International Journal of Trend in Scientific Research and Development (IJTSRD)
Volume 9 Issue 5, Sep-Oct 2025 Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470

# An Octopus Modelled Massager Mimicking Human Finger Movements using Embedded Systems

**Thaarmika Shree. S[1], Manasa. J[2], Farah Ibreez. Z[3], Deepthi. N[4], Dr. Srilatha. Y[5]**

[1,2,3,4]Department of CSE-DS, Dayananda Sagar Academy of Technology and Management, Bangalore, Karnataka, India
[5]Department of Physics, Dayananda Sagar Academy of Technology and Management, Bangalore, Karnataka, India
*Corresponding Author: Dr. Srilatha Y

**ABSTRACT**

The Octopus Massager is a soft, silicone-based automatic massager designed to mimic the effect of human fingers using vibrating tentacles and servo motor-driven movements. The aim is to provide a hands-free massage experience that is compact, skin-adhering, and user-friendly. The design is inspired by an octopus, where each tentacle serves as a massaging arm, simulating kneading and vibration motions. The design uses a combination of servo motors, vibration motors, and an Arduino- based control system. This is built using 6 servo motors for tentacle motion and coin vibration motors for vibration effect. An Arduino microcontroller manages the input from the control button and drives the two operating modes: gentle and intense massage. The button changes between these modes, altering motor speed and vibration intensity. A breadboard is used for interconnecting the components.

***How to cite this paper:*** Thaarmika Shree. S | Manasa. J | Farah Ibreez. Z | Deepthi. N | Dr. Srilatha. Y "An Octopus Modelled Massager Mimicking Human Finger Movements using Embedded Systems" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-9 | Issue-5, October 2025, pp.293-297, URL: www.ijtsrd.com/papers/ijtsrd97487.pdf

IJTSRD97487



## I. INTRODUCTION

In today's fast-paced world, physical and mental stress are common. Traditional massage techniques, while helpful, often require another person or bulky equipment that isn't portable or flexible. Most commercial massagers are handheld, rigid, and operated manually, making them impractical for continuous or hands-free use. Our project aims to design and create a smart, hands-free octopus-shaped massager that imitates human finger movements with flexible, vibrating tentacles. This device offers a compact, wearable, and self-operated massage experience. The system runs on an Arduino microcontroller that manages the movement and

## II. Customer research

To understand people's problems and needs, we conducted some interviews with:

1. Students with poor posture and prolonged screen time.
2. Software engineers who work on the computer for a long time without breaks.
3. Senior citizens seeking comfort from muscle stiffness.
4. Physiotherapist for feedback on massage efficiency.

From this survey, we got to know that most users desire a portable, lightweight, hands-free solution that gives the same comfort as human fingers without requiring effort.

## III. Customer journey map

### STAGE 1: Awareness

The customer journey begins with the awareness stage, where users learn about the product through demos or Ads and feel curious and hopeful, presenting an opportunity to deliver a visually appealing and clear value message.

### STAGE 2:Consideration

During the consideration phase, users compare it with traditional massagers and may feel confused by numerous options, making it crucial to highlight unique features and simplicity.

**STAGE 3: Purchase**

Users are pleasantly surprised by the product's soft-touch feel, suggesting a focis on comfort and automode functions. 1

**STAGE 4:Post-use**

In this stage, users feel relieved and relaxed, offering a chance to encourage user reviews and establish a feedback loop.

## IV. Project planning

The first step in this was ideation and problem identification, in which we conducted brainstorming sessions and identified gaps in existing massaging products. The next step was research and feasibility analysis, and researched about servo and vibration motor integration, and also looked into the availability and cost of components such as Arduino. We then created circuit diagrams and tested components on a breadboard. Next, we did the implementation and testing by integrating the code into Arduino, and we conducted multiple iterations to refine the tentacle motion and vibration intensity.

## V. Project execution(Elaborated)

**STAGE 1:**

In the concept finalization and design planning stage, the team finalized the idea of an octopus-shaped wearable massager inspired by therapeutic tools and bio-inspired models. The Aim was to create a soft, flexible, hands-free device that mimics human finger massage using vibrating and flexing tendons. Key functional requirements included secure skin attachment, multiple massage modes, a soft touch body for comfort, realistic finger-like sensation via servo and vibration motors, and a battery-powered portable system.

**STAGE 2:**

In the hardware assembly stage, essential components were selected to meet the device's functional requirements, including 6 SG90 MICRO SERVO MOTORS,6 Coin vibration motors, an Arduino UNO board, a push button for mode control, A step down voltage converter, A 7.4 volt rechargeable Li-ion battery, a necessary breadboard, and jumper wires.

Initial circuit testing was conducted on a breadboard to validate motor, power, and button functions, requiring careful pin management. A step-down converter was used to regulate voltage, ensuring a stable 5V supply to prevent component damage.

**STAGE 3:**

In the silicon body fabrication stage, soft silicon rubber was selected for its skin-friendly, flexible, and durable properties. A custom octopus-shaped mold with six tentacles was created, and motors were embedded during the semi-cured stage to ensure internal without compromising softness. Tentacles were made hollow to enable servo movement and vibration motors at the tips, creating a life-like, flexible motion that mimics human finger massage.

**STAGE 4:**

In the software programming stage, the Arduino IDE was used to write control code for servos and motors. A button toggled between gentle and intense massage modes, with synchronized, wave-like motor patterns and dynamically adjusted for realistic vibrations. Code optimisation included delay adjustments for smooth movement. And button debounce for stable mode switching.

**STAGE 5:**

In the final stage of testing, feedback and refinement, each component and mode was individually and systematically tested to evaluate servo stability, vibration response, and power usage with the user. User trials were conducted with volunteers to assess comfort, effectiveness, and usability. Based on the feedback, improvements included adjusting servo angles for better tentacle flexibility, slightly reducing the weight for improved skin adhesion and refining the code to lower power consumption and enhance vibration consistency .After successful testing, the final assembly involved securely mounting all components inside the silicon body with neatly routed wiring to maintain to maintain compactness.

**Gap Analysis**

Most existing massagers in the market are handheld, rigid, and require manual effort to operate. While electric back and head massagers exist, they are either bulky or hard to handle and do not provide flexible movements. Wearable or Adhesive massagers with realistic finger-mimicking action are not widely available, especially in a compact, toy-like form. The primary gap lies in the lack of a small, portable massager that can independently move across the body, deliver a realistic massage experience, and stay attached to the skin. Current systems do not combine self-movement, skin grip, and realistic finger-like stimulation. This project addresses the need for a more comfortable, hands-free, and natural-feeling massage device.

## VI. Methodology

We used the following hardware components based on their functionality and compatibility with an Arduino-based embedded system:

**Hardware requirements:**

1. **Arduino UNO:** It is the main controller for motor control and input handling.
2. **6 Servo motors:** It was used to control the motion of the tentacles.

3. **Push button:** To switch between two modes 6 coin vibration motors to create vibration in each tentacle.
4. **Step down converter:** It regulates voltage to protect the motors and the Arduino.
5. **Li-Ion battery:** To power the whole system.
6. **Breadboard:** Used for interconnecting the components.
7. **Jumper wires:** Used for the connections
8. **Silicon material:** For the outer body of the octopus.

## VII. Flow diagram:

**System initialization:** The Arduino microcontroller powers on and initialises all connected components, including servo motors, vibration motors and the control button.

**Default mode activation:** Upon startup, the system defaults to the gentle massage mode, with preset low speed servo movements and mild vibration intensity.

**Button monitoring begins:** The microcontroller continuously monitors the state of the button input using digital signals.

**Mode toggle detection:** The system toggles between two operating modes:
1. If the current mode is gentle, it switches to intense mode.
2. If the current mode is intense, it switches back to gentle mode.

**Execution of selected mode:**
1. In gentle mode, servo motors move the tentacles slowly in rhythmic motion to produce soft finger fingertip-like sensations.
2. In intense mode, servo motors move faster with wider angles for stronger stimulation.

**Continuous operation:** The massager continues operating in the selected mode until a new button press is detected.

**Loop and feedback:** The system remains in a loop, allowing users to switch modes at any time during operation.

**Power off or reset:** If the device is manually turned off or reset, the system stops all motor operations and returns to the default mode upon the next startup.

**Hardware implementations:**

**Tentacle mechanism:**

Each of the six tentacles was equipped with an SG90 micro servo motor to stimulate finger-like flexing and a coin vibration motor at the tip to mimic the pulsating touch of a human finger.

**Main controller and power system:**

These components were powered and controlled by an Arduino UNO, which served as the central controller, handling input from a digital push button that toggled between gentle and intense massage modes. A 7.4V rechargeable Li-ion battery powered the system, with a buck convertor regulating the volatge to safe 5V.All components were initially assembled on a breadboard to facilitate flexible testing and debugging during the design phase.

## VIII. User feedback:

To asses the usability and overall effectiveness of the massager, formal and informal feedback was gathered from people of different professions including students, office workers and elderly people.

In terms of comfort and feel, users expressed high satisfaction, commenting that the device felt extremely soothing, with fingers tapping and kneading their skin. The soft silicone material used for the body of the massager was particularly appreciated for its comfort and flexibility during its prolonged use.

The hands-free design of the device also received positive responses. Users appreciated that the massager did not require them to hold or manually operate it during use.

**One of the users:**

"I love that I dont have to hold anything-just stick it and relax"

This feedback highlights the convenience and comfort that the product offered.

The other user mentioned that:

"It was perfect for working at a desk or relaxing on a couch."

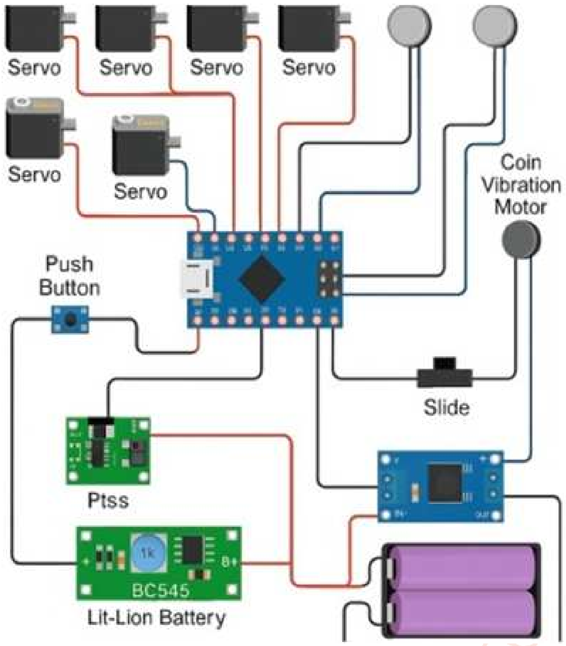
Pointing out the versatile nature of the design in different modes and in different settings.

**Feedback on the massage modes:**

It revealed that users could feel the distinctness between the gentle and intense modes. The gentle mode was described as soothing and appropriate for general relaxation, while the intense mode was found to be highly effective for targeting back stiffness and providing deeper muscle relief.

Users also provided suggestion for future improvements:
1. Some of them recommended adding an automatic timer to enhance convenience and allow the device to turn off after a set time.
2. Many other users suggested coming up with a wireless remote or a mobile application which could control the manual push button, in turn making the operation easier and help full for users

who are physically challenged with limited mobility.




3. Also, an update to a Bluetooth connection device for it to be easily used.

We have considered all the above suggestions and are planning to work on them later.

## IX. Conclusion and Future scope:

The whole document concludes that the smart hands-free octopus-shaped massager successfully demonstrates the potential of combining soft robotics, embedded systems, and user-centered design to create a compact and concise, skin-friendly massaging device.

Its key strengths are being a simple, portable design, and it offers a hands-free solution for relaxation and pain relief. The project ultimately showcases the potential of wearable massaging technologies for personal well-being.

### Future scope:

The document outlines several areas for future improvement to enhance the massager's functionality and user experience.

1. Bluetooth and mobile app integration: This allows for wireless control and customization of settings like mode, duration, and intensity through a mobile app.
2. AI-driven adaptability: To integrate AI that can adjust massage patterns based on the user's feedback and his or her needs.
3. Longer battery life: To improve usage time by using more efficient battery technology or energy-saving techniques.
4. Improved motor control: To optimize motor synchronization for more natural and synchronized movements of the tentacles.

## References:

[1] Arduino Official Documentation https://www.arduino.cc/en/Guide

[2] SG90 Micro Servo Motor Datasheet https://components101.com/motors/sg 90-servo-motor.

[3] Fritzing Circuit Design Tool https://fritzing.org

[4] Sustainable Development Goals United Nations https://sdgs.un.org/goals

[5] IDEO Design Thinking Process https://designthinking.ideo.com

[6] Soft Robotics Design Insights, Kim, S. et al. (2013), "Soft robotics: A bioinspired evolution in robotics", *Trends in Biotechnology*

[7] Embedded Systems with Arduino – Banzi, M. & Shiloh, M. (2014), Getting Started with Arduino, Maker Media

[8] Practical Electronics for Inventors – Scherz, P. & Monk, S. (2016), McGraw-Hill Education

[9] UX Research Basics – Nielsen Norman Group – https:/www.nngroup.com/ articles/ux-research-cheat-sheet

[10] R. Srilatha, G. Markandeyulu and V. Murty, "Effect of Co on the magnetic properties of YGdFe17Ga," *2006 IEEE International Magnetics Conference (INTERMAG)*, San Diego, CA, USA, 2006, pp. 917-917. https://doi.org/10.1109/INTMAG.2006.374948

[11] Y. Srilatha, R. Triveni, G. Markandeyulu, The structural and magnetic studies on off-stoichiometric Sm2Fe17-xCoxGa, Journal of

Magnetism and Magnetic Materials, Volume 630, 2025, 173382, ISSN 0304-8853, https://doi.org/10.1016/j.jmmm.2025.173382.

[12] The structural and magnetic studies on off-stoichiometric $YGdFe_{17-x}Co_xSi$ compounds, Y Srilatha, K Vagdevi, R Naidu, *AIP Conf. Proc.* 3263, 160076 (2025), https://doi.org/10.1063/5.0261305

[13] Stoichiometric Studies on Effect of Co on the Magnetic properties of $YGdFe_{17}Si$, R. Srilatha., ZKG INTERNATIONAL, 87- 93, Volume IX, Issue I, Jan 2024,

[14] https://www.researchgate.net/profile/Dr-Ramakuru/publication/383946385_stoichiometric_studies_on_effectof_coonthemagneticproperties_ofygdfe_17_si/links/66e1ca0cbd20173667cac03a/stoichiometric-studies-on-effectof-coonthemagneticproperties-ofygdfe-17-si.pdf

[15] Triveni, R., Srilatha, Y., Somani, P.R. *et al.* Facile synthesis of a NiO-based $Fe_2O_3$:$SiO_2$-rGO nanocomposite thin film and its application as a highly sensitive hydrogen sensor. *J Mater Sci: Mater Electron* 36, 909 (2025). https://doi.org/10.1007/s10854-025-14881-1

[16] K. B. Anoop Baby, R. Srilatha, Magnetostriction studies of thin nickel strips in perpendicular and parallel configurations, Materials Today: Proceedings, Volume 49, Part 3, 2022, Pages 690-692, ISSN 2214-785 https://doi.org/10.1016/j.matpr.2021.05.173

[17] R. Srilatha, Ravi, G. Markandeyulu and V. S. Murty, "Effect of Co on the Magnetic Properties of YGdFe17rm−rmxCormxGa," in *IEEE Transactions on Magnetics*, vol. 42, no. 10, pp. 2918-2920, Oct. 2006, https://doi.org/10.1109/TMAG.2006.879892.

[18] Magnetic properties of YGdFe17− x (Ga, Al) x (x= 0–8) R Srilatha, VS Murty, G Markandeyulu, *J. Appl. Phys.* 97, 10M503 (2005) https://doi.org/10.1063/1.1847291

[19] Agrosagenet: Self-Adaptive Intelligence to Address Global Food Demand and Crop Disease Detection and Diagnosis for Sustainable Precision Agriculture, Link to paper: https://theaspd.com/index.php/ijes/article/view/7372.

[20] $R_2Fe_{17}$ Intermetallics: A Review, Suhas Subramani, Srilatha. Y, DOI:https://doi.org/10.5281/zenodo.17120916