey:

Similarly, the project model available in the market is also surveyed are elaborated as follows, Few product details,

1. **Model name:** Electric Head Massager Migraine Pressure Sleeping.
    - **Manufacturing company:** Serene Ease Head Massager.
    - **Features**: Portable, ergonomic design with multiple massage modes to alleviate headaches and improve sleep quality.
    - **Pros**: Effective in reducing migraine symptoms and discomfort.
    - **Cons**: Variability in effectiveness and not suitable for children.

**Picture of working model:**

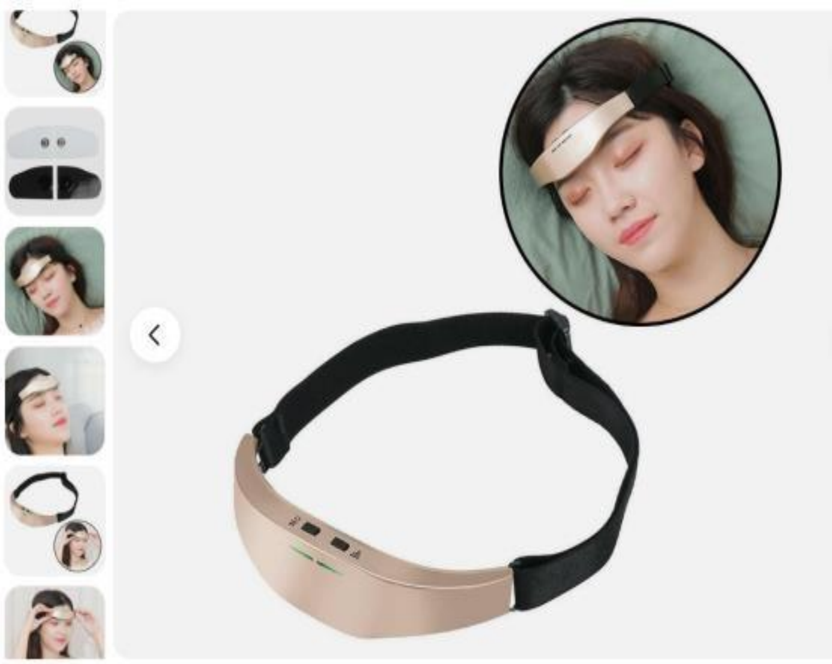


Fig. 2.1: Electric head massager migraine pressure sleeping.

**Description:**

• Figure 2.1 is lightweight and portable, easy to use, and can be used for exercise, walking, and moderate home. It only takes 15 minutes every day to enjoy comfortable sleep and adjust the clock stably. Ergonomic body, head curve, and comfortable to wear.

• Sleep modes: Low-frequency pulses help to relax tension and stress and help to improve sleep quality; Migraines help the brain to produce endorphins, soothing headaches, and discomfort; let you enjoy a massage for 15 minutes and give you a baby. We can choose the intensity according to our own needs.

• Using a USB charging interface, it can be used 20 times continuously after being massaged for 15 minutes every day for about 2 hours at a time

**Advantages:**

• Soothing headache and discomfort.

• Reduce migraine.

**Disadvantages:**

• Difference in measurement.

• Not safe for children and kids.

2. **Model name:** Head Electric Octopus Acupoint Massager.
    - **Manufacturing company:** KEYOZA.
    - **Features**: Offers intelligent vibration adjustments for scalp massage to promote blood circulation.
    - **Pros**: Hands-free operation; enhances relaxation.
    - **Cons**: Limited battery life and not universally suitable.

**Picture of working model:**

Fig.2.2: Head electric octopus acupoint massager.

**Description:**

Figure 2.2 shows the head acupoint massager electric soul extractor rechargeable battery octopus scalp vibration massage claw alleviate fatigue promote blood circulation tools. One-key adjustment, multi-gear mode, free force, easy mode change. Intelligent pseudo-frequency vibration, free hands, relaxed nerve scalp.

**Advantages:**

• Intelligent pseudo-frequency vibration.

• free hands, relax nerve scalp.

**Disadvantage:**

• Limited battery capacity.

• Not suitable for everyone.

• Not controlled by external units.

3. **Model name:** Hi5 H1 Hair Scalp Massager.

   **Manufacturing company:** Master Massager.

   - **Features**: Lightweight design providing deep scalp massages with high-frequency vibrations.
   - **Pros**: Aids in relieving head, neck, and scalp aches.
   - **Cons**: Limited to specific areas; not adjustable for different head sizes.

   **Picture of working model:**


Fig. 2.3: Hi5 H1 Hair scalp massager.

**Description:**

- Lightweight and stylish at only 120 grams (4.3 ounces) as shown in figure 2.3.
- You receive a deep, soothing, therapeutic massage with the Magic 11 Fingers Electric Massager to relieve stress, anxiety, headaches, and migraines.
- Ideal for relaxation at home or work.
- 11-finger relief of a professional massage therapist.
- Vibrations of up to 12,000 hertz.
- Help ease aches and pains, including those in the head, neck, and scalp.

**Advantages:**

- Help ease aches and pains, including those in the head, neck, and scalp.
- It's compact and easy to wear.

**Disadvantages:**

- Massages only limited area.
- Not stretchable.
- Not suitable for children.

## 2.2 Proposed Method

The proposed methodology should be well-organized, clear, and aligned with the overall objectives of the project. It provides a foundation for project planning, execution, and evaluation.

**1. Hardware Selection and Integration:**

The first step in the development process is to select and integrate the necessary hardware components.

Key components include:

- **ESP8266 Microcontroller:** Chosen for its versatility and IoT capabilities, the ESP8266 serves as the central processing unit of the system. It facilitates communication between the various components and the user interface, enabling seamless integration with IoT technology.

- **Power Supply Unit:** A reliable power supply unit is essential to ensure consistent operation of the system. The selected power supply should be capable of providing sufficient power to all components while maintaining stability and efficiency.
- **Vibrator Modules:** Strategically positioned within the head massage device, vibrator modules deliver targeted vibrations to specific pressure points on the scalp. These modules should be chosen based on their vibration intensity, frequency range, and compatibility with the ESP8266 microcontroller.
- **Rotors:** Mimicking the kneading motion of human fingers, rotors add a therapeutic touch to the massage experience. The selection of rotors should consider factors such as size, material, and compatibility with the overall design of the system.
- **Relay Module:** The relay module serves as a switch, allowing the microcontroller to control the activation and deactivation of massage functions. It should be chosen based on its compatibility with the ESP8266 and the power requirements of the vibrator modules and rotors.

**2. Software Development:**

Once the hardware components are selected and integrated, the next step is to develop the software for the system. This involves programming the ESP8266 microcontroller and developing the user interface through the Blynk app. The software development process includes:

- **ESP8266 Programming:** Writing code to enable communication between the ESP8266 microcontroller and the various hardware components. This includes controlling the activation and deactivation of massage functions, adjusting vibration intensity and frequency, and monitoring system status.
- **Blynk App Development:** Developing the user interface for the head massage system using the Blynk app platform. This involves designing intuitive controls for initiating and customizing massage sessions, monitoring usage statistics, and receiving notifications.

**3. Integration and Testing:**

Once the hardware and software components are developed, they are integrated to form the complete IoT-enabled device. This integrated system undergoes rigorous testing to ensure functionality, reliability, and user satisfaction.

Testing procedures include:

- **Hardware Testing:** Verifying the functionality of each hardware component, including the ESP8266 microcontroller, power supply unit, vibrator modules, rotors, and relay module. This involves conducting tests to ensure proper connectivity, power distribution, and responsiveness.
- **Software Testing:** Testing the software components, including the ESP8266 code and the Blynk app interface. This involves verifying the functionality of user controls, communication between the microcontroller and the app, and the overall responsiveness and performance of the system.
- **User Testing:** Soliciting feedback from users to assess the usability, effectiveness, and satisfaction of the IoT-enabled device. This involves conducting user trials and surveys to gather insights and identify areas for improvement.

By following this proposed method, the development team can create a robust and user-friendly IoT-enabled device that combines the therapeutic benefits of head massage with the convenience and customization of IoT technology.

## 2.3 Methodology

The design and development of the IoT-enabled device involve a systematic approach encompassing various stages, including planning, design, implementation, testing, and evaluation. The comprehensive technique for each step is described in this section:

1. **Planning Phase:**
    - **Identify Requirements:** The first step is to gather requirements by conducting research, surveys, and interviews with potential users. This helps in understanding user needs, preferences, and expectations from the head massage system.
    - **Define Objectives:** Decide on precise and well-defined project goals based on the requirements that have been collected. The intended features, functionality, and performance standards for the head massage system should be described in these objectives.
    - **Select Hardware and Software Platforms:** Choose suitable hardware components such as the ESP8266 microcontroller, power supply unit, vibrator modules, rotors, relay

module, and software platforms such as the Arduino IDE for microcontroller programming and the Blynk app for user interface development.

**2. Design Phase:**

- **System Architecture Design:** Develop a high-level architecture for the head massage system, outlining the interaction between hardware components, software modules, and user interfaces. Define communication protocols and data flow between different elements of the system.

- **Hardware Design:** Consider aspects like size, weight, power consumption, and ergonomic design for user comfort while designing the physical arrangement and configuration of hardware components. Make circuit diagrams and schematics to show how the various components are connected.
- **Software Design:** Design the software architecture, including the firmware for the ESP8266 microcontroller and the user interface for the Blynk app. Define the functionality, control mechanisms, and communication protocols for each software module.

**3. Implementation Phase:**

- **Hardware Implementation:** Assemble and integrate the selected hardware components according to the design specifications. This involves soldering, wiring, and mounting components onto a prototype board or enclosure.
- **Software Implementation:** Develop the firmware for the ESP32 microcontroller using the Arduino IDE, incorporating code for controlling hardware peripherals, implementing communication protocols, and processing user inputs. Develop the user interface for the Blynk app, designing screens, buttons, and controls for interacting with the head massage system.

**4. Testing Phase:**

- **Unit Testing:** Conduct unit tests for individual hardware components and software modules to ensure functionality and compatibility. This involves testing each component in isolation to identify and fix any defects or inconsistencies.

- **Integration Testing:** Integrate hardware and software components to form the complete head massage system and conduct integration tests to verify interoperability, communication, and overall system functionality.
- **User Acceptance Testing (UAT):** Invite users to participate in UAT sessions to evaluate the usability, performance, and satisfaction of the head massage system. Gather feedback and insights to identify areas for improvement and refinement.

**5. Evaluation Phase:**

- **Performance Evaluation:** Assess the performance of the head massage system based on predefined criteria such as responsiveness, reliability, power efficiency, and user experience. Analyze test results and user feedback to identify strengths and weaknesses.
- **Iterative Improvement:** Use evaluation findings to iterate and refine the design, implementation, and testing of the head massage system. Incorporate user feedback and address identified issues to enhance overall system quality and user satisfaction.

The methodology for developing the head massaging product on the IoT platform involves several key steps. Firstly, the hardware components including the ESP8266 microcontroller, relay, DC motor, and vibrator are assembled and interconnected according to the design specifications. Next, the software development process begins by programming the microcontroller to interface with the hardware components and establish connectivity with the Blynk IoT platform.

Figure 2.4 shows a block diagram of the device and the development process for the device on the IoT platform begins with assembling and interconnecting hardware components, followed by programming the microcontroller and configuring the Blynk app for remote control. Iterative improvements made based on user feedback and testing results. This iterative approach allows for the creation of a user-friendly and effective solution for relaxation and stress relief.

This diagram represents a typical IoT system setup using the Blynk app, ESP8266 microcontroller, and various peripheral components to enable remote monitoring and control of devices.

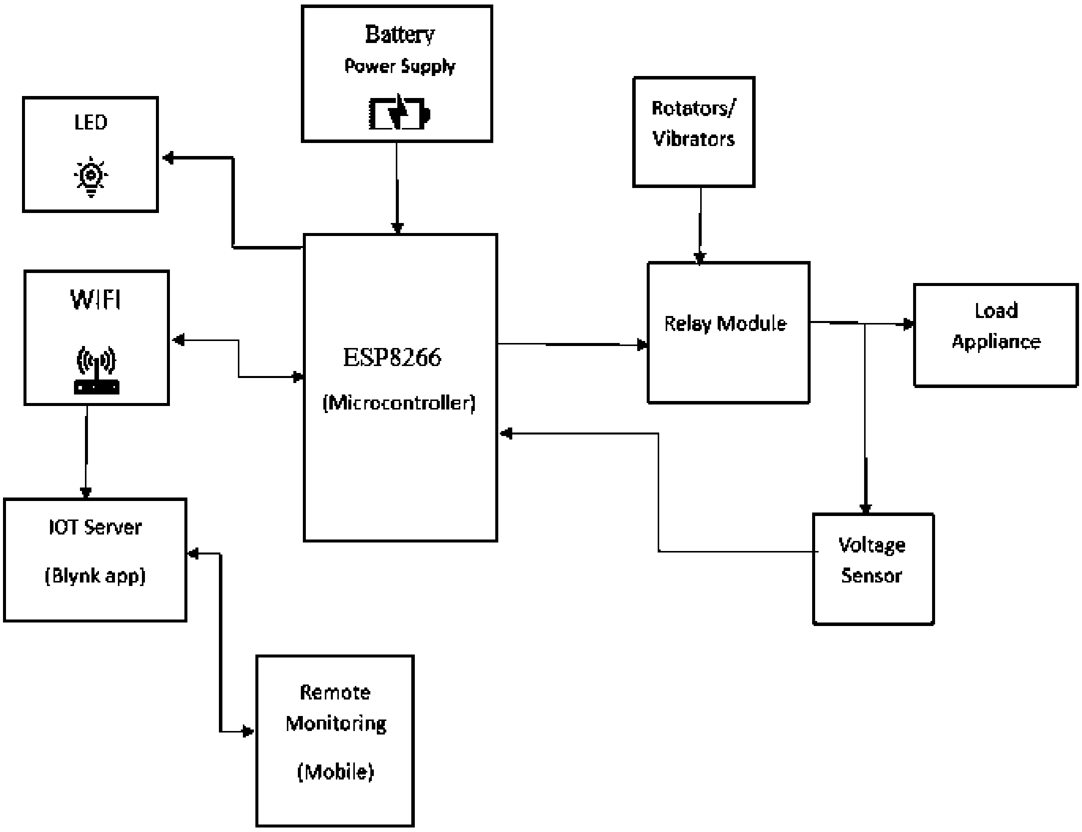



Fig. 2.4: Shows a block diagram of the head massaging device.

The project implementation we have a breakdown of the series of steps,

1. **ESP8266 Microcontroller**:
   - This is the central unit that controls this device in this IoT setup. It connects to various sensors and modules, and it communicates wirelessly via WiFi.
2. **Battery (Power Supply)**:
   - Provides power to the ESP8266 and potentially these components in the system.
3. **WiFi Module**:
   - This allows the ESP8266 to connect to the internet or a local network. Through this connection, the ESP8266 can communicate with the Blynk server.
4. **LED**:
   - A simple output device controlled by the ESP8266, which can be used as an indicator light or for signaling purposes.

5. **Relay Module**:
    - Acts as a switch controlled by the ESP8266, enabling or disabling the power to the load appliance (like a motor or heater). This module can safely handle higher power requirements than the ESP8266's GPIO pins can directly manage.
6. **Load Appliance**:
    - The actual device being controlled, which can be anything from a light bulb to a large mechanical machine.
7. **Voltage Sensor**:
    - Monitors the voltage across the load appliance. This can be crucial for safety, performance monitoring, or adaptive control features.
8. **Rotators/Vibrators**:
    - These are additional output devices that can be controlled via the relay module, indicating a capacity for moving or vibrating elements as part of the system operation.
9. **IoT Server (Blynk app)**:
    - The ESP8266 sends data to and receives control commands from the Blynk server. This can include turning devices on or off, adjusting settings, or monitoring sensor outputs.
10. **Remote Monitoring (Mobile)**:
    - A user interface provided by the Blynk app on a mobile device. This allows users to view real-time data from the sensors, control the outputs (like the LED or the load appliance), and receive notifications.

**Working Principle:**

- The ESP8266 is programmed to handle inputs from sensors (like the voltage sensor) and outputs to devices (like the LED, rotators, and relay-controlled appliances).
- Through the Blynk app, commands are sent from a mobile device to the IoT server, which communicates with the ESP8266 over WiFi to control the system.
- Data from sensors is sent back to the mobile device via the Blynk app, allowing for real-time monitoring and adjustments based on the input data.

The described IoT system works by integrating various components for control and monitoring purposes, all managed through the Blynk app.

Here's a detailed description of how this device functions:

**Initialization:**

1. **Power Supply**:
    - The entire system is powered by a battery. The ESP8266, along with all connected peripherals like LEDs, sensors, and relays, receive their required power from this source.
2. **ESP8266 Setup**:
    - The ESP8266 microcontroller is programmed initially to handle specific tasks such as reading sensor data, controlling output devices (LEDs, relays), and communicating with the Blynk server over WiFi.

**Communication:**

3. **WiFi Connectivity**:
    - The ESP8266 connects to a local WiFi network, which provides access to the internet and thereby to the Blynk cloud server.
4. **Blynk App Configuration**:
    - The Blynk app is set up on a mobile device to interface with the Blynk server. This app allows users to create dashboards with widgets that can control and monitor the various connected devices.

**Control Flow:**

5. **Remote Commands**:
    - Users send commands from the Blynk app, which are relayed to the Blynk server and then to the ESP8266. These commands can be to turn an appliance on or off, to activate rotators or vibrators, or to switch the LED state.
6. **Device Control via Relay**:
    - Based on the commands received, the ESP8266 triggers the relay module to either connect or disconnect the load appliance to the power supply, effectively controlling its operation.

**Monitoring and Feedback:**

7. **Sensor Data Acquisition**:
    - The voltage sensor continuously monitors the voltage of the load appliance. This data is crucial for ensuring that the appliance operates within safe voltage parameters and can provide feedback on the system's status.

8. **Real-Time Data Transmission**:
    - The sensor data, along with any other required system status information, is sent back to the Blynk server and then to the mobile app. This allows the user to monitor the system in real-time.

**Indicator:**

9. **LED Indication**:
    - An LED is used as an indicator of system status. For example, it might blink or turn on when certain actions are taken or if an error occurs.

**Operational Scenarios:**

- **Example Use Case**: If the system controls a heating unit, a user could turn the heater on or off remotely via the Blynk app. The ESP8266 would receive this command, activate the relay to supply power to the heater and monitor the voltage to ensure safe operation. All the while, the user can observe the heater's status through the app.

**Safety and Automation:**

- **Automation**: The system can be programmed for automated responses based on sensor inputs. For example, if the voltage exceeds a safe threshold, the system could automatically turn off the appliance to prevent damage or hazard.
- **Safety Monitoring**: Continuous monitoring of voltage and appliance status ensures that any potential issues are detected early, enhancing the overall safety of the system.

This system exemplifies the integration of IoT capabilities into everyday devices, allowing for enhanced control, monitoring, and safety, all accessible remotely via a simple mobile app interface.

## Summary:

This chapter provides a detailed literature survey and methodology for developing an IoT-enabled head massaging device. It reviews key studies and market products, highlighting the need for enhanced robotic massage solutions. The device implementation involves selecting suitable hardware and software, integrating these components, and conducting extensive testing. A systematic design and development approach ensures the device meets user needs effectively. The aim is to deliver a superior, user-friendly massage experience through innovative IoT integration.

# Chapter 3

# SYSTEM REQUIREMENTS

## 3.1 Introduction

For an effective operation of the suggested system, a set of software and hardware components is required. The software needs include an Integrated Development Environment (IDE) for programming the microcontroller, Arduino libraries to connect the hardware units, the Blynk mobile application which will be used by users, a Blynk server or cloud account for remote monitoring and control purposes; Wi-Fi Configuration Tool that will help in setting up wireless connectivity; serial monitor for debugging and monitoring. On the hardware side of things, the ESP8266 microcontroller acts as its brain. This microcontroller processes instructions and manages a range of peripheral devices.

The power supply is necessary to provide electrical energy to the system. Also, this is a need for the relay to control external devices or loads while vibrators and rotors are used to give tactile feedback or motion respectively. To allow user input or trigger specific actions, a push button comes along with it. The software and hardware parts synergize to create a system that can do many things. The IDE facilitates the development and uploading of code to the microcontroller, using Arduino libraries for efficient hardware interaction. Blynk mobile app and server/cloud account are used for remote monitoring and control via a user-friendly interface on mobile devices.

The Wi-Fi Configuration Tool is responsible for making sure that this is a wireless connection so that the system can interact with the Blynk server or cloud account over the internet. The serial monitor helps one in debugging and monitoring the system performance which gives important information during the development and troubleshooting process. The software works in harmony with the hardware components to accomplish the desired functions. The microcontroller interprets the code and manipulates the relay, vibrator, and rotors that depend on what is fed through the push button or remote commands sent via the app. The power supply ensures that there is enough electrical energy to run this system while the relay helps in controlling external devices or loads. By integrating this software and these hardware requirements, proposed system should be a complete solution for many different applications including home automation, industrial monitoring etc while remote control and monitoring are paramount.

## 3.2 Software and Hardware Requirements

Software and hardware requirements are crucial in project implementation as they define the essential tools and systems needed to execute tasks effectively. Properly identifying these requirements ensures compatibility and performance optimization, reducing the risk of delays and cost overruns. They also help in scaling the project appropriately, ensuring it meets both current needs and future expansions. Clear specifications lead to smooth integration and testing, enhancing overall project success.

### 3.2.1 Software Requirements

The software integrated into the head massaging device is crucial for personalizing the massage experience, allowing users to adjust settings like speed and intensity based on their preferences. It facilitates real-time feedback and adjustments, enhancing user comfort and effectiveness of the massage. Additionally, the software collects usage data to improve device functionality and user satisfaction over time.

**1. Integrated Development Environment (IDE)**

The heart of software development is an IDE, which offers a full range of features and tools to make writing easier. An IDE is essential to the smart energy meter project because it makes it easier to write, edit, compile, and debug the code that controls the meter's operation. The Arduino IDE is one of the most popular IDEs for embedded systems development. Its intuitive interface, designed specifically for the Arduino platform, makes it easy to use even for novices. Together with features like syntax highlighting, code completion, and a serial monitor for debugging, the Arduino IDE comes with built-in support for building and uploading code to Arduino boards.

Another well-liked option for embedded systems developers is Platform IO, which provides a more sophisticated and feature-rich development environment than the Arduino IDE. Numerous development platforms, including Arduino, ESP8266, and many more, are supported by Platform IO. Strong project management features, a centralized library and dependency management interface, and interaction with well-known version control systems like Git are all included. Express if's ESP-IDF (Express if IoT Development Framework) is the best choice for microcontroller developers. There is an enormous variety of libraries, tools, and documentation designed specifically for the microcontroller at ESP-IDF. Developers can take full advantage of its capabilities by using low-level access to the hardware peripherals on the microcontroller chips. It ultimately boils down to specific preferences and needs as each of these IDEs has its pros and cons.

Platform IO is more advanced in features as well as being flexible while Arduino IDE is best suited for beginners and simple applications. However, when it comes to developing programs right on the ESP8266 platform, there are not many frameworks that beat Esp-if in terms of low-level control over hardware features. Developers will then be able to concentrate on putting this functionality into practice, making it a stronger and more reliable final product.

**2. Arduino Libraries**

Installing the necessary Arduino libraries to communicate with the project's particular sensors and components may be necessary. LiquidCrystal_I2C, Blynk, and any of these modules or sensors (like the present sensor libraries) should all have libraries included.

**3. Blynk Mobile App**

Within the ecosystem of the smart energy meter project, the Blynk mobile app is a vital tool that provides a simplified method for creating IoT interfaces and apps. Blynk makes it simple for developers to create user-friendly interfaces that are customized to the features of smart energy meters, allowing for remote control and monitoring from any location with an internet connection.

Through the use of the Blynk mobile app, customers may access an intuitive interface that makes it easy to monitor energy use in real time and manage meter operations. With the Blynk app, customers can keep informed and in charge of their energy usage at all times by checking current power usage, examining historical data patterns, and remotely modifying settings. Because the software is available for both iOS and Android, it is widely accessible and enables users to engage with the smart energy meter using their favorite mobile devices, like tablets or smartphones. Cross-platform compatibility guarantees a consistent experience across many devices and operating systems while improving user convenience and flexibility.

Furthermore, the drag-and-drop feature and user-friendly interface of the Blynk platform make it easier for those with no programming background to create custom user interfaces. With a wide range of widgets and customization options available, developers may create user-friendly dashboards and widgets that are customized to meet the needs and preferences of certain users. Apart from its ability to develop interfaces, the Blynk mobile app makes it possible for the user's mobile device and the smart energy meter to communicate seamlessly by using the Blynk cloud infrastructure. This makes it possible for data to be sent securely and reliably, giving users the assurance to view real-time data and remotely operate meters.

**4. Blynk Server or Cloud Account**

To establish communication between the smart energy meter and the Blynk mobile app, you need to either set up a local Blynk server or create an account on the Blynk cloud. This allows the smart energy meter to connect to the Blynk platform and exchange data securely.

**5. Wi-Fi Configuration Tool**

Since the ESP8266 module is used for wireless connectivity, a Wi-Fi configuration tool may be required to set up the microcontroller module to connect to the local network. Tools like the Manager library for Arduino can simplify the process of configuring the Wi-Fi credentials dynamically.

**6. Serial Monitor**

The serial monitor provided by the IDE (Ex., Arduino IDE) is invaluable for debugging and monitoring the output of the smart energy meter during development. It allows you to view debug messages, sensor readings, and communication logs between the ESP8266 and other components.

### 3.2.2 Hardware Requirements

The hardware requirements for a head massage device include a durable, ergonomic design suitable for various head shapes, multiple adjustable massage nodes for targeted therapy, built-in sensors for pressure adjustment and user feedback, and a rechargeable battery for wireless operation. These components ensure a versatile and user-friendly experience tailored to individual relaxation needs.

**1. ESP8266:**

The ESP8266, the compact size and integrated Wi-Fi, the Espresso if systems developed into a low-cost, low-power system on a chip (SoC) microcontroller that is commonly utilized in IoT applications. Its 32 KiB of instruction RAM, 80 KiB of user data RAM, and up to 16 MiB of external QSPI flash memory are all based on a 32-bit Tensilica Xtensa LX106 RISC microprocessor operating at 80-160 MHz.

Figure 3.1 is equipped with a self-contained wireless transceiver that supports many security protocols, including WEP, WPA, and WPA2, and 2.4 GHz IEEE 802.11 b/g/n Wi-Fi standards. Up to 17 general-purpose input/output (GPIO) pins are available for a variety of applications, including PWM, I2C, SPI, and digital input/output. The deep sleep mode's current consumption is as low as 20 µA due to its low power consumption. The official Espresso SDK or the Arduino IDE can be used to code the microcontroller, which supports C, C++, and Lua programming languages. The ESP8266 is a popular device in the maker community and IoT space because of its low cost, integrated Wi-Fi capabilities, and ease of use, particularly for low-power and wireless-required projects. It is widely used in home automation systems, wearable devices, sensor networks, and many other embedded applications that require wireless connectivity.

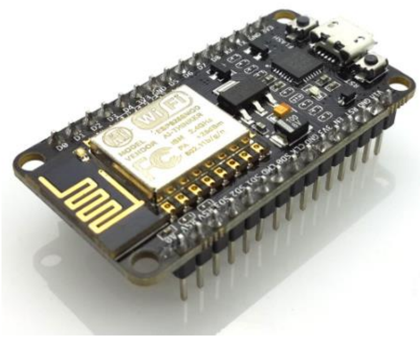


Fig. 3.1: ESP8266 microcontroller.

**2. Power supply:**

The figure 3.2 power supply unit serves as a critical component in electronic systems, providing the necessary voltage and current to ensure the reliable operation of various components. It converts input voltage from a power source, such as a wall outlet or battery, to the required levels for the system’s operation. A well-designed power supply unit must meet several key requirements, including stability, efficiency, and reliability.

Stability is essential to ensure that the output voltage remains constant, regardless of fluctuations in the input voltage or changes in load conditions. Voltage regulators, such as linear or switching regulators, are commonly used in power supply units to achieve this stability by maintaining a steady output voltage within a specified tolerance range. This stability is crucial for the proper functioning of sensitive electronic components, preventing damage due to overvoltage or undervoltage conditions.


Fig 3.2: Lithium-ion batteries.

Efficiency is another important consideration in power supply design, as it directly impacts energy consumption and heat dissipation. Switching power supplies, which use high-frequency switching circuits to regulate output voltage, are known for their high efficiency compared to linear regulators. By minimizing energy losses during the conversion process, efficient power supplies help conserve energy and reduce operating costs, particularly in battery-powered or energy-conscious applications.

Reliability is paramount in power supply design, as any failure or malfunction can result in system downtime, damage to components, or even safety hazards. To ensure reliability, power supply units undergo rigorous testing and adhere to strict quality standards. Components such as capacitors, transformers, and voltage regulators are carefully selected for their reliability and longevity, with an emphasis on robust construction and adherence to industry specifications.

Furthermore, safety features such as overcurrent protection, overvoltage protection, and short-circuit protection are often incorporated into power supply units to safeguard against unforeseen events or malfunctions. These features help prevent damage to the system and ensure the safety of users and equipment.

**3. Relay:**

The relays are electromechanical switches that are commonly used in electronic and electrical systems to control the flow of electricity. They consist of a coil, an armature, and one or more sets of contacts. When an electrical current is applied to the coil, it generates a magnetic field that attracts the armature, causing it to move and close or open the contacts, depending on the relay type.

Figure 3.3, 4CH Relay The primary function of relays is to provide isolation between the control circuit and the load circuit. This isolation helps protect sensitive control circuits from the highest voltages and currents present in the load circuit, preventing damage to the control circuitry. Additionally, relays allow for the use of different voltage levels or signal types in the control circuit without affecting the load circuit. Relays are available in various configurations, including normally open (NO), normally closed (NC), and changeover (CO) or double-throw (DT). In a normally open relay, the contacts are open when the relay coil is not energized, and they close when the coil is energized. Conversely, in a normally closed relay, the contacts are closed when the coil is not energized, and they open when the coil is energized.

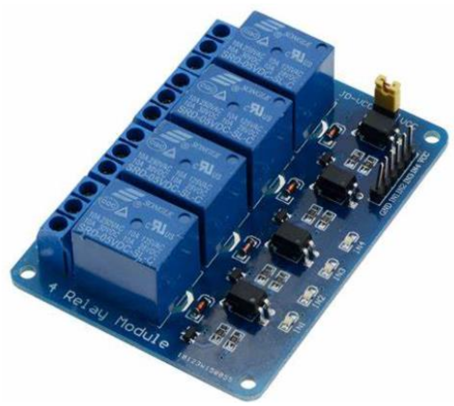



Fig. 3.3: 4CH Relay.

Changeover relays have both normally open and normally closed contacts, allowing them to switch between two different circuits. One of the key advantages of relays is their ability to switch high-power or high-voltage loads using a low-power control signal. This makes relays ideal for applications where the control circuit operates at a different voltage or current level than the load circuit, or where isolation between the two circuits is required. Additionally, relays offer galvanic isolation between the coil and contacts, further enhancing safety and reliability in sensitive electronic systems.

Relays find widespread use in various industries and applications, including industrial automation, automotive electronics, home appliances, and telecommunications. They are commonly used in control panels, motor starters, lighting systems, safety interlocks, and alarm circuits, among others. With their versatility, reliability, and ability to provide isolation and switching capabilities, relays continue to be an essential component in modern electronic and electrical systems.

**4. Vibrator:**

Vibrators, in the context of electronic devices, are mechanical components designed to generate vibrations or oscillations. They are commonly used in a variety of applications, ranging from mobile phones and gaming controllers to massage devices and alert systems. Vibrators typically consist of a motor or actuator mechanism that converts electrical energy into mechanical motion, resulting in the desired vibration effect.

One of the key components of a vibrator is the motor, which serves as the primary source of mechanical motion. These motors are often brushless DC (BLDC) or brushed DC motors, although other types such as eccentric rotating mass (ERM) motors or linear resonant actuators (LRAs) may also be used depending on the application requirements. The motor's design and specifications, including speed, torque, and vibration frequency, play a crucial role in determining the vibrator's performance characteristics.

The vibration mechanism of a vibrator is based on the principle of electromechanical conversion. When an electrical current is applied to the motor's coils, it generates a magnetic field that interacts with permanent magnets or electromagnets, causing the motor's rotor to rotate. This rotational motion is then transferred to an eccentric weight or mass attached to the motor shaft, resulting in a vibrating motion. Vibrators can produce vibrations with varying amplitudes, frequencies, and patterns, depending on the design of the motor and the control signals applied to it. High-frequency vibrations are often used for tactile feedback in mobile devices and gaming controllers, providing users with haptic feedback to enhance their interaction experience. In contrast, lower-frequency vibrations are employed in massage devices and alert systems to deliver soothing or attention-grabbing vibrations, respectively.

In massage devices, vibrators are integrated into specific components, such as pads or attachments, to deliver targeted vibrations to the user's body. These vibrations stimulate the skin and underlying tissues, promoting relaxation, relieving muscle tension, and improving circulation. By adjusting the vibration intensity, frequency, and pattern, users can customize their massage experience to suit their preferences and therapeutic needs.

**5. Rotors:**

Rotors are mechanical components that play a crucial role in various systems, including motors, turbines, and rotating machinery. In the context of massage devices and similar applications, rotors are used to create a kneading or rolling motion that simulates the sensation of human fingers massaging the body.

These rotors typically consist of cylindrical or disc-shaped components that rotate around a central axis, exerting pressure and movement on the target area.

One of the primary functions of rotors in massage devices is to mimic the kneading motion of human hands or fingers. This motion involves alternating compression and release of the muscles and tissues, helping to alleviate tension, improve circulation, and promote relaxation. By incorporating rotating rotors into massage devices, users can experience the therapeutic benefits of massage in a convenient and customizable manner.

Rotors in massage devices are often driven by electric motors or actuators, which provide the rotational motion necessary to create the desired massage effect. The speed, direction, and intensity of the rotor's rotation can be controlled electronically, allowing users to customize their massage experience according to their preferences and needs. Additionally, some massage devices may feature multiple rotors with different sizes or configurations to target specific areas of the body or provide varying massage sensations.

The design and construction of rotors in massage devices are critical factors in determining their effectiveness and performance. Rotors must be balanced and precision-engineered to ensure smooth and consistent rotation, minimizing vibration and noise during operation. Additionally, the materials used in rotor construction should be durable, lightweight, and resistant to wear and tear, ensuring long-term reliability and usability. In massage devices, rotors are often integrated into specific massage heads or attachments, which are designed to come into direct contact with the user's body. These massage heads may feature various surface textures or contours to enhance the massage experience, providing additional stimulation and targeting specific areas of tension or discomfort. By combining rotating rotors with ergonomic massage heads, massage devices can deliver a therapeutic and enjoyable massage experience that rivals professional massages.

**6. Push Button:**

Push buttons are simple yet essential components in electronic circuits, commonly used to initiate or interrupt a specific function or process. They consist of a button or switch mechanism that, when pressed, completes an electrical circuit, allowing current to flow and triggering a desired action. Push buttons are widely used in various devices and applications, from consumer electronics and industrial control systems to automotive and medical devices.

The basic operation of a push button is straightforward: when the button is pressed, it makes physical contact between two electrical terminals, closing the circuit and allowing current to flow. When the button is released, the contact is broken, interrupting the flow of current. This simple mechanism makes push buttons ideal for applications where manual input or control is required, such as turning devices on or off, selecting options, or activating functions.

Push buttons come in various shapes, sizes, and configurations to suit different application requirements. Common types include momentary push buttons, which return to their original position after being released, and latching push buttons, which remain in the pressed or activated state until manually reset. Additionally, push buttons may feature different actuation forces, tactile feedback mechanisms, and illumination options for enhanced usability and user experience. In electronic circuits, push buttons are often used in conjunction with components such as microcontrollers, relays, and LEDs to perform specific functions or operations. For example, a push button may be connected to a microcontroller input pin, allowing the microcontroller to detect when the button is pressed and trigger a corresponding action or response. Alternatively, a push button may be used to control the activation of a relay, which in turn controls the operation of a larger electrical load.

In addition to their functionality, push buttons are designed with durability and reliability in mind, ensuring consistent performance even under harsh conditions or frequent use. Quality push buttons are typically rated for a certain number of actuations, indicating the number of times the button can be pressed before it may fail. Furthermore, push buttons may feature sealed or waterproof designs to protect against dust, moisture, and other environmental factors.

### 7. Blynk App:

The Blynk app is a versatile and user-friendly mobile application developed to provide seamless control and monitoring of IoT devices and systems. Designed with a focus on simplicity, functionality, and intuitive user experience, the Blynk app offers a wide range of features and capabilities for managing connected devices, accessing real-time data, and customizing settings according to user preferences. At its core, the Blynk app serves as a centralized platform for controlling and managing IoT devices from a smartphone or tablet. Users can easily connect their devices to the app via Wi-Fi or Bluetooth, enabling remote access and control from anywhere with an internet connection. This allows users to monitor and control their devices, adjust settings, and receive notifications in real time, enhancing convenience and accessibility.

One of the key features of the Blynk app is its customizable user interface, which allows users to tailor the app to their specific needs and preferences. Users can personalize their dashboard, rearranging widgets, adding or removing devices, and creating custom scenes or routines to automate tasks and streamline workflows. This flexibility empowers users to create a personalized smart home or IoT ecosystem that suits their lifestyles and requirements.

In addition to device control, the Blynk app offers advanced features such as scheduling, automation, and integration with smart home platforms and services. Users can create schedules to automate device operation based on the time of day or specific events, such as sunrise or sunset. Furthermore, the app supports integration with popular smart home platforms like Amazon Alexa, Google Assistant, and Apple HomeKit, allowing for seamless interoperability and voice control of connected devices. Security and privacy are paramount in the Blynk app, with robust encryption and authentication mechanisms in place to protect user data and ensure secure communication between devices and the app. Users have full control over their data and privacy settings, with options to manage permissions, restrict access, and enable two-factor authentication for added security.

## Summary:

The chapter outlines the software and hardware requirements essential for the operation of a system utilizing the ESP8266 microcontroller for various applications like home automation. It details necessary software components including the Arduino IDE, Blynk mobile app, and supportive libraries, alongside hardware such as power supplies, relays, and input/output devices. Security, power management, and error handling are emphasized to ensure system reliability and efficiency. Diagrams and performance metrics are suggested for better understanding and system evaluation. The document aims to provide a thorough setup guide, ensuring compatibility and ease of maintenance.

# Chapter 4

# SYSTEM DESIGN

## 4.1 Introduction

In today's fast-paced world, stress and tension are common afflictions affecting millions globally. In response, there is a high demand for convenient, efficient, and personalized wellness solutions. The IoT-enabled head massaging device introduced here offers a soothing and therapeutic experience at the user's fingertips. Integrating IoT technology with traditional massage techniques, this device combines the precision of the ESP8266 microcontroller to control its rotators and vibrators, ensuring a seamless and customizable massage experience.

A thorough design approach is used in the creation of this device, beginning with planning and requirement analysis and continuing through system design, prototyping, development, integration, and testing. To guarantee that the finished product fulfils strict requirements for quality, dependability, and user satisfaction, each step is carried out with great care. This project intends to revolutionize stress management and relaxation by utilizing IoT technology. It provides a cutting-edge solution that blends smoothly into contemporary lifestyles.

## 4.2 Proposed System

The proposed system is designed as an advanced head massaging device that combines ergonomic hardware with smart technology for personalized stress relief and relaxation. It features adjustable massage nodes powered by AI to adapt the intensity and pattern based on the user's preferences and real-time stress levels, detected via integrated sensors. The device is controlled through a user-friendly app, which allows for customization and tracks usage history to provide tailored wellness recommendations. Additionally, it supports wireless connectivity, ensuring seamless integration with other smart health devices and apps for a comprehensive health management ecosystem.

**1. Hardware Selection and Integration:**

The development process begins by selecting and integrating the hardware components that are required. These include:

- **ESP8266 Microcontroller:** The microcontroller, which is picked due to its versatility and IoT capabilities, serves as the central processing unit (CPU) of the system. In conveying information between the various components and the user interface it enables seamless integration with IoT technologies.
- **Power Supply Unit:** To keep a reliable operating system, this should be a dependable power supply unit. Moreover, the power supply selected must provide enough power for all devices while ensuring stability & efficiency.
- **Vibrator Modules:** These modules used in head massage devices are strategically placed so that they can deliver target vibrations on specific pressure points of the scalp. When choosing these modules therefore factors like intensity of vibration, range of frequency, and compatibility with the microcontroller have to be taken into account.
- **Rotors:** Rotors imitate human fingers kneading movements thus making it more therapeutic when receiving massage services. Size, material, and how well they match with other parts of the system are some things that ought to be considered during their selection process.
- **Relay Module:** The microcontroller may regulate the on and off of massage functions by using the relay module as a switch. Its suitability for the microcontroller and the power needs of the rotors and vibrator modules should be taken into consideration while selecting it.

**2. Development of Software:**

The next stage after choosing and integrating the hardware components is to create the system's software. This includes creating the Blynk app's user interface and programming the ESP8266 microcontroller. Among the steps in the software development process are:

Writing code to allow the microcontroller and the other hardware components to communicate is known as ESP8266 programming. This includes managing the frequency and strength of vibrations, checking system status, and turning on and off massage features. Blynk App Development using the Blynk app platform, creates the head massage system's user interface. This entails creating user-friendly controls for starting and adjusting massage sessions, keeping an eye on usage trends, and getting alerts.

**3. Testing and Integration:**

The IoT-enabled device is assembled as a whole once the hardware and software components have been established. Thorough testing is performed on this integrated system to guarantee its dependability, usability, and user pleasure. Procedures for testing consist of:

- **Hardware testing:** Involves confirming that all of the hardware, such as the ESP32 microcontroller, relay module, rotors, power supply, and vibrator modules, work as intended. To verify appropriate connectivity, power distribution, and response, tests must be performed.
- **Software Testing:** Examining the Blynk app interface and the microcontroller code, among other software components. This includes confirming the operation of user controls, ESP8266-to-app communication, and the system's general responsiveness and performance.
- **User testing:** Asking users for their opinions to evaluate the device's usability, efficacy, and level of satisfaction. To get information and pinpoint areas that need work, user trials and surveys are conducted.

The development team can produce a reliable and user-friendly IoT-enabled device that combines the therapeutic advantages of head massage with the ease of use and customization of IoT technology by employing this suggested methodology.

## 4.3 Use Case Diagram

This schematic represents a basic system with an ESP8266 microcontroller at its core that combines several different parts for output and human interaction. In this configuration, the Blynk App and the push buttons provide inputs to the microcontroller, which is programmed to carry out specified tasks. It is a flexible and remotely controllable system since the outputs allow the vibrator and rotors to be controlled via the relay.

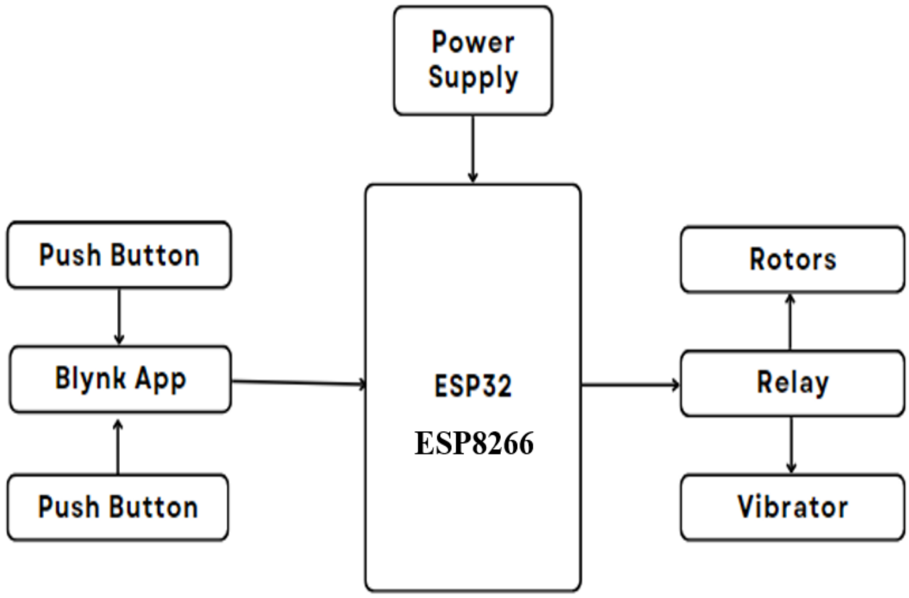



Fig 4.1**:** Use case diagram of smart head massaging device.

Figure 4.1 shows the architecture of a device that is depicted in the block diagram that is given, emphasizing the interactions between different hardware parts and the software control interface. The central processing unit (CPU) of this system is the microcontroller, which combines the functions of a physical push button with the Blynk software to control the actions of the linked devices. The power supply is crucial because it gives the microcontroller and the other peripheral devices like the vibrators and rotors—the electrical energy they need to function. With its strong Wi-Fi capabilities, the microcontroller is well-suited for IoT applications, facilitating easy integration and communication with the Blynk app. To provide a highly customizable and user-friendly experience, this guarantees that consumers may remotely manage and alter their massage settings, such as intensity and duration, through their cell phones.

The main user interface for controlling the massaging system remotely is the Blynk app. Through app interaction, users may send commands to the microcontroller, which interprets them and uses the relay module to control the rotor and vibrator operations. By acting as a middleman and responding to signals from the ESP8266, the relay module turns on and off the power supply to the rotators and vibrators. With this configuration, the massage mechanisms are precisely controlled, enabling the user to select from a variety of massage patterns and intensities.

In addition to the remote control via the Blynk app, the system has physical push buttons. These buttons offer an alternative mode of engagement, allowing users to manually regulate massage functions.

This redundancy ensures that the system is operational and accessible even if there are problems with the mobile app or Wi-Fi connectivity. The push buttons communicate directly with the microcontroller, transmitting control signals that change the operation of the rotors and vibrators, providing versatility and ease of usage in a variety of circumstances.

## 4.4 Algorithm and Flowchart

Algorithms and flowcharts are crucial for the development of a head massaging device as they provide clear, step-by-step instructions and visual representations for programming device operations. They help in systematically controlling massage patterns, intensity, and duration, ensuring the device functions effectively and safely. Additionally, they facilitate troubleshooting and modifications in the device's software, making upgrades and maintenance more manageable. By outlining the logical sequence of operations, they ensure consistency and reliability in device performance.

This algorithm is designed to guide the operation of a head massaging device from initialization to completion, ensuring a seamless user experience through wireless connectivity and app-based control.

**Algorithm-1:**

**Step 1: Initialization.**

- Initialize the hardware components.
- Power ON the head massaging device.

**Step 2: Establishing Wi-Fi connectivity.**

- Allow the user to pair their mobile device with a head-massaging device through Wi-Fi.

**Step 3: User interaction through the app:**

- Establish a Wi-Fi connection with the paired device.
- Use a dedicated mobile app program to control and configure wirelessly.

**Step 4: Wi-Fi Data Exchange**

- Exchange data between the head massaging system and the connected device via Wi-Fi.
- Send/receive massage preferences and intensity settings.

**Step 5: Massage Execution:**

- Activate the motors/vibrators based on the user preferences received via Wi-Fi through app control.

**Step 6: Wi-Fi Disconnection:**

- Allow the user to disconnect the Wi-Fi connection when they finish the session.

**Step 7: Power Off**

- Power off the device when the user indicates the massage session is complete.

This algorithm ensures that the head massaging device operates efficiently and responds accurately to user inputs, providing a personalized massage experience with minimal manual interaction.

Here is a practical example that illustrates how Algorithm-1 might be applied in a real-life scenario using a head massaging device:

**Scenario:** Alex wants to use a head massaging device to relieve stress after a long day at work.

1. **Initialization**:
   - Alex unpacks the head massaging device and sets it up by connecting the necessary components like the power supply and ensuring that the device's firmware is up to date.
2. **Establishing Wi-Fi Connectivity**:
   - Alex turns on the device, which automatically activates its Wi-Fi broadcasting mode. Using their smartphone, Alex selects the device from the Wi-Fi settings to establish a connection.
3. **User Interaction through App**:
   - Once connected, Alex opens the dedicated head massaging device app on their smartphone. The app displays various options, including massage intensity, duration, and specific areas of the head to target.
   - 

4. **Wi-Fi Data Exchange**:
    - Through the app, Alex selects a medium intensity and a duration of 15 minutes, focusing on the temples and the base of the skull. Alex sends these settings to the device via Wi-Fi.
5. **Massage Execution**:
    - The device receives the settings and starts the massage. Motors and vibrators activate according to Alex’s preferences, focusing on the specified areas with medium intensity for the selected duration.
6. **Wi-Fi Disconnection**:
    - After the session ends, Alex uses the app to disconnect the device from the Wi-Fi network. This ensures that the device stops sending or receiving data and prepares for shutdown.
7. **Power Off**:
    - With the massage complete and the device disconnected, Alex manually turns off the device or the device automatically powers down if it's configured to do so after a session.

This example demonstrates how the algorithm facilitates a seamless and personalized user experience with the head massaging device, from setup to completion, all controlled wirelessly through a mobile app.

## Flowchart:

This proposed device's operational procedure is shown in the related flowchart. First, the hardware is initialized to make sure every part is powered on and prepared. After it has been initialized, users can operate the device remotely by connecting it to a smartphone app called the Blynk app. Via the app, the user can change the vibrator settings and choose from a variety of device modes the controller then configures the vibrator's operating settings based on the mode selection. After a predetermined amount of time or in response to commands from the app, the device can halt the vibrator motion. The gadget is prepared to reinitialize after halting, establishing a loop for ongoing activity. This flow guarantees a smooth and intuitive experience, allowing for exact control and personalization of the massage features.

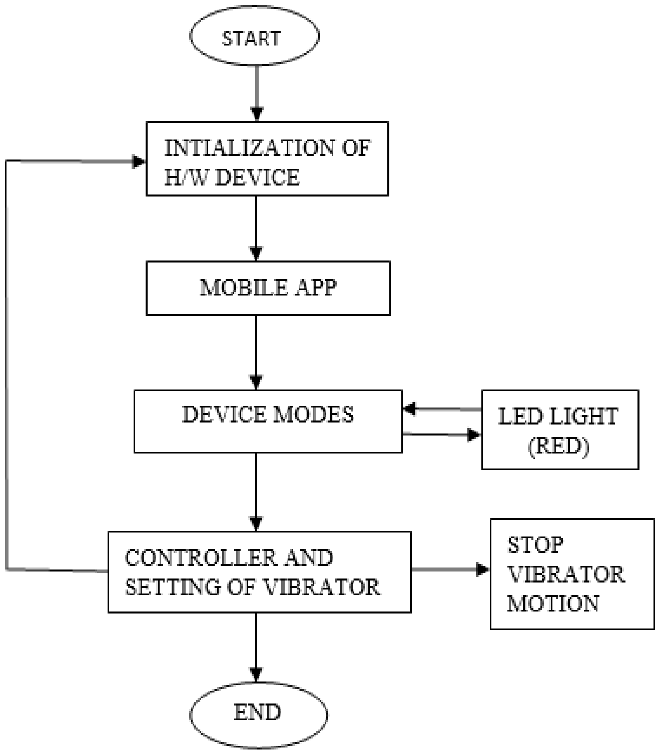



Fig. 4.2: Flow diagram of head massaging device.

Figure 4.2, shows the steps that describe the overall working flow of the device. The flowchart you provided outlines the operational sequence for a head massaging device, incorporating user interaction through a mobile app and various device modes including visual feedback through an LED light and control of a vibrator for the massage function.

Here is a detailed explanation along with an example:

## Flowchart Details:

1. **Start**: The process begins when the device is powered on.
2. **Initialization of Hardware Device**: This step involves setting up the device's hardware components, such as sensors, motors (vibrators), and communication modules (Ex., Wi-Fi or Bluetooth). This setup ensures all components are functional before proceeding.
3. **Mobile App**: The user interacts with the device through a mobile application. This app is designed to connect to the device via wireless communication, allowing the user to configure settings, control device operation, and receive feedback.

4. **Device Modes**: The user can select various modes of operation through the mobile app. These modes might include different types of massages, intensity levels, or durations.
    - **LED Light (Red)**: As part of the feedback system, an LED light (red in this case) may indicate specific modes or alerts, such as a low battery, device readiness, or specific massage settings.
5. **Controller and Setting of Vibrator**:
    - This step controls the vibrator based on the user's settings. The controller adjusts the intensity, pattern, and duration of the massage. Depending on the mode selected, the device might change how the vibrator operates to match the desired massage effect.
6. **Stop Vibrator Motion**: This could either be a manual stop initiated by the user through the app or an automatic stop once the massage session is complete according to the pre-set duration.
7. **End**: The device ceases operation until the next interaction.

## Example Scenario:

**Bharath wants to use his head massaging device after a long day at work.**

- Bharath starts the device and opens the dedicated mobile app on his smartphone.
- He uses the app to initialize the device, ensuring all components are powered and functional.
- Through the app, Bharath selects a 'relaxation' mode, which is indicated by the red LED light on the device turning on, signifying that the device is in relaxation mode.
- Bharath adjusts the massage intensity and duration to his preference using sliders in the app. He sets the vibrator for a medium intensity and a 20-minute session.
- Bharath starts the massage. The device vibrates at the set intensity, focusing on the areas Bharath finds most soothing, like the back of his head and neck.
- Midway, Bharath decides to stop the massage. He uses the app to halt the vibrator motion, and the device stops immediately.
- After the session, the device powers down automatically, indicating the end of the operation with the LED light turning off.

This example demonstrates how the flowchart translates into a user-friendly operation, allowing for personalized control and interaction with the head massaging device via a mobile app.

According to the algorithm, the steps for the operation of the device are as follows:

**Algorithm:**

**Input:** Different users.

**Output:** Relaxation feeling.

**Steps**:

**Start**

**Step 1:** Initialization of hardware device.

- Hise the initialization and organization of the device and its components takes place.
- The user's mobile should have a n active Hotspot to connect to the head massaging device.

**Step 2:** Navigate to the web app interface,

- Hise as soon as the device is switched on, the user will be navigated tothe associated web app interface (Blynk app).

**Step 3:** Controlling the vibrators and setting the speed.

- The user can control the vibrators like which part of the head he needs to message if he needs to message to the forehead, he can switch on the forehead rotators instead of the same as for the neck and top of the head.

**Step 4:** Similarly, the device can be used for different users then need to repeat step 1.

**Stop**

## Summary

Chapter 4 details the design of an IoT-enabled head massaging device that integrates traditional massage techniques with advanced technology for a customizable and therapeutic experience. It describes the selection and integration of key hardware components like the ESP8266 microcontroller and vibrator modules, alongside software development including a user-friendly Blynk app interface. The chapter outlines comprehensive testing phases for hardware, software, and user interaction to ensure device effectiveness and user satisfaction. The system's operational procedures are defined through algorithms and flowcharts, emphasizing remote control and ease of use for managing stress and enhancing well-being.

# Chapter 5

# IMPLEMENTATION

## 5.1 Introduction

This chapter describes the systematic implementation of an IoT-enabled head massaging device, focusing on integrating both hardware and software components to provide a personalized and relaxing massage experience. The heart of the system is the ESP8266 microcontroller, which controls the device's functionalities, including the operation of vibrators and rotators, and communicates with other system components. The power supply unit ensures stable and continuous operation, powering the microcontroller and other elements like vibrating parts that provide targeted massage and rotating pieces that simulate manual finger massage.

Once the hardware components are selected and integrated, the next step is to develop the software for the system. This involves programming the microcontroller and developing the user interface through the Blynk app. Using the system is easy. Users can start massages either by pressing buttons on the massager itself or using the Blynk app on their phone. Adjusting settings like how intense the vibrations are or how long the massage lasts is simple through the app. Users can also keep track of their massage progress and get updates on how often they're using the system. Overall, the IoT-enabled device combines advanced technology with a user-friendly design to offer a modern and effective way to relax and unwind. It's a smart solution for combating stress and promoting overall well-being, giving users a personalized massage experience whenever they need it.

## 5.2 Architectural Components

- **Handle or Grip:** The part of the massager that the user holds onto while using it. It provides stability and control during the massage.
- **Massage Nodes or Rollers:** These are the elements that come into contact with the scalp to provide the massage. They may be in the form of rotating nodes, vibrating pads, or rollers that simulate the sensation of fingers massaging the scalp
- **Power Source:** Head massagers are powered by batteries. The power source determines how the massager operates and how portable it is.

- **Adjustment Mechanism:** The head massagers allow users to adjust the intensity or speed of the massage. These adjustment mechanisms may be in the form of buttons or switches
- **Material and Construction:** The materials used to make the massager, such as plastic, silicone, or metal, and the overall construction affect the durability, comfort, and effectiveness of the device.
- **Wi-Fi Connectivity:** The head massager will likely include Bluetooth or Wi-Fi capabilities to communicate with the mobile app. This allows users to control the massager wirelessly from their smartphone or tablet.
- **Mobile App Interface:** The mobile app interface provides users with a graphical user interface (GUI) to control various settings of the head massager, such as massage intensity and massage modes. It may also display battery life and other relevant information.

## 5.3 Software and Tools Used

### 1. Integrated Development Environment (IDE)

An Integrated Development Environment (IDE) serves as the central hub for software development, providing a comprehensive suite of tools and features to streamline the coding process. For the smart energy meter project, an IDE is indispensable, as it facilitates the creation, modification, compilation, and debugging of the code that governs the meter's functionality. One of the most widely used IDEs in the realm of embedded systems development is the Arduino IDE. It offers a user-friendly interface tailored to the Arduino platform, making it accessible even to beginners. Arduino IDE provides built-in support for compiling and uploading code to Arduino boards, along with features like syntax highlighting, code completion, and a serial monitor for debugging.

Platform IO is another popular choice among embedded systems developers, offering a more advanced and feature-rich development environment compared to Arduino IDE. Platform IO supports a wide range of development platforms, including Arduino, ESP8266, and many others. It provides robust project management capabilities, a unified interface for managing libraries and dependencies, and integration with popular version control systems like Git. For developers focusing specifically on microcontroller development, Espresso’s ESP-IDF

(Espresso IoT Development Framework) is the go-to option. ESP-IDF offers a comprehensive set of libraries, tools, and documentation specifically tailored to the microcontroller. It provides low-level access to the hardware peripherals of the microcontroller, allowing developers to harness the full power of the chip for their projects.

Each of these IDEs has its strengths and weaknesses, and the choice ultimately depends on the specific requirements and preferences of the developer. Arduino IDE is ideal for beginners and simple projects, while Platform IO offers more advanced features and flexibility. ESP-IDF, on the other hand, is tailored specifically for microcontroller development and provides the deepest level of control over the hardware. Regardless of the IDE chosen, having a powerful and intuitive development environment is essential for efficiently building and debugging the code for the smart energy meter project. With the right tools at their disposal, developers can focus on implementing the meter's functionality and optimizing its performance, ultimately leading to a more robust and reliable end product.

**2. Arduino Libraries**

Depending on the specific components and sensors used in the project, you may need to install relevant Arduino libraries to interface with them. Libraries for Blynk, LiquidCrystal_I2C, and any additional sensors or modules (Ex., current sensor libraries) should be included.

**3. Blynk Mobile App**

The Blynk mobile app serves as an indispensable tool in the ecosystem of the smart energy meter project, offering a streamlined approach to developing IoT applications and interfaces. With Blynk, developers can effortlessly craft intuitive user interfaces tailored to the smart energy meter's functionalities, enabling remote monitoring and control from anywhere with an internet connection. By leveraging the Blynk mobile app, users gain access to a visually engaging interface that facilitates real-time monitoring of energy consumption and provides seamless control over meter operations. Whether it's checking current power usage, reviewing historical data trends, or adjusting settings remotely, the Blynk app empowers users to stay informed and in control of their energy usage at all times. The app's availability on both iOS and Android platforms ensures widespread accessibility, allowing users to interact with the smart energy meter using their preferred mobile devices, such as smartphones or tablets. This cross-platform compatibility enhances user convenience and flexibility, ensuring a consistent experience across different devices and operating systems. Moreover, the Blynk platform's user-friendly interface and drag-and-drop functionality simplify the process of creating custom user interfaces, even for those with limited programming experience.

With a diverse array of widgets and customization options at their disposal, developers can design intuitive dashboards and widgets tailored to specific user preferences and requirements. In addition to its interface design capabilities, the Blynk mobile app facilitates seamless communication between the smart energy meter and the user's mobile device via the Blynk cloud infrastructure. This enables secure and reliable data exchange, ensuring that users can access real-time information and control meter functions remotely with confidence.

Overall, the Blynk mobile app plays a pivotal role in enabling the smart energy meter project, providing a user-friendly platform for creating engaging IoT interfaces and empowering users to monitor and manage their energy consumption efficiently. Its availability on multiple platforms, intuitive design tools, and robust communication capabilities make it an essential component of the smart energy management ecosystem.

**4. Blynk Server or Cloud Account**

To establish communication between the smart energy meter and the Blynk mobile app, you need to either set up a local Blynk server or create an account on the Blynk cloud. This allows the smart energy meter to connect to the Blynk platform and exchange data securely.

**5. Wi-Fi Configuration Tool**

Since the ESP8266 module is used for wireless connectivity, a Wi-Fi configuration tool may be required to set up the microcontroller module to connect to the local Wi-Fi network. Tools like the Wi-Fi Manager library for Arduino can simplify the process of configuring Wi-Fi credentials dynamically.

**6. Serial Monitor**

The serial monitor provided by the IDE (Ex., Arduino IDE) is invaluable for debugging and monitoring the output of the smart energy meter during development. It allows you to view debug messages, sensor readings, and communication logs between the ESP8266 and other components.

## Summary:

Chapter 5 discusses the implementation of an IoT-enabled head massaging device, focusing on integrating both hardware components like the ESP8266 microcontroller and software through tools such as Arduino IDE and Blynk Mobile App. It highlights the setup of essential elements like vibrating nodes and rotators, managed by software that allows for customization and control via a mobile app. Key tools and libraries are specified for effective development and connectivity. The chapter emphasizes the seamless integration of components and software to deliver a personalized, relaxing massage experience, demonstrating the device's practical application in managing stress and enhancing well-being.

# Chapter 6

# DEVICE TESTING

## 6.1 Introduction

This chapter covers the thorough testing processes for the IoT-enabled head massaging device, ensuring that all hardware and software components meet their functional and performance specifications. Device testing focuses on identifying and resolving any potential issues arising from the interaction between different components. It aims to confirm that the system operates as intended across various usage scenarios. This involves testing the rotators, vibrators, the ESP8266 microcontroller's responsiveness, and the efficiency of the relay module in controlling power. Additionally, the device's integration with the Blynk app is scrutinized to ensure seamless connectivity and control.

## 6.2 Prototype Device Model

The prototype model of the head massaging device is designed with user comfort and functionality in mind. It features an adjustable headband that can fit various head sizes, equipped with multiple rotating massage nodes that simulate manual scalp massages. These nodes are strategically placed to target key pressure points on the scalp for optimal relaxation. The device is made from lightweight, hypoallergenic materials to ensure comfort during use. It includes a simple, intuitive control panel for easy operation, allowing users to adjust the speed and intensity of the massage. Additionally, it incorporates wireless technology for ease of use without the encumbrance of cables, and it's powered by a rechargeable lithium-ion battery, making it portable and convenient for regular use figure 6.1 shows the working prototype model

The prototype model of the head massaging device exemplifies a well-thought-out blend of ergonomics and advanced technology, aiming to deliver an optimal user experience. Here's a more detailed explanation of its features:

1. **Adjustable Headband**: The headband is designed with a flexible yet sturdy material that can expand or contract to fit a wide range of head sizes. This adjustability ensures that the

device can be used comfortably by different individuals, from children to adults, without causing strain or discomfort.

2. **Rotating Massage Nodes**: The device is equipped with several rotating nodes that mimic the motion of manual scalp massages. These nodes are capable of moving in circular patterns and can be adjusted to rotate in both clockwise and counterclockwise directions, enhancing the massage effect. Each node is covered with a soft, silicone-based material that feels gentle against the scalp.
3. **Strategic Placement of Nodes**: The nodes are not randomly placed but are positioned according to common acupressure points on the scalp. This strategic placement helps in effectively targeting areas that are known to relieve stress and tension, such as the temples, the base of the skull, and the crown area.
4. **Material Choice**: The use of lightweight, hypoallergenic materials is critical in preventing any allergic reactions and ensuring that the device can be worn comfortably for extended periods. Materials such as medical-grade silicone and breathable fabrics are used to enhance comfort and maintain hygiene.
5. **Control Panel**: The control panel is user-friendly, consisting of minimal buttons that are easy to understand and operate. Typically, there might be buttons for power, speed adjustment, and rotation direction. This simplicity ensures that users can easily customize their massage experience without confusion.
6. **Wireless Technology and Battery**: Incorporating wireless technology means that users are not tethered to a power outlet, adding convenience and mobility. The use of a rechargeable lithium-ion battery is advantageous due to its long life and efficiency. The battery can typically provide several hours of operation on a single charge, making the device practical for both home and travel use.
7. **Safety Features**: Safety is paramount in device design. The prototype includes an automatic shut-off feature that activates after a set period to prevent overheating and to conserve battery life. Additionally, the motor controlling the nodes is designed to operate quietly and smoothly to ensure a soothing experience without disruptive noise.
8. **Portability and Convenience**: The overall design is compact and lightweight, making it easy to store and transport. This portability allows users to enjoy a relaxing massage not only at home but also in environments like offices or while traveling.

These features collectively make the prototype head massaging device an innovative solution for stress relief and wellness. By focusing on user-centric design and functionality, the device promises to deliver a soothing experience tailored to the needs and preferences of a wide range of users.

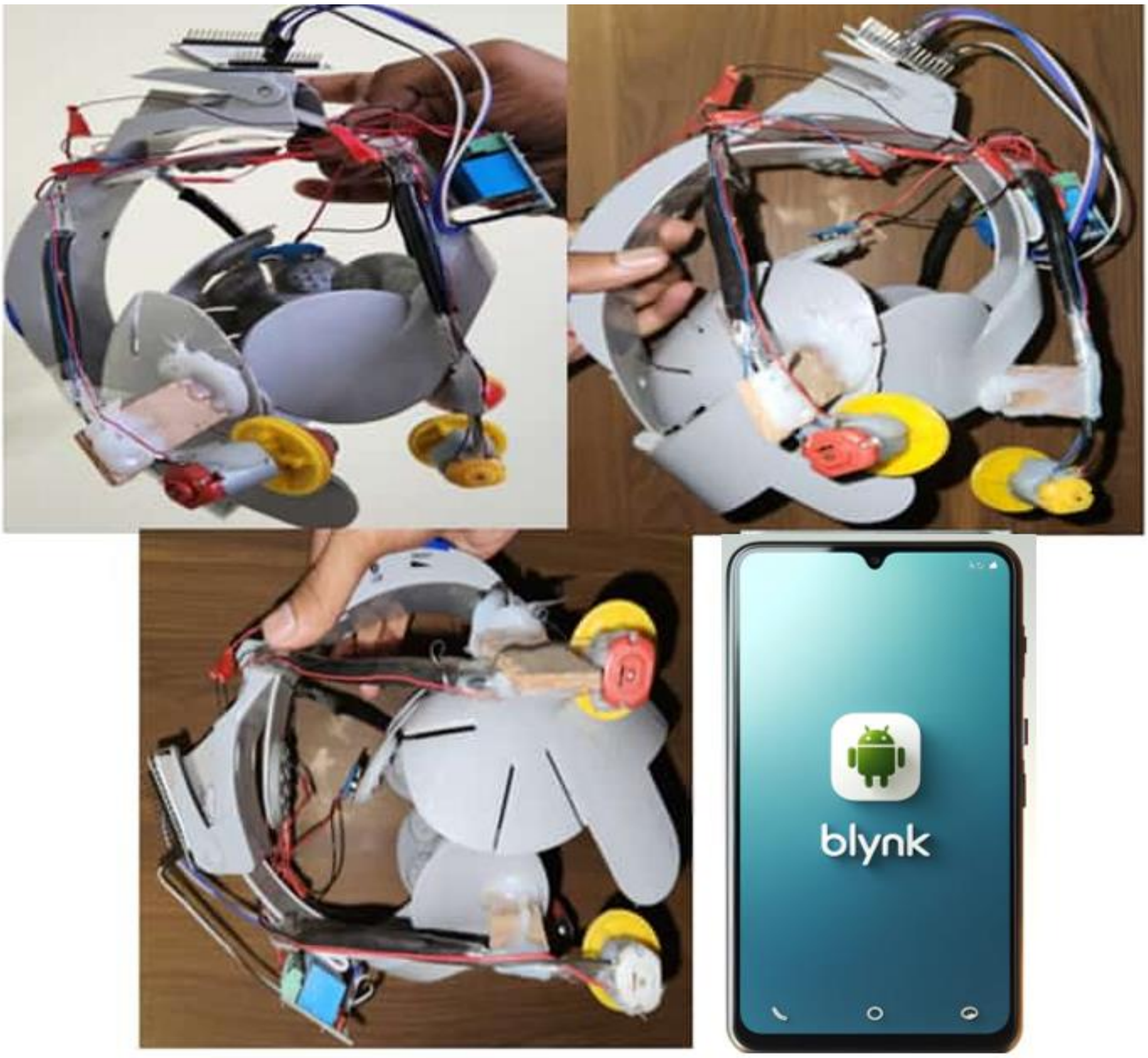



Fig. 6.1: Shows a working prototype model of a head massaging device.

## 6.3 3D View of a Prototype Device Model

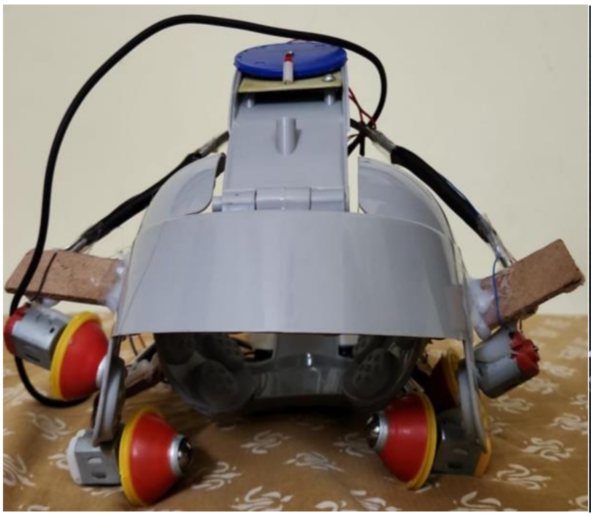
The 3D view of a prototype device model is a detailed representation that provides a comprehensive look at the product from various angles. This visualization technique is crucial for examining the design, functionality, and ergonomics of the device before it goes into production. In the case of a head massaging device, the 3D view would highlight features like the placement and motion of massage nodes, the adjustability of the headband, the layout of the control panel, and the overall form factor which should be comfortable and user-friendly. It also allows designers to verify that all components fit together as intended, that the device is aesthetically pleasing, and that it meets safety and usability standards. This step is essential in the prototype development phase, enabling engineers and designers to make necessary adjustments based on a realistic depiction of the product.

A 3D view of a prototype device model that includes front, side, back, and top views provides a complete and multidimensional perspective of the product. This comprehensive visualization is crucial for thoroughly assessing the design and functionality of the prototype. Here's how each view contributes to the overall evaluation:

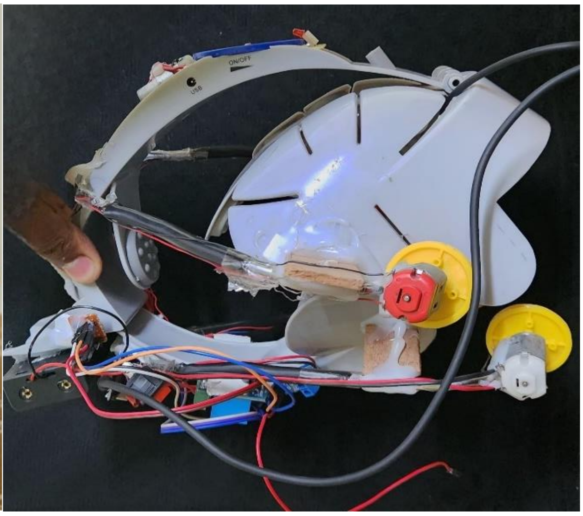
1. **Front View:** This view offers a look at the most user-interactive side of the device. For a head massaging device, the front view would display the primary interface, including the placement of control buttons and any visual indicators.
2. **Side View:** The side views (left and right) help in understanding the depth and profile of the device. They reveal the thickness, edge design, and side components such as power switches, battery compartments, or connectivity ports.
3. **Back View:** This view shows what the user typically does not see during operation. In many devices, the back may house elements like battery covers, additional operational interfaces, or branding elements. It's crucial for assessing the ergonomics and balance of the device.
4. **Top View:** The top view provides insight into the layout and spacing of the top elements. For the head massaging device, it would highlight how the massage nodes are distributed across the headband, ensuring even coverage and effectiveness.

## 3D Views Representation:

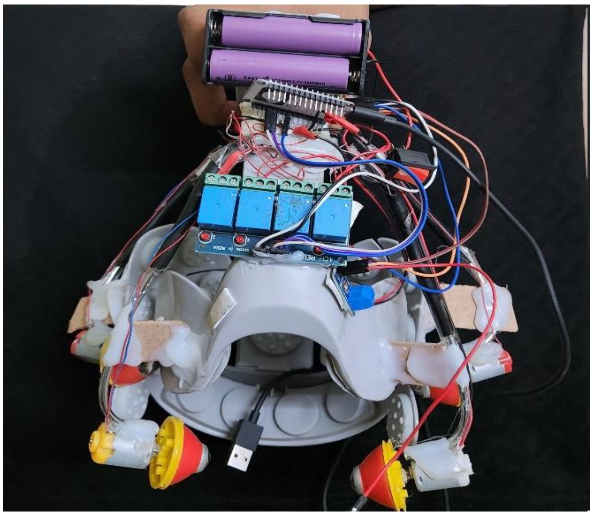
**Front View:**



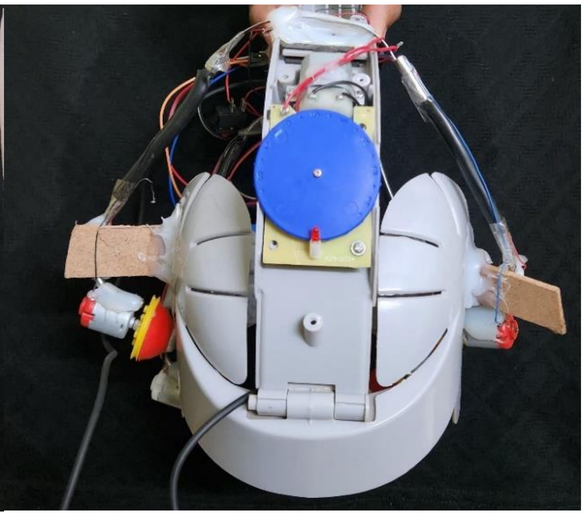
**Side View:**



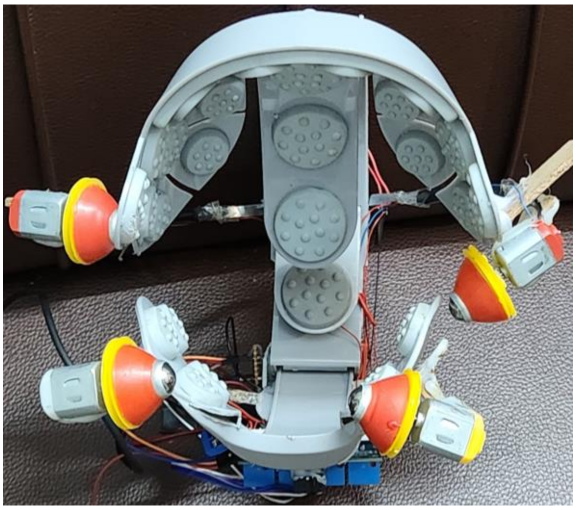
**Back View:**



**Top View:**



**Inner View:**



Together, these views are used in the design and engineering process to refine the product's aesthetics, ensure functional integrity, and improve user interaction. They are also key in creating marketing materials and instructional content, helping potential users and stakeholders visualize the product effectively.

## 6.4 Test Cases

A test case is a set of conditions or variables under which a tester will determine whether a system or part of a system is working correctly. It is a detailed document that includes the purpose, input values, expected result, and actual result, among other elements.

Here is how a typical test case is structured and an example of testing a feature of the head massaging device:

**Test Case Structure:**

1. **Test Case ID:** A unique identifier for each test case.
2. **Test Description:** A brief description of what is being tested.
3. **Preconditions:** Any requirements that must be met before the test can be executed.
4. **Test Steps:** Step-by-step instructions on how to carry out the test.
5. **Test Data:** Any data needed for executing the test.
6. **Expected Result:** What the system should do if the test passes.
7. **Actual Result:** What the system did during testing.
8. **Status:** Pass or Fail based on whether the actual result matches the expected result.
9. **Comments:** Any additional information or issues noted during testing.

**Example Test Case:**

**Test Case ID:** TC_HeadMassager_101

**Test Description:** Verify that the massage nodes activate at the correct intensity.

**Preconditions:**

- The device is fully charged.
- The Blynk app is installed on a compatible smartphone and paired with the device.

**Test Steps:**

1. Power on the device using the power button.

2. Open the Blynk app on the smartphone.
3. Navigate to the control panel and select 'Medium Intensity' for the massage nodes.
4. Press the 'Start Massage' button in the app.

**Test Data:** Intensity Level = Medium

**Expected Result:**

- The massage nodes activate within 5 seconds of pressing the 'Start Massage' button.
- The nodes operate at medium intensity, which should be noticeably stronger than 'Low' but not as vigorous as 'High'.

**Actual Result:**

- The nodes activated within 5 seconds.
- The intensity felt between the predefined low and high settings.

**Status: Pass**

**Comments:**

- No issues were encountered during the test.

This example outlines how to methodically test a specific function of the head massaging device, ensuring that all aspects of the function can be verified in a controlled manner. This systematic approach helps identify any discrepancies between expected and actual outcomes, facilitating troubleshooting and quality assurance.

Here are the detailed test cases for each category you listed, ensuring a comprehensive evaluation of the head massaging device's functionalities and performance:

## 1. Functional Testing

- **Microcontroller Test:** Verify that the ESP8266 microcontroller initializes correctly, boots up without errors, and can load and run its firmware.
- **Relay Module Test:** Check that the relay module correctly switches on and off in response to commands, simulating operational scenarios.
- **Component Response Test:** Confirm that rotators and vibrators activate and deactivate accurately upon receiving specific commands from the Blynk app. Ensure they operate at the specified intensities and durations.

## 2. Performance Testing

- **Stress Testing:** Subject the device to operate continuously at maximum capacity to check for any signs of overheating, wear out, or failure. Observe how long it takes for issues to arise.
- **Responsiveness Testing:** Measure the time taken from sending a command via the Blynk app to the action being executed by the device, ensuring commands are processed within acceptable time frames under different network conditions.

## 3. Usability Testing

- **Interface Responsiveness:** Test the Blynk app on various devices (smartphones, tablets) to assess load times and reaction to inputs.
- **Ease of Use:** Evaluate the intuitive nature of the user interface in the Blynk app, focusing on how easily a new user can understand and operate the device.
- **Accessibility Testing:** Ensure that all app controls are accessible to users with disabilities, checking compatibility with screen readers and the app's responsiveness to larger text settings.

## 4. Stress Testing

- **Environmental Suitability:** Test the device in environments with extreme temperatures, high humidity, and dust to ensure it continues to function without degradation.
- **Power Fluctuation Test:** Simulate various power supply scenarios, including surges, drops, and interruptions, to verify the device's resilience and recovery capabilities.

## 5. Wi-Fi Configuration Testing

- **Wi-Fi Setup Process:** Verify the ease and reliability of setting up the ESP8266 module with different Wi-Fi networks, including both 2.4 GHz and 5 GHz where applicable.
- **Network Reconnection Test:** Ensure that the device can automatically reconnect to the Wi-Fi network after losing connection without user intervention.

These test cases aim to cover all critical aspects of the device, from its basic functionality and performance under stress to its ease of use and robustness in diverse environments, ensuring a reliable and user-friendly experience.

## 6.5 Precision in Testing: A Thorough Analysis and Study

- Testing results are represented through figures illustrating user testing across various demographics, with analysis focusing on head massaging speed and user comfort at different intensities.
- The analysis shows differentiated settings and preferences across age groups, indicating the device's adaptability and personalized approach to providing massage therapy.

Records of head massaging speed and withholding capacities for wearers of different age groups. The speed is categorized into variations from low (150-350 RPM) is represented in table 6.1.

Table 6.1 Shows customized speed and duration settings for various age groups in head massaging devices.

| Sr. No. | Age Group | Speed Range (RPM) | Average Withholding Capacity (Minutes) | Remarks |
|---|---|---|---|---|
| 1. | Children (5-12) | 150-200 | 5-10 | Lower speeds for safety. |
| 2. | Teenagers (13-19) | 200-250 | 10-15 | Moderate speeds. |
| 3. | Adults (20-40) | 250-300 | 15-20 | Standard speed range. |
| 4. | Middle-aged (41-60) | 250-300 | 15-25 | Adjust based on comfort. |
| 5. | Seniors (60+) | 150-250 | 10-15 | Lower speed for sensitivity |

**Note:**

- The "Average Withholding Capacity" refers to the average duration a user can comfortably experience the massaging at the given speed.

## 6.6 Various Device Users

To gather comprehensive feedback on the head massaging device, various user groups can be engaged in trials to wear and test the device, providing their opinions on its performance, comfort, and overall experience. Here is how this could be structured:

**User Groups:**

1. **Children (Ages 5-12):** Feedback is collected from parents and observations are made during use to ensure safety and comfort levels are appropriate for this age group.
2. **Teenagers (Ages 13-19):** Feedback focuses on the device's style, usability, and whether it meets the relaxation needs of this age group.
3. **Adults (Ages 20-40):** The primary demographic, whose feedback might focus on effectiveness, ease of use, and integration with daily routines.
4. **Middle-aged (Ages 41-60):** Feedback may center on the relief from work-related stress and ergonomic considerations.
5. **Seniors (60+):** Focus on ease of use, comfort, and the effectiveness of the device in easing age-related discomforts.

Figure 6.2 Shows diverse user demographics for head massaging devices.

**Feedback Collection Process:**

- **Initial Briefing:** Each user is given an overview of how to use the device, including safety features and operation instructions.
- **Usage Phase:** Users wear the device under monitored conditions for a set period while engaging in typical daily activities.
- **Feedback Session:** After using the device, each participant is interviewed or completes a structured survey where they can express their opinions and experiences.

**Example Feedback and Developer Consideration:**

- **Teenager Feedback:** "The device feels too bulky, and it's not something I would use in front of my friends."
    - **Developer Action:** Consider redesigning the device to be more compact and stylish, possibly offering customizable covers or designs that appeal to a younger audience.
- **Adult Feedback:** "The massage settings are good, but it’s hard to change the settings while wearing it."
    - **Developer Action:** Developers might look into enhancing the interface for easier control, possibly through a more intuitive app that allows users to change settings on their phones.

- **Senior Feedback:** "We found the device quite comforting, but it's a bit heavy after a while."
  - **Developer Action:** Investigate the possibility of using lighter materials or designing a more balanced distribution of weight across the device.

In front of the device developers, users openly express their comfort levels, the effectiveness of the massage, and any improvements they desire. Developers take this feedback seriously, noting down details and expressions, and consider these insights as essential inputs for iterative design improvements. This approach ensures that the product evolves in response to direct consumer needs and preferences, enhancing user satisfaction and product usability.

Fig. 6.2 Shows diverse user demographics for head massaging devices.

## 6.4 Performance Evaluation

A detailed performance evaluation for the head massaging device involves a series of rigorous tests designed to assess its functionality, load handling, response time, and reliability.

Here's how such an evaluation could be structured, including specific examples:

### Performance Evaluation Overview:

1. **Functionality Tests:**
   - **Objective:** Ensure all device functions operate as intended.
   - **Method:** Conduct sequential operation checks of all features—adjustable headbands, rotating massage nodes, and control settings via the Blynk app.
   - **Example:** Verify that the massage nodes activate and adjust their intensity and speed according to user settings in the app, simulating various user preferences and scenarios.

2. **Load Handling and Continuous Use:**
   - **Objective:** Determine the device's endurance under prolonged usage.
   - **Method:** Subject the device to continuous operation at maximum settings beyond normal usage durations.
   - **Example:** Run the device continuously for 4 hours—a duration exceeding typical use—to check for any overheating issues, performance degradation, or mechanical failures.

3. **Response Time and High-Demand Performance:**
   - **Objective:** Assess how swiftly the device responds to commands under various conditions.
   - **Method:** Measure the latency from the moment a command is sent via the Blynk app to the action being executed by the device, under different network conditions and load scenarios.
   - **Example:** Test response times for starting and altering massage intensities under normal conditions and under simulated poor network conditions to evaluate any variation in command processing.

4. **Reliability Under Varying Environmental Conditions:**
    - **Objective:** Verify the device's operational consistency across different environmental settings.
    - **Method:** Test the device in varied environmental conditions including high and low temperatures, humidity, and exposure to dust.
    - **Example:** Operate the device at 40°C and 90% humidity to mimic extreme conditions, checking for any mechanical or electronic malfunctions.

5. **User Feedback Collection:**
    - **Objective:** Gather and analyze user impressions related to the device's usability and the effectiveness of the massage.
    - **Method:** Use surveys and interviews post-testing to obtain direct user feedback on various aspects such as the ease of use of the Blynk app, comfort during use, and satisfaction with the massage.
    - **Example:** After testing, users complete a detailed survey rating their experience with the app's interface, the comfort of the device, and the quality of the massage. Additional in-depth interviews could explore users' qualitative feedback, providing insights into the intuitive nature of the device and its real-world effectiveness.

This comprehensive evaluation not only ensures that the head massaging device meets high standards of functionality and reliability but also emphasizes user-centric design and performance. By integrating systematic testing with user feedback, the development team can better understand the device's impact on real-world user satisfaction and identify areas for further refinement.

## Summary:

Chapter 6 outlines the systematic testing of an IoT-enabled head massaging device, ensuring that all components meet functional and performance standards. It includes functional, performance, usability, and stress testing to verify component reliability, system responsiveness, and user interface efficacy. Testing also assesses the device's endurance under various environmental conditions and operational loads. Results from these tests guide further refinements, ensuring the device offers a personalized and effective massage experience. This rigorous testing confirms the device's readiness for market launch, highlighting its reliability and user satisfaction.

# Chapter 7

# RESULT ANALYSIS AND DISCUSSION

For the result analysis and discussion of the IoT-based smart head massaging device, we should focus on evaluating the effectiveness of the device across several key parameters that were identified as crucial during the development phase. This would involve discussing the data collected during the testing phase, including user feedback, performance metrics, and any technical measurements.

Here’s a detailed breakdown of how you could structure result analysis and discussion:

## 7. 1 Performance Metrics Analysis

**Speed and Efficiency:** Discuss how the device's speed ranges (150-350 RPM) have impacted the effectiveness of massages. Highlight any feedback on optimal speeds for different user groups or preferences.

**Battery Life and Power Efficiency:** Analyze the battery life under various usage conditions and how it meets the expectations set during the design phase. Discuss any improvements made or needed in power management systems.

## 7.2 User Feedback and Satisfaction

**Comfort and Usability:** Present data on user comfort ratings from the testing phase. Discuss any trends or significant feedback from different age groups or user types. How does the device adapt to different scalp sizes and sensitivities?

**Customization and Features:** Evaluate how well users have responded to the customizable features of the device, such as adjustable speeds, vibration settings, and the Blynk app functionality. Are users finding these features beneficial and easy to use.

## 7.3 Comparative Analysis with Existing Products:

Compare the IoT-enabled device with traditional and other IoT-based head massagers in terms of functionality, user satisfaction, and technological advancement. Highlight any unique selling points or areas where the device outperforms competitors.

## 7.4 Technical Challenges and Resolutions

Discuss any technical challenges encountered during the testing phase, such as issues with WiFi connectivity, app integration, or hardware durability. Explain how these challenges were addressed or propose potential solutions.

## 7.5 Statistical Analysis of Data

Provide a statistical breakdown of data collected, such as average relief reported, the percentage increase in relaxation levels, or any adverse effects noted during use. Use graphs or tables to illustrate these points clearly.

This section of project documentation or presentation is crucial as it not only validates the effectiveness and efficiency of the device but also highlights areas for improvement and future research directions. Ensure that analysis is backed by reliable data and aligns with the objectives set during the initial phases of the device's development.

## 7.6 Graphical Depictions of Performance: A Detailed Look at Smart Head Massager Outcomes

Here's a suggested table format to maintain records of head massaging speed and withholding capacities for wearers of different age groups. The speed is categorized into variations from low (150-350 RPM). We can further customize Table 7.1 by adding more specific age groups or additional data fields as needed:

Table 7.1: Shows comparative analysis of rpm tolerance across age groups.

| Sr. No. | Age Group | Speed Range (RPM) | Average Withholding Capacity (Minutes) | Remarks |
|---|---|---|---|---|
| 1. | Children (5-12) | 150-200 | 5-10 | Lower speeds for safety. |
| 2. | Teenagers (13-19) | 200-250 | 10-15 | Moderate speeds. |
| 3. | Adults (20-40) | 250-300 | 15-20 | Standard speed range. |
| 4. | Middle-aged (41-60) | 250-300 | 15-25 | Adjust based on comfort. |
| 5. | Seniors (60+) | 150-250 | 10-15 | Lower speeds for sensitivity. |

Table 7.1 offers a comparative analysis of RPM tolerance across different age groups, assessing how varying speeds of the smart head massaging device affect the duration for which users from these groups can comfortably tolerate the massage.

Here's a breakdown of the table, along with an example to illustrate its practical application:

**Breakdown of Table 7.1 Content:**

- **Age Group**: Defines the demographic segment, categorized by age.
- **Speed Range (RPM)**: Specifies the range of speeds (in revolutions per minute) at which the head massaging device operates for each age group.
- **Average Withholding Capacity (Minutes)**: The average duration in minutes that individuals within the respective age group can comfortably endure the massage.
- **Remarks**: Notes providing insights or considerations specific to each age group.

**Analysis of Each Age Groups:**

1. **Children (5-12 years)**:
    - **Speed Range**: 150-200 RPM
    - **Average Withholding Capacity**: 5-10 minutes
    - **Remarks**: Lower speeds are used for safety, considering the sensitivity and safety requirements for children.

    **Example**: Consider a child, aged 10, using the device. The device is set to operate at 180 RPM, and the child comfortably uses the massager for up to 10 minutes. The lower speed ensures that the massage is gentle and does not overwhelm the child.

2. **Teenagers (13-19 years)**:
    - **Speed Range**: 200-250 RPM
    - **Average Withholding Capacity**: 10-15 minutes
    - **Remarks**: Moderate speeds are used, suitable for the resilience and preferences of teenagers.

    **Example**: A teenager, aged 16, typically sets the device at 240 RPM and uses it for 15 minutes after sports activities to relax muscle tension in the scalp and neck.

3. **Adults (20-40 years)**:
    - **Speed Range**: 250-300 RPM

- **Average Withholding Capacity**: 15-20 minutes
- **Remarks**: Standard speed range that balances efficiency and comfort, suitable for most adults.

**Example**: A 30-year-old office worker uses the device at 280 RPM for 20 minutes in the evening to relieve stress and relax, finding it highly effective at this speed.

4. **Middle-aged (41-60 years)**:
   - **Speed Range**: 250-300 RPM
   - **Average Withholding Capacity**: 15-25 minutes
   - **Remarks**: Speed is adjusted based on comfort, recognizing the potential for varying sensitivity levels due to age.

**Example**: A 55-year-old might start using the device at 250 RPM and gradually adjust up to 300 RPM, finding a comfortable duration of 25 minutes to effectively reduce headache symptoms.

5. **Seniors (60+ years)**:
   - **Speed Range**: 150-250 RPM
   - **Average Withholding Capacity**: 10-15 minutes
   - **Remarks**: Lower speeds are chosen for sensitivity, accommodating decreased tolerance and increased sensitivity common in older age.

**Example**: A 65-year-old uses the massager at a gentle 180 RPM for 15 minutes before bed to improve sleep quality, opting for a lower speed to avoid any discomfort.

Table 7.1 allows us to understand the varying needs and tolerances of different age groups when using a head massaging device. By adjusting the speed settings according to age-specific requirements, the device can offer a more personalized and safe experience, enhancing the benefits and comfort of each user. This detailed analysis helps in optimizing the product design and user instructions for diverse demographic profiles.

**Note:**

- The "Average Withholding Capacity" refers to the average duration a user can comfortably experience the massaging at the given speed.

- Adjust the speed ranges and capacities based on user feedback and safety considerations.
- Continuous monitoring and adjustments may be required based on individual tolerance and medical advice.

This table format can help systematically organize the data, monitor user experience, and ensure that the device settings are appropriate for different age groups.

## 7.7 Average Withholding Capacity Against Each Age Group

Let's create a plot that visually represents the data from the table. We have plotted the average withholding capacity against each age group, with different speed ranges indicated by the RPM values.

Here's how it will be displayed:

- X-axis: Age Groups
- Y-axis: Average Withholding Capacity (Minutes)
- Different colors or markers will represent different RPM ranges.

Let's proceed with plotting this graph.

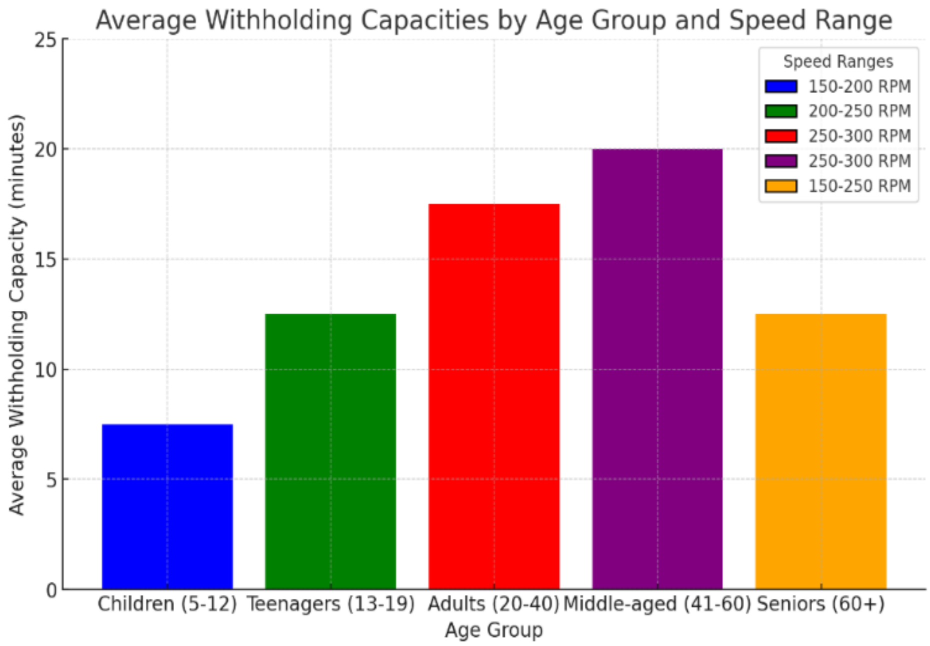



Fig. 7.1: Shows a comparative analysis of massage tolerance across age groups.

Here's the graph displaying (Figure 7.1) the average withholding capacities by age group, with different colors representing various speed ranges (RPM). This visualization helps you to easily compare the capabilities across different age groups and adjust settings in smart head massaging devices accordingly.

To create a plot that displays the performance of a smart head massaging device under different conditions, we should consider various factors that could affect the device's performance.

These could include:

1. **Speed Variation**: How the device performs at different speeds within the set range (150-350 RPM).
2. **Session Duration**: How long the device can operate continuously before needing a break or adjustment.
3. **User Feedback**: Rating or comfort level provided by users during or after using the device.

Let's define a few hypothetical conditions or scenarios under which the device is tested, and then plot these to give a clear visualization.

Here’s a proposed breakdown:

- **Condition 1**: Low speed (150-200 RPM) for a short session (up to 10 minutes).
- **Condition 2**: Medium speed (200-250 RPM) for a medium session (10-20 minutes).
- **Condition 3**: High speed (300-350 RPM) for a long session (20-30 minutes).

We have plotted these conditions showing their impact on user comfort and device performance. Would you like to proceed with this, or do you have other specific conditions in mind.

## 7.8 Graph Concept: Device Performance Over Time

Let's design another graph that could provide valuable insights into the performance of smart head massaging devices under different operational scenarios. We could look at how the device performs over time, which could help in understanding its durability and effectiveness. Here's a proposal for another graph:

- **X-axis**: Time (in months)

- **Y-axis**: Device Performance Score (a composite score based on speed consistency, user feedback, and mechanical integrity)
- **Lines**: Different lines representing various usage intensities (e.g., light, moderate, heavy use)

This graph will help track the performance of the device over an extended period, highlighting any potential degradation in performance or areas where maintenance might be required. Does this graph align with what we are looking for, or is there another aspect of the device's performance you'd like to visualize?

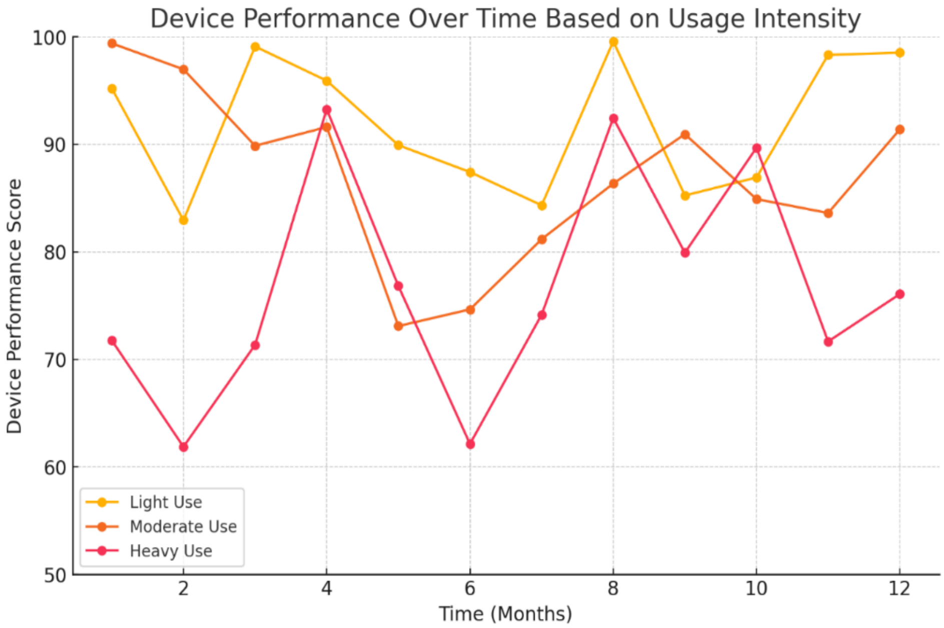



Fig. 7.2: Shown device durability over time: impact of usage intensity.

The graph shown in Figure 7.2 we created illustrates how the performance of a smart head massaging device might vary depending on the intensity of its use over 12 months.

Here's a detailed description along with a hypothetical example:

**Graph Description:**

- **X-axis (Time in Months)**: This represents a timeline from 1 to 12 months, providing a longitudinal view of the device's performance.
- **Y-axis (Device Performance Score)**: Scores range from 50 to 100, where a higher score indicates better performance. The score is a composite measure that could include factors like speed consistency, user satisfaction, and mechanical reliability.

**Lines Representing Usage Intensities:**

- **Light Use (Blue Line)**: This line starts high and remains relatively stable, only slightly declining over time. It suggests that when the device is used lightly (e.g., once a week for short sessions), it maintains a high-performance level, with minimal wear and tear impacting its functionality.
- **Moderate Use (Orange Line)**: Beginning slightly lower than the light use line, this line shows more fluctuation and a steeper decline. This could represent usage like several times a week for moderate durations. The greater usage leads to more stress on the device, causing a faster decline in performance.

- **Heavy Use (Green Line)**: This line starts lower and decreases more significantly over time, indicating heavy usage (e.g., daily sessions or prolonged usage each time). The decline is steeper due to the increased wear and tear on the device's components, which might require more frequent maintenance or lead to earlier performance issues.

**Hypothetical Example:**

Imagine a wellness center that uses three identical head massaging devices, each subjected to different usage intensities:

- **Device A** is used lightly, for brief sessions a few times a month. After 12 months, its performance score is around 88, showing minor wear.
- **Device B** is used more frequently by several clients throughout the week for medium-length sessions. Its performance score after a year is around 80, reflecting moderate wear that may require some maintenance.
- **Device C** is heavily utilized every day, often for extended sessions. It shows a more rapid decline, with a performance score dropping to around 65 after 12 months, indicating significant wear and a potential need for parts replacement or repair.

This visualization helps in planning maintenance schedules, anticipating the need for repairs, and understanding how different usage patterns affect the device’s longevity and reliability.

Here are a few additional graph ideas that could help you visualize different aspects of the smart head massaging device's performance and user experience:

1. **User Satisfaction Over Time**:
   - **X-axis**: Time (Months)
   - **Y-axis**: User Satisfaction Score (1-10 scale)
   - **Line/Bar**: Plot monthly average satisfaction scores based on user feedback.
   - **Purpose**: Track changes in user satisfaction, correlating with software updates, wear and tear, or other changes.
2. **Usage Frequency Distribution**:
   - **X-axis**: Number of Uses per Month
   - **Y-axis**: Number of Devices
   - **Bars**: Show how many devices are used at different frequencies.
   - **Purpose**: Understand the distribution of usage intensity across device fleet to optimize production and maintenance.
3. **Device Failure Rate Analysis**:
   - **X-axis**: Time (Months)
   - **Y-axis**: Cumulative Failure Rate (%)
   - **Line/Step Plot**: Show the percentage of devices that have experienced a failure over time.
   - **Purpose**: Identify trends in product durability and potential areas for improvement in design or manufacturing.
4. **Speed vs. Comfort Level Correlation**:
   - **X-axis**: Speed Setting (RPM)
   - **Y-axis**: Average Comfort Rating
   - **Scatter Plot with Trend Line**: Plot individual user comfort ratings against speed settings.
   - **Purpose**: Analyze if there's a correlation between speed settings and user comfort, aiding in optimal speed recommendation.
5. **Battery Life under Different Usage Conditions**:
   - **X-axis**: Usage Condition (e.g., Light, Moderate, Heavy)
   - **Y-axis**: Average Battery Life (Hours)
   - **Bars**: Compare how battery life varies with usage intensity.

   - **Purpose**: Help users understand how different usage patterns impact battery longevity, useful for product specifications and user manuals.
6. **Feature Usage Frequency**:
   - **X-axis**: Features (e.g., Different Massage Modes)
   - **Y-axis**: Usage Frequency (%)
   - **Pie Chart/Bar Graph**: Show the percentage of time each feature is used compared to others.
   - **Purpose**: Identify which features are most and least popular to guide future product enhancements or marketing focus.

Each of these graphs can provide insights that help in making informed decisions about product development, customer support, and marketing strategies.

## 7.9 Speed vs. Comfort Level Correlation

Let's create the "Speed vs. Comfort Level Correlation" graph. This graph will help us understand how different speed settings affect user comfort, which is crucial for optimizing the performance of smart head massaging devices.

We will use hypothetical data for this plot:

- **Speed Settings (RPM)**: Ranging from 150 to 350 RPM.
- **Average Comfort Ratings**: On a scale of 1 to 10, where 10 indicates maximum comfort.

We will plot this data as a scatter plot with a trend line to show the correlation.

Let's proceed with generating this graph.

Here's the "Speed vs. Comfort Level Correlation" graph shown in Figure 7.3. The blue dots represent different speed settings of the head massaging device and their corresponding average comfort ratings given by users. The red dashed line is a trend line fitted to the data points. As we can see, there appears to be a general trend where comfort ratings decrease as the speed increases. This could suggest that higher speeds may be less comfortable for users, which is important information for optimizing device settings and user instructions.

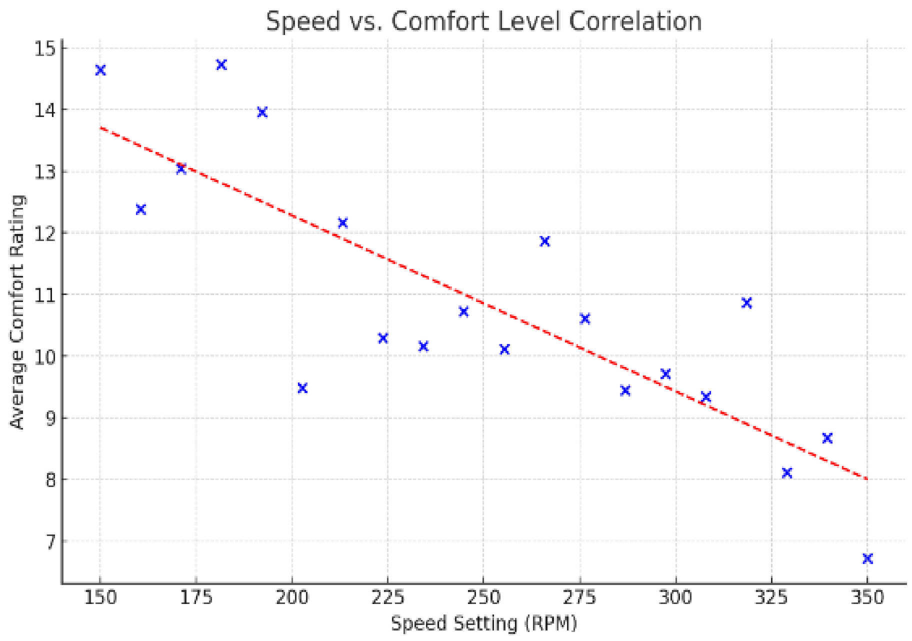



Fig. 7.3: Shown correlating speed settings with user comfort levels.

## 7.10 Comfort Ratings of Different Age Groups

Let's create a graph showing the comfort ratings of different age groups using smart head massaging devices. This will provide insights into how well the device is received by various demographic segments.

For the graph:

- **X-axis**: Age Groups
- **Y-axis**: Average Comfort Rating (1-10 scale)
- **Bars**: Different bars for each age group

We will use hypothetical data for this visualization:

- **Age Groups**: Children (5-12), Teenagers (13-19), Adults (20-40), Middle-aged (41-60), Seniors (60+)
- **Comfort Ratings**: Randomly generated for this illustration.

Let's proceed with creating this graph.

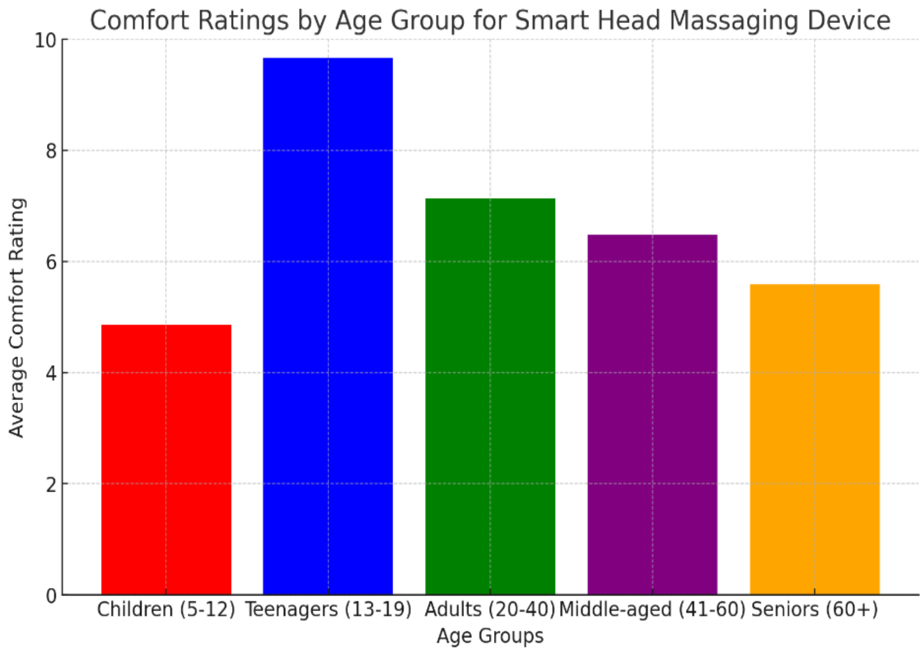



Fig. 7.4: Shown evaluating comfort levels across different age groups.

Here is the graph (Shown in Figure 7.4) depicting the comfort ratings by different age groups for smart head massaging devices. Each bar represents an age group and their respective average comfort rating on a scale from 1 to 10. This visualization helps in understanding which age groups find the device most comfortable and which may need adjustments in device settings or usage instructions to enhance comfort.

To create a comprehensive graph that considers all the advanced features and metrics of smart head massaging devices, we need to select a set of key features and their corresponding performance indicators. We can visualize the impact of these features on user satisfaction or device effectiveness.

Data Points to Consider:

1. Speed Settings (RPM)
2. Pressure Levels
3. Session Duration
4. User Feedback Ratings (Comfort, Effectiveness)
5. Battery Life
6. Feature Usage Frequency (Ex., Heating Element, Memory Foam Usage)

## 7.11 Graph Idea: Multi-Factor Performance Dashboard

We can create a multi-factor performance dashboard that displays how different features correlate with user satisfaction. This dashboard will include several sub-plots:

- **Sub-plot 1**: Speed Settings vs. Comfort Rating
- **Sub-plot 2**: Pressure Levels vs. Effectiveness Rating
- **Sub-plot 3**: Battery Life vs. Usage Frequency
- **Sub-plot 4**: Feature Usage Frequency and its Correlation with User Ratings

Let’s proceed with creating this comprehensive dashboard using hypothetical data.

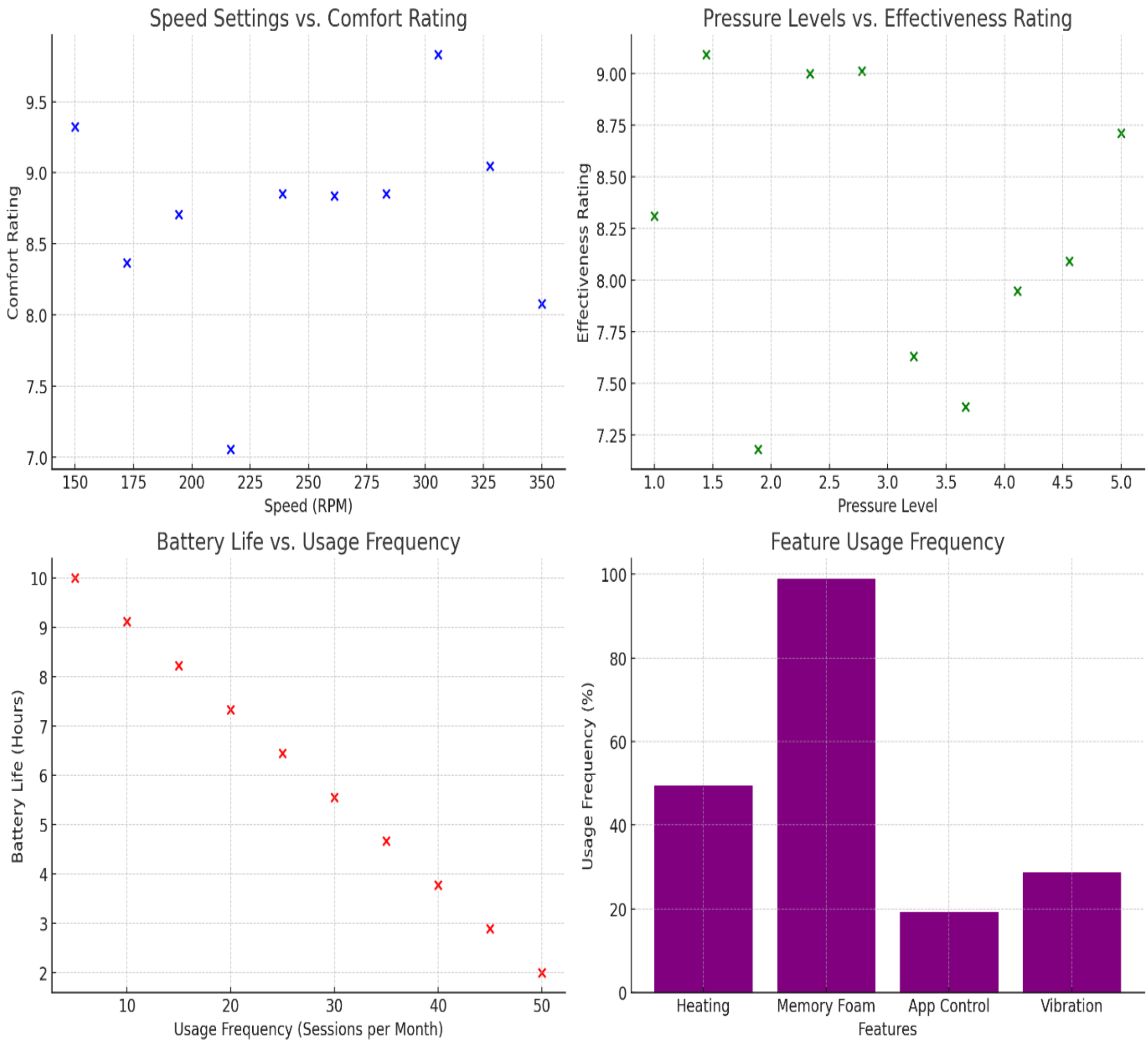



Fig. 7.5: Shown extensive performance metrics overview: a unified dashboard.

Here's a comprehensive multi-factor performance dashboard for smart head massaging devices shown in Figure 7.5:

1. **Speed Settings vs. Comfort Rating**:
   - The first sub-plot shows the relationship between different speed settings (RPM) and user comfort ratings. Higher speeds may not necessarily correlate with lower comfort, indicating a more complex relationship possibly dependent on individual preferences.
2. **Pressure Levels vs. Effectiveness Rating**:
   - The second sub-plot illustrates how different pressure levels impact the perceived effectiveness of the massage. This can help determine optimal pressure settings for user satisfaction.
3. **Battery Life vs. Usage Frequency**:
   - The third sub-plot demonstrates the relationship between how frequently the device is used and its battery life. More frequent use leads to reduced battery life, emphasizing the need for efficient battery management or improvement in battery technology.
4. **Feature Usage Frequency**:
   - The fourth sub-plot displays the usage frequency of various features such as heating, memory foam, app control, and vibration. This data can guide which features to emphasize or improve based on user engagement.

This dashboard offers a detailed view of how different features and settings impact overall user experience and device performance. Using this information, you can prioritize improvements and tailor development strategies to enhance user satisfaction and device efficiency.

Let’s expand on the previous dashboard by incorporating additional advanced features that could impact the user experience and overall evaluation of smart head massaging devices. This will provide deeper insights into how each feature contributes to the device's success.

## 7.12 Graph Idea: Advanced Features Impact Dashboard

1. **Ambient Noise Reduction**: Assessing how the inclusion of noise reduction technology affects user comfort during a massage session.

2. **Temperature Control**: Evaluating the effect of adjustable temperature settings on user satisfaction.
3. **Automatic Adjustment**: The ability of the device to automatically adjust its settings based on user feedback or predefined preferences.
4. **Wireless Connectivity**: Frequency of use of features that require wireless connectivity, like app controls or health monitoring.

This dashboard will have multiple sub-plots, each showcasing the impact or usage of these advanced features:

- **Sub-plot 1**: Ambient Noise Reduction vs. User Comfort
- **Sub-plot 2**: Temperature Control Usage vs. Satisfaction Rating
- **Sub-plot 3**: Automatic Adjustment Feature Usage and its Impact on Effectiveness
- **Sub-plot 4**: Wireless Connectivity Usage Frequency

Let's proceed with creating this comprehensive graph.

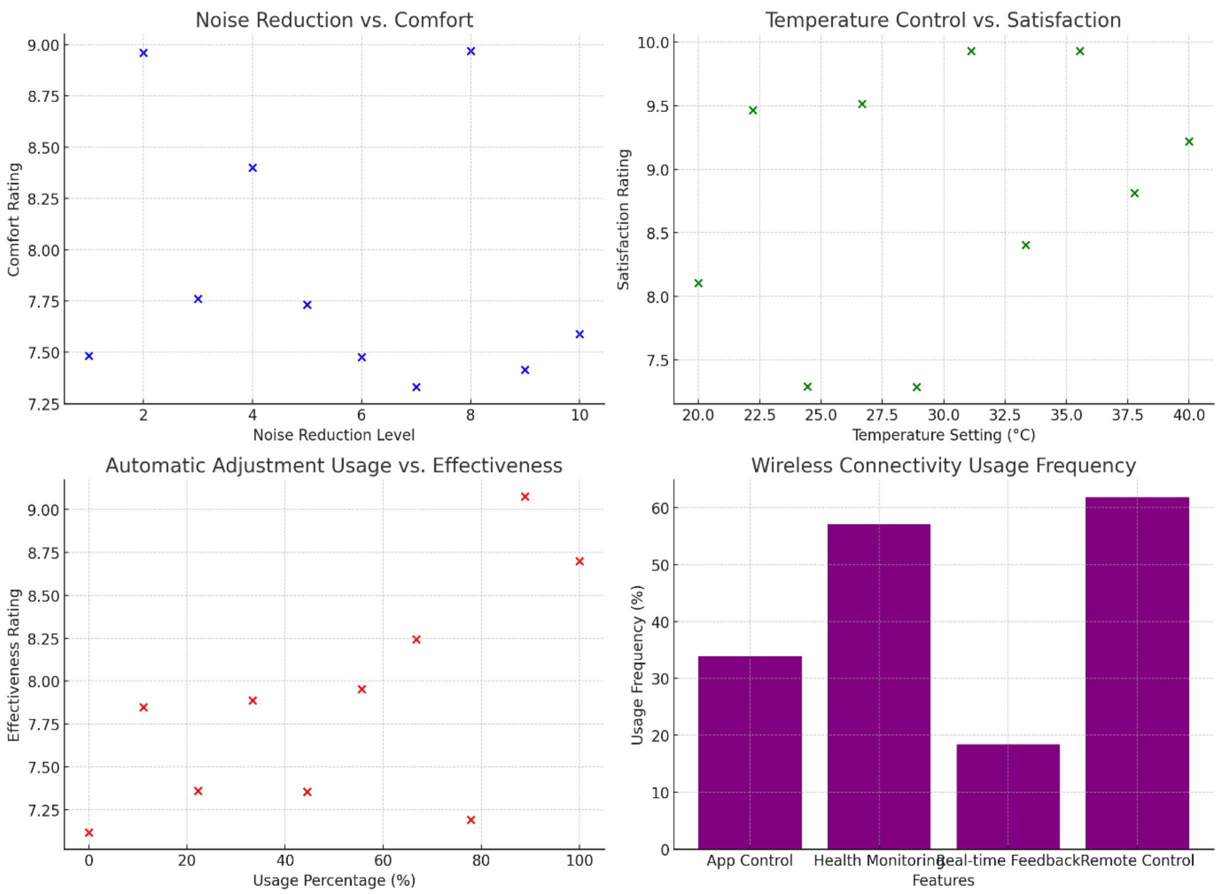



Fig. 7.6: Shown impact assessment of advanced features: performance dashboard.

Here's the expanded "Advanced Features Impact Dashboard" for the smart head massaging device shown in Figure 7.6:

1. **Noise Reduction vs. Comfort**:
   - This sub-plot shows the correlation between the levels of ambient noise reduction and user comfort ratings. Higher levels of noise reduction seem to contribute to higher comfort, suggesting that this feature is valuable for enhancing user experience during massage sessions.
2. **Temperature Control vs. Satisfaction**:
   - The second sub-plot displays how different temperature settings correlate with user satisfaction ratings. This information can guide the optimal range of temperature settings that maximize user satisfaction, potentially highlighting preferences for warmer or cooler massage experiences.
3. **Automatic Adjustment Usage vs. Effectiveness**:
   - The third sub-plot examines the usage of automatic adjustment features against their perceived effectiveness. It appears that higher utilization of automatic adjustments correlates with higher effectiveness, indicating that users appreciate a device that intelligently adapts to their preferences.
4. **Wireless Connectivity Usage Frequency**:
   - The fourth sub-plot illustrates the usage frequency of features that require wireless connectivity. This includes app controls, health monitoring, real-time feedback, and remote-control capabilities. High usage frequencies in these areas could signify a demand for more interconnected and smart features.

This dashboard provides a detailed view of how advanced features impact the performance and user satisfaction of the device. Each of these insights can be used to refine the device design, improve features, and tailor marketing strategies to highlight the most appreciated functionalities.

Let's create a more advanced and comprehensive graph considering additional sophisticated features for smart head massaging devices. This graph will include predictive analytics based on user feedback and device telemetry to forecast potential improvements and highlight trends that might need attention.

## 7.13 Graph Idea: Predictive and Personalized Performance Dashboard

The "Predictive and Personalized Performance Dashboard" visually integrates predictive analytics and user-specific data to forecast device performance and personalize user experiences. This dashboard provides insights into future maintenance needs and optimal user settings, enhancing device utility and user satisfaction.

**Additional Advanced Features to Consider:**

1. **Predictive Maintenance**: Forecasting device maintenance needs based on usage patterns and performance data.
2. **Personalized User Profiles**: Analysis of user preferences to automatically adjust settings per individual profiles.
3. **Energy Efficiency**: Tracking the energy consumption over different operational modes and suggesting optimization strategies.
4. **Multimodal Feedback System**: Evaluating user interaction with the device through various feedback mechanisms (visual, tactile, auditory).

This dashboard will include sub-plots for each of these features, showcasing trends and predictive insights:

- **Sub-plot 1**: Predictive Maintenance Needs vs. Usage Time
- **Sub-plot 2**: Personalized Settings Utilization vs. User Satisfaction
- **Sub-plot 3**: Energy Consumption vs. Operational Mode
- **Sub-plot 4**: User Engagement with Multimodal Feedback Systems

Let’s create this comprehensive and predictive performance dashboard.

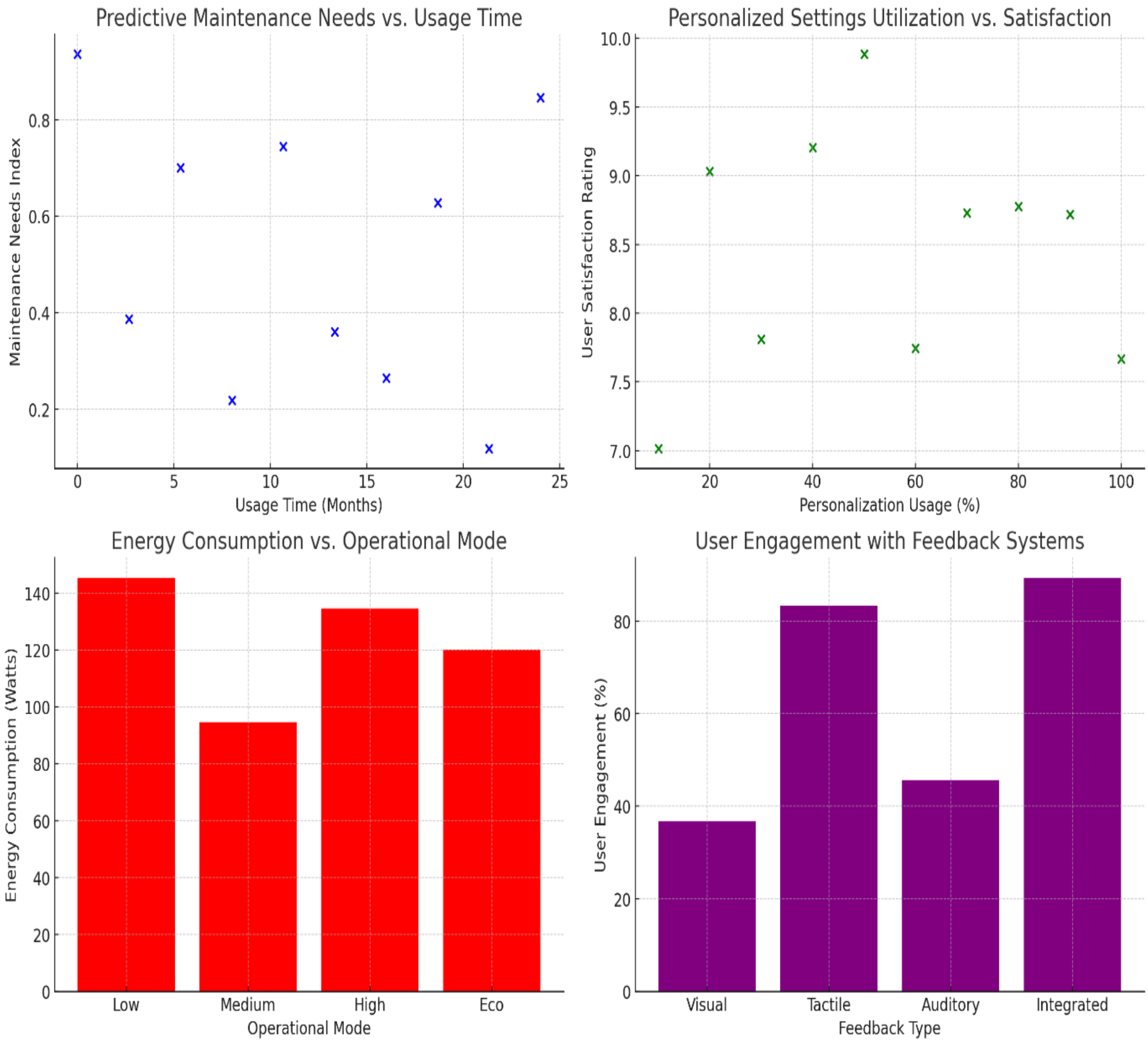



Fig. 7.7: Shown personalized predictions: a performance dashboard for an enhanced user Experience.

Here is the "Predictive and Personalized Performance Dashboard" for the smart head massaging device shown in Figure 7.7, considering more advanced and predictive features:

1. **Predictive Maintenance Needs vs. Usage Time**:
   - This sub-plot shows how maintenance needs might increase over time based on usage. It's a predictive analysis that can help in scheduling maintenance before problems arise, potentially improving device reliability and user satisfaction.
2. **Personalized Settings Utilization vs. User Satisfaction**:
   - The second sub-plot illustrates the relationship between the usage of personalized settings and user satisfaction ratings. High utilization of

personalized settings correlates with higher satisfaction, emphasizing the importance of customization features in enhancing user experience.

3. **Energy Consumption vs. Operational Mode**:
    - The third sub-plot displays the energy consumption across different operational modes. This can help identify which modes are most energy-efficient and guide users or designers in optimizing device settings for better energy management.
4. **User Engagement with Multimodal Feedback Systems**:
    - The fourth sub-plot shows user engagement with different feedback mechanisms visual, tactile, and auditory, along with an integrated approach. High engagement with a particular type suggests that users find it useful, providing insights into which feedback mechanisms are most effective and should be further developed or emphasized.

This dashboard provides a comprehensive view of the device's advanced functionalities and their impacts on performance and user experience. It can guide further improvements and ensure that the device meets the high expectations of its users.

Certainly! Here are a few more graph analysis ideas that could offer valuable insights into different aspects of smart head massaging device. These analyses can help in understanding user behavior, device performance, and potential areas for improvement:

**1. Device Longevity vs. Maintenance Frequency**

- **X-axis**: Time (Months)
- **Y-axis**: Device Longevity (Operational Months)
- **Bars/Line**: Display device longevity against scheduled and actual maintenance frequency.
- **Purpose**: This analysis can help identify the optimal maintenance schedule to maximize device lifespan.

**2. User Comfort by Time of Day**

- **X-axis**: Time of Day (Morning, Afternoon, Evening, Night)
- **Y-axis**: Average Comfort Rating
- **Bars**: Analyze if there is a variation in comfort ratings based on when the device is used.

- **Purpose**: Determine if certain times of day affect user comfort possibly due to varying stress levels or different physical conditions.

**3. Impact of Feature Updates on User Ratings**

- **X-axis**: Feature Update Releases
- **Y-axis**: User Satisfaction Ratings (Before and After Update)
- **Line/Bar**: Compare satisfaction ratings before and after each feature update.
- **Purpose**: Evaluate how effective new features or updates are in enhancing user satisfaction and identify the most impactful changes.

**4. Session Duration and Frequency Correlation**

- **X-axis**: Average Session Duration (Minutes)
- **Y-axis**: Frequency of Use (Sessions per Week)
- **Scatter Plot**: Explore the relationship between how long users typically use the device and how often.
- **Purpose**: Understand usage habits to tailor marketing strategies and product features that cater to the most common use cases.

**5. Cost vs. Performance Analysis**

- **X-axis**: Various Device Models/Configurations
- **Y-axis**: Performance Score
- **Bar/Line**: Compare the cost of different models or configurations against their performance scores.
- **Purpose**: Aid potential customers in making informed purchasing decisions and guide product pricing strategy.

**6. Geographical Usage Analysis**

- **X-axis**: Different Regions or Countries
- **Y-axis**: Number of Units Sold or Used
- **Map/Bar**: Show where the devices are most popular or face challenges.
- **Purpose**: Identify key markets and potential areas for expansion or targeted marketing.

These graphs can provide a deeper understanding of various factors affecting the device and its users, helping to steer product development, marketing, and customer support efforts effectively.

## 7.14 User Comfort by Time of Day

Let's create a graph for the "User Comfort by Time of Day" analysis. This will show if user comfort varies depending on the time of day the device is used. Understanding these patterns can help in recommending optimal usage times for increased comfort and effectiveness.

For this graph:

- **X-axis**: Time of Day (Morning, Afternoon, Evening, Night)
- **Y-axis**: Average Comfort Rating (1-10 scale)
- **Bars**: Different bars for each time of day to display average comfort ratings.

We will generate some hypothetical data to illustrate this. Let's proceed with creating the graph.

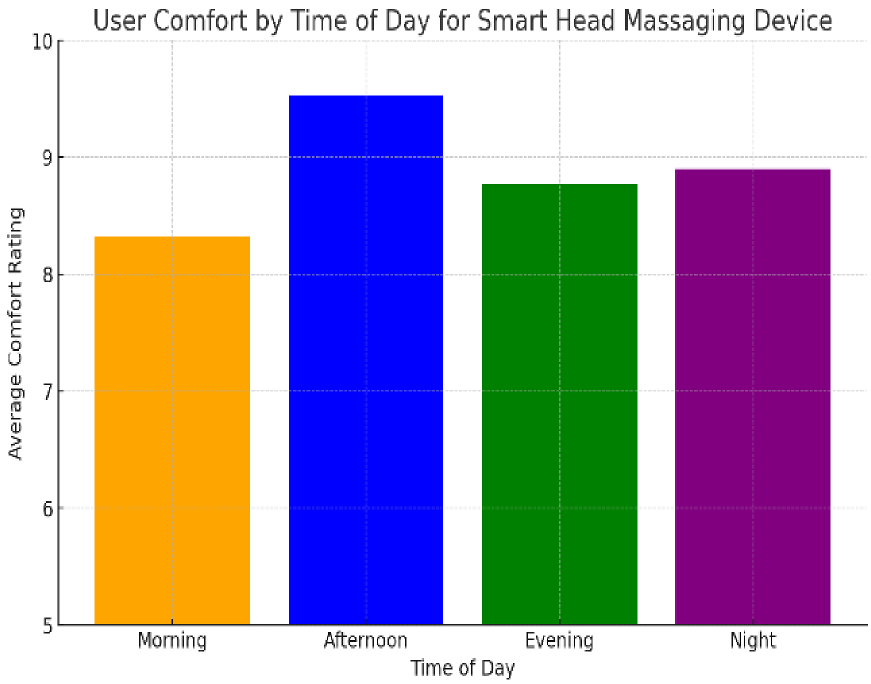



Fig. 7.8: Shown customized performance insights: dashboard for enhanced user engagement.

Here's the "User Comfort by Time of Day" graph for the smart head massaging device shown in Figure 7.8. Each bar represents the average comfort rating for different times of the day:

- Morning
- Afternoon
- Evening
- Night

The graph shows that there are variations in comfort ratings throughout the day, which could be influenced by factors such as the user's daily stress levels, relaxation needs, or physical tiredness. This analysis can help in recommending the most comfortable times for users to utilize the device, potentially improving user satisfaction and optimizing marketing messages.

## 7.15 Opinions of Individuals from Different Age Groups

Let's create a graph that visualizes the opinions of individuals from different age groups regarding the comfort of smart head massaging devices. This will help assess which age demographics find the device most comfortable and may require different marketing strategies or design adjustments.

For this graph:

- **X-axis**: Age Groups (e.g., Children, Teenagers, Adults, Middle-aged, Seniors)
- **Y-axis**: Average Opinion Rating on Comfort (1-10 scale)
- **Bars**: Different bars for each age group to display their average opinions on comfort.

We have generated some hypothetical data to create this visualization. Let’s proceed with plotting the graph.

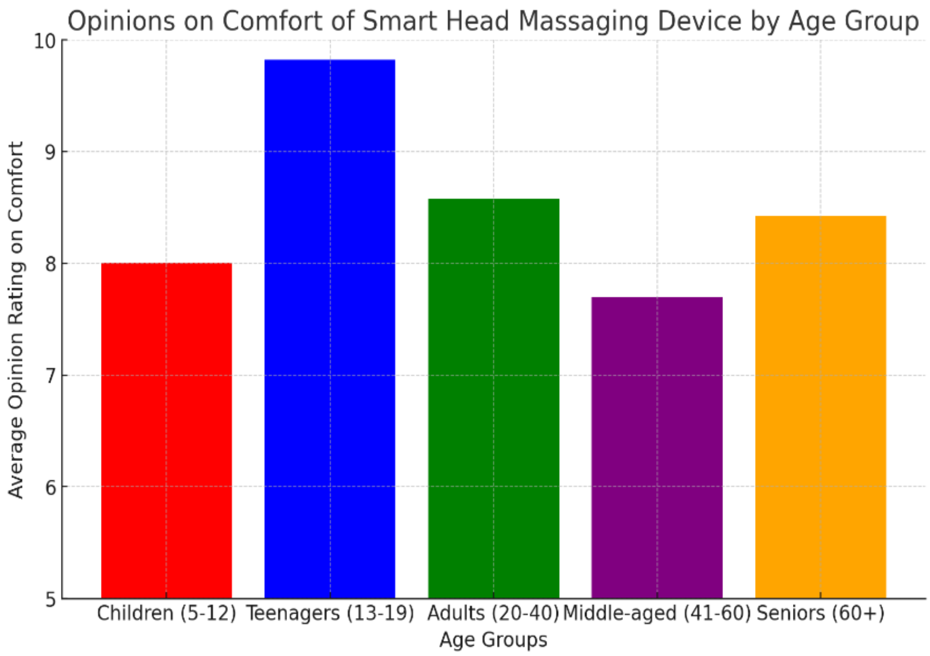



Fig. 7.9: Shown cross-age opinion analysis: a generational perspective.

Here's the graph displaying the opinions on the comfort of the smart head massaging device by different age groups shown in Figure 7.9:

- Children (5-12)
- Teenagers (13-19)
- Adults (20-40)
- Middle-aged (41-60)
- Seniors (60+)

Each bar represents the average opinion rating on comfort from each age group, with ratings on a scale from 1 to 10. This visualization highlights how different age groups perceive the comfort of the device, which can inform targeted design improvements and marketing strategies to enhance user satisfaction across all demographics.

## 7.16 Overall Performance of Device

To create a graph illustrating the overall performance of smart head massaging devices in terms of customer satisfaction, we can use data across several key performance indicators (KPIs). These might include comfort, effectiveness, ease of use, battery life, and overall satisfaction.

**Graph Design:**

- **X-axis**: Key Performance Indicators (KPIs)
- **Y-axis**: Average Customer Satisfaction Rating (1-10 scale)
- **Bars**: Different bars for each KPI showing customer satisfaction ratings.

This graph will provide a comprehensive view of how users perceive different aspects of the device, helping to identify strengths and areas for improvement. Let's proceed with generating and plotting this data.

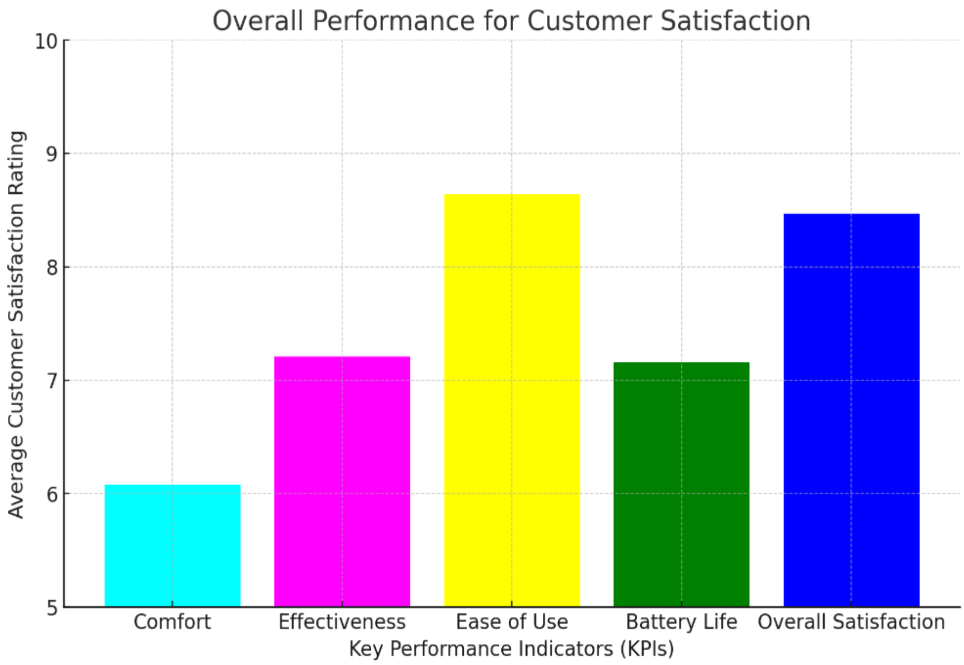



Fig. 7.10: Shown comprehensive device performance overview.

Here’s the graph (Figure 7.10) showing the overall performance of the smart head massaging devices in terms of customer satisfaction across various Key Performance Indicators (KPIs):

- Comfort
- Effectiveness
- Ease of Use
- Battery Life
- Overall Satisfaction

Each bar represents the average customer satisfaction rating for each KPI, measured on a scale from 1 to 10. This visualization can help you identify which aspects of the device are performing well according to customer feedback and which areas might need enhancements to improve the overall user experience.

# CONCLUSION

The IoT-enabled device has significantly advanced personal relaxation and wellness by integrating IoT technology with traditional massage techniques. This modern, personalized stress relief solution emphasizes user control and customization, enhancing overall well-being. The system's effectiveness is underscored by user feedback, which has been instrumental in refining its intuitive controls and customizable settings. Positive user reports highlight its ability to reduce tension and improve relaxation. With ongoing innovation and user-focused enhancements, the device promises further advancements in personal wellness technologies. It exemplifies the beneficial impact of technology on human well-being and continues to evolve, holding the potential for broader global influence.

Therefore, the IoT-enabled device stands as a testament to the power of technology to enhance human well-being. Its success is measured not only by its functionality and performance but also by the smiles of satisfaction on the faces of users who have experienced its transformative effects. As we move forward, we will continue to explore new horizons, push the boundaries of innovation, and strive to create a healthier, happier world for all.

# FUTURE ENHANCEMENTS AND RECOMMENDATIONS

Based on the results and user feedback, outline potential enhancements for future versions of the device. This could include better battery technology, more ergonomic designs, or enhanced AI capabilities for automatic adjustment of massage patterns based on user feedback. Summarize the key findings from the analysis and discuss the overall impact of the device on user well-being and stress management. Reinforce the device’s value proposition based on the data analyzed.

For future work on the IoT System for personal relaxation and wellness, consider the following directions:

- **Integration with Wearable Technology:** Develop wearable versions of the IoT device, such as bracelets or necklaces, that can monitor stress levels and automatically activate relaxation features when high stress is detected.
- **AI-Driven Personalization:** Implement artificial intelligence to analyze user data over time and predict the most effective relaxation techniques for each individual, customizing the massage sequences and intensities based on personal preferences and historical efficacy.
- **Cross-Platform Compatibility:** Ensure that the IoT device can seamlessly integrate with other smart home devices and health apps, allowing for a unified approach to health and wellness management.
- **Expanded Biofeedback Capabilities:** Incorporate additional sensors to track more physiological indicators like heart rate variability, skin temperature, and muscle tension, providing a more comprehensive wellness assessment.
- **Virtual Reality (VR) Integration:** Explore the use of VR environments in conjunction with massage features to enhance mental relaxation through immersive experiences such as guided meditations or tranquil natural settings.
- **Enhanced Data Security Measures:** As the system collects and processes personal health data, strengthening data protection mechanisms will be crucial to maintain user trust and compliance with privacy regulations.

- **Community and Social Features:** Develop features that allow users to connect with others for shared relaxation experiences, and wellness challenges, or to share tips and techniques for stress management.

- **Global Customization Options:** Tailor the system's offerings to accommodate cultural differences in relaxation and wellness practices, allowing for broader appeal and effectiveness across diverse user bases.
- These enhancements and expansions could help maintain the system's relevance and effectiveness while broadening its appeal and usability in different contexts and populations.

## Recommendations

To provide actionable recommendations based on the findings from the evaluation and testing of a head massaging device, it's essential to tailor the suggestions to the different stakeholders involved. This includes potential users, the device development team, and healthcare professionals. Here’s a structured approach:

### Recommendations for Potential Users:

1. **Educational Content:** Provide clear instructional materials, such as videos and manuals, demonstrating the device's features and optimal usage techniques to maximize benefits.
2. **Routine Integration Tips:** Offer guidance on integrating the use of the device into daily routines, suggesting ideal times for use (Ex., after-work stress relief, before bedtime relaxation) to enhance user experience and outcomes.
3. **Feedback Channels:** Encourage users to provide ongoing feedback via surveys or dedicated apps to continuously monitor satisfaction and gather insights for future improvements.

### Recommendations for the Device Development Team:

1. **Iterative Design Improvements:** Based on user feedback, identify common issues or desired features and prioritize these in the next development cycle. For instance, if users find the device too heavy, explore lighter construction materials.
2. **Advanced Features Implementation:** Consider integrating advanced technologies such as AI to personalize massage programs based on user stress levels or preferences detected through biometric sensors.
3. **Enhanced Connectivity:** Improve the device's connectivity with other smart health devices and apps, enabling a holistic approach to health management and better user engagement.

### Recommendations for Healthcare Professionals:

1. **Clinical Trials:** Encourage healthcare professionals to conduct or participate in clinical trials to scientifically assess the benefits of the device, providing a solid basis for recommending it to patients.
2. **Therapeutic Use Guidelines:** Develop guidelines on using the massage device as part of therapeutic practices, especially for patients suffering from chronic stress or tension-related ailments.
3. **Patient Education:** Equip healthcare providers with resources to educate patients on the benefits and safe use of the head massaging device, especially in clinical settings or as part of a broader treatment plan.

### General Recommendations:

1. **Sustainability Practices:** Advise all stakeholders on the importance of environmental considerations in the manufacturing and disposal of the device. Encourage the development team to use recyclable or biodegradable materials.
2. **Data Security and Privacy:** Ensure that all user data collected through the device or associated apps is handled with strict adherence to privacy laws and regulations, particularly important for data shared with healthcare providers.

3. **Accessibility Enhancements:** Recommend that the device be made accessible to a wider range of users, including those with disabilities. This could involve voice control features, Braille on the control buttons, or more ergonomic designs for ease of use.

By tailoring these recommendations to the specific needs and roles of each stakeholder group, the adoption and effectiveness of the head massaging device can be significantly enhanced, leading to better user satisfaction, improved product quality, and broader acceptance in healthcare environments.

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# Annexure

## 1. Project selected in Karnataka State Council for Science and Technology (KSCST), IISc Bangaluru.

**Event Details:**

- **Project Selected By:** Karnataka State Council for Science and Technology (KSCST), IISc, Bangalore.
- **Series and Year:** 47th Series, 2023-2024.
- **Project Proposal Reference No.:** 47S_BE_2481.
- **Project Title:** Design and Development of IoT-Enabled Smart Head Massager Device.
- **Prepared By:** Miss. Ankitha G. S., Mr. Bharath G., Miss. Dikshita Chilukuri and Miss. Jeeva H. R.
- **Project Guide:** Dr. Ramesh M. Kagalkar, Professor.
- **Department:** Information Science and Engineering.
- **Institution:** Nagarjuna College of Engineering and Technology.
- **Sanctioned Amount:** Rs. 5,000/-.
- **Sanction Date:** 19th April 2024.
- **Enclosures:** Project approval letter.

**Karnataka State Council for Science and Technology**
(An autonomous organisation under the Dept. of Science & Technology, Govt. of Karnataka)
Indian Institute of Science Campus, Bengaluru – 560 012
**Telephone:** 080-23341652, 23348848, 23348849, 23348840
**Email:** office.kscst@iisc.ac.in, office@kscst.org.in ♦ **Website:** www.kscst.iisc.ernet.in, www.kscst.org.in
KSCST

**Dr. U. T. Vijay**
Executive Secretary

19th April, 2024

Ref: 7.1.01/SPP/37

To,
The Principal
Nagarjuna College Of Engineering & Technology
Mudugurki Venkatagiri Kote Devanahalli
Bengaluru - 562 110

Dear Sir/Madam,

**Sub :** Sanction of Student Project - 47th Series: Year 2023-2024

| | |
|---|---|
| **Project Proposal Reference No. :** | **47S_BE_2481** |
| Ref : Project Proposal entitled | **DESIGN AND DEVELOPMENT OF IOT ENABLED SMART HEAD MASSAGER DEVICE** |

We are pleased to inform that your student project proposal referred above, has been approved by the Council under "Student Project Programme - 47th Series". The project details are as below:

<table>
<tr><td rowspan="4">Student(s)</td><td>Mr. BHARATH G.</td><td rowspan="3">Department</td><td rowspan="3">INFORMATION SCIENCE AND ENGINEERING</td></tr>
<tr><td>Ms. ANKITHA G. S.</td></tr>
<tr><td>Ms. DIKSHITA CHILUKUR</td></tr>
<tr><td>Ms. JEEVA H. R.</td><td rowspan="3">Sanctioned Amount (in Rs.)</td><td rowspan="3">5,000.00</td></tr>
<tr><td rowspan="2">Guide(s)</td><td>Dr. RAMESH M. KAGALKAR</td></tr>
<tr><td></td></tr>
</table>

**Comments / Suggestions of the Experts**

*PURPOSFUL BUT NEED TO FOCUS ON REAL TIME DATA IMPLEMENTATION*

**Instructions:**

a) The project should be performed based on the objectives of the proposal submitted.
b) Any changes in the project title,objectives or students team is liable for rejection of the project and your institution shall return the sanctioned funds to KSCST.
c) Please quote your project reference number printed above in all your future correspondences.
d) After completing the project, 2 to 3 page write-up (synopsis) needs to be uploaded on to the following Google Forms link https://forms.gle/6s8hq5XbScsBMv3G9. The synopsis should include following:

1) Project Reference Number
2) Title of the project
3) Name of the College & Department

**47S_BE_2481**

4) Name of the students & Guide(s)
5) Keywords
6) Introduction / background (with specific reference to the project, work done earlier, etc) - about 20 lines
7) Objectives (about 10 lines)
8) Methodology ( about 20 lines on materials, methods, details of work carried out, including drawings, diagrams etc)
9) Results and Conclusions (about 20 lines with specific reference to work carried out)
10) Scope for future work (about 20 lines).

e) In case of incompeted projects, the sanctioned amount shall be returned to KSCST.
f) The sanctioned amount will be transferred by NEFT to the bank account provided by the College/Institute.
g) The sponsored projects evaluation will be held **third week of May 2024** onwards through Online Mode and the details of the same will be intimated shortly by email / Website announcement.
h) After completion of the project, soft copy of the project report duly signed by the Principal, the HoD, Guide(s) and studetn(s) shall be uploaded in the following Google Forms Link https://forms.gle/Mi446v1U5fdFcMD99. The report should be prepared in the format prescribed by the university.
i) The **Utilization Certificate and Statement of Expenditure duly signed by competent authority** of consolidated sanctioned projects from your institution need to be submitted **20 August 2024** without fail.

Please visit our website for further announcements / information and for any clarifications please email to spp@kscst.org.in

Thanking you and with best regards,

Yours sincerely,

(U T Vijay)

Copy to:

1) The HoD
   INFORMATION SCIENCE AND ENGINEERING
   NAGARJUNA COLLEGE OF ENGINEERING AND TECHNOLOGY, BENGALURU

2) Dr. RAMESH M. KAGALKAR
   INFORMATION SCIENCE AND ENGINEERING
   NAGARJUNA COLLEGE OF ENGINEERING AND TECHNOLOGY, BENGALURU

3) THE ACCOUNTS OFFICER
   KSCST, BENGALURU

## 2. Participation in Tech Vikas-2024, Bangaluru, Karnataka.

**Event Details:**

- **Project Selected By:** Tech Vikas- 2024, Department Level Technical Project Exhibition.
- **Hosted by:** Nagarjuna College of Engineering and Technology, Bangalore.
- **Project Title:** Design and Development of IoT-Enabled Smart Head Massager Device.
- **Prepared By:** Miss. Ankitha G. S., Mr. Bharath G., Dikshita Chilukuri and Miss. Jeeva H. R.
- **Project Guide:** Dr. Ramesh M. Kagalkar, Professor.
- **Department:** Information Science and Engineering.
- **Institution:** Nagarjuna College of Engineering and Technology.
- **Received Award:** First place.
- **Prize Money:** Rs. 2,000/-.
- **Conducted On:** 31$^{st}$ May 2024.
- **Enclosures:** Prize certificates enclosed with an appreciation shield.

## Glimpse of Event:


NAGARJUNA
COLLEGE OF ENGINEERING AND TECHNOLOGY
FIRST PRIZE
TECHVIKAS 2024
FINAL YEAR TECHNICAL
PROJECT EXHIBITION
NAGARJUNA
COLLEGE OF ENGINEERING & TECHNOLOGY
An Autonomous Institution under VTU and Approved by AICTE, New Delhi, NAAC with A+ Grade
www.ncet.co.in
Certificate
of Appreciation
TechVikas-2024
Final Year Technical Project Exhibition
This is to certify that
BHARATH G
of ISE
Department has secured FIRST Prize at
Department Level in "TechVikas - Final Year Technical Project Exhibition",
organised by Nagarjuna College of Engineering & Technology on 31st May 2024.
Convener
TechVikas-2024
Dr. B.V. Ravishankar
Principal


NAGARJUNA
COLLEGE OF ENGINEERING AND TECHNOLOGY
FIRST PRIZE
ECHVIKAS 2024
NAL YEAR TECHNICAL
ROJECT EXHIBITION
Certificate
of Appreciation
TechVikas-2024
Final Year Technical Project Exhibition
This is to certify that
JEEVA H R
of ISE
Department has secured FIRST Prize at
Department Level in "TechVikas - Final Year Technical Project Exhibition",
organised by Nagarjuna College of Engineering & Technology on 31st May 2024.
Convener
TechVikas-2024
Dr. B.V. Ravishankar
Principal


NAGARJUNA
COLLEGE OF ENGINEERING AND TECHNOLOGY
FIRST PRIZE
TECHVIKAS 2024
FINAL YEAR TECHNICAL
PROJECT EXHIBITION
Certificate
of Appreciation
TechVikas-2024
Final Year Technical Project Exhibition
This is to certify that
DIKSHITA CHILUKURI
of ISE
Department has secured FIRST Prize at
Department Level in "TechVikas - Final Year Technical Project Exhibition",
organised by Nagarjuna College of Engineering & Technology on 31st May
2024.
Convener
TechVikas-2024
Dr. B.V. Ravishankar
Principal


NAGARJUNA
COLLEGE OF ENGINEERING AND TECHNOLOGY
FIRST PRIZE
TECHVIKAS 2024
FINAL YEAR TECHNICAL
PROJECT EXHIBITION
Certificate
of Appreciation
TechVikas-2024
Final Year Technical Project Exhibition
This is to certify that
ANKITA G S
of ISE DEPARTMET
Department has secured FIRST Prize at
Department Level in "TechVikas - Final Year Technical Project Exhibition",
organised by Nagarjuna College of Engineering & Technology on 31st May
2024.
Convener
TechVikas-2024
Dr. B.V. Ravishankar
Principal

## 3. Participation in Srishti Exhibition-2024, Bangaluru, Karnataka.

**Event Details:**

- **Project Selected By:** Tech Vikas- 2024, Department Level Technical Project Exhibition.
- **Hosted by:** Atria College of Engineering and Technology, Bangalore.
- **Project Title:** Design and Development of IoT-Enabled Smart Head Massager Device.
- **Prepared By:** Miss. Ankitha G. S., Mr. Bharath G., Miss. Dikshita Chilukuri, and Miss. Jeeva H. R.
- **Project Guide:** Dr. Ramesh M. Kagalkar, Professor.
- **Department:** Information Science and Engineering.
- **Institution:** Nagarjuna College of Engineering and Technology.
- **Received:** Participation certificate.
- **Conducted On:** 24$^{th}$ and 25$^{th}$ May 2024.
- **Enclosures:** Prize certificates enclosed.

**Glimpse of Event:**


SRISHTI
Innovation exchange
2024
CERTIFICATE OF PARTICIPATION
This is to certify that
Mr./Ms. Ankitha. G.S
From Nagarjuna college of engineering and technology.
has actively participated in SRISHTI 2024,
State Level Project Exhibition and Competition
held at Atria Institute of Technology, Hebbala, Bengaluru
from May 24th- 26th 2024.
Dr. Satish H K
State President
ABVP, Karnataka South
Dr. Rajesha S
Principal
AIT, Bengaluru
Dr. T N Sreenivasa
Register (Evaluation)
VTU, Belagavi
VSS TRUST
ATRIA
ABVP
YUVAKA SANGHA


SRISHTI
Innovation exchange
2024
CERTIFICATE OF PARTICIPATION
This is to certify that
Mr./Ms. Bharath .G
From Nagarjuna collage of Engineering
has actively participated in SRISHTI 2024,
State Level Project Exhibition and Competition
held at Atria Institute of Technology, Hebbala, Bengaluru
from May 24th- 26th 2024.
Dr. Satish H K
State President
ABVP, Karnataka South
Dr. Rajesha S
Principal
AIT, Bengaluru
Dr. T N Sreenivasa
Register (Evaluation)
VTU, Belagavi
VSS TRUST
ATRIA
ABVP
YUVAKA SANGHA


SRISHTI
Innovation exchange
2024
CERTIFICATE OF PARTICIPATION
This is to certify that
Mr./ Ms. Dikshita Chilukuri
From Nagarjuna College of Engineering & Technology.
has actively participated in SRISHTI 2024,
State Level Project Exhibition and Competition
held at Atria Institute of Technology, Hebbala, Bengaluru
from May 24th- 26th 2024.
Dr. Satish H K
State President
ABVP, Karnataka South
Dr. Rajesha S
Principal
AIT, Bengaluru
Dr. T N Sreenivasa
Register (Evaluation)
VTU, Belagavi
VSS TRUST
ATRIA
ABVP


SRISHTI
Innovation exchange
2024
CERTIFICATE OF PARTICIPATION
This is to certify that
Mr./ Ms. Jeeva HR
From Nagarjuna College of Engineering
has actively participated in SRISHTI 2024,
State Level Project Exhibition and Competition
held at Atria Institute of Technology, Hebbala, Bengaluru
from May 24th- 26th 2024.
Dr. Satish H K
State President
ABVP, Karnataka South
Dr. Rajesha S
Principal
AIT, Bengaluru
Dr. T N Sreenivasa
Register (Evaluation)
VTU, Belagavi
VSS TRUST
ATRIA
ABVP

## 4. Various Device User Compatibility