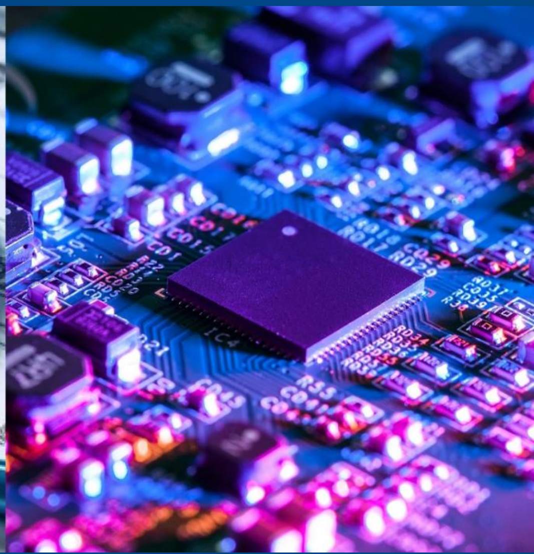
ISSN: 2582-7219

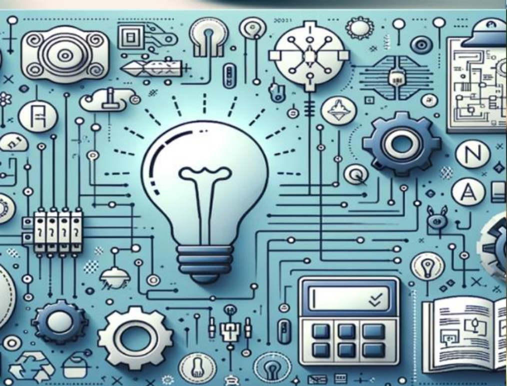




International Journal of Multidisciplinary Research in Science, Engineering and Technology

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)



Impact Factor: 8.206

Volume 9, Issue 3, March 2026

www.ijmrset.com ijmrset@gmail.com +91 6381 907 438 +91 63819 07438

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

TITAN OCTAPICK: Arduino Based Hand Gesture Controlled Robot with Octopus-Inspired Robotic Arm

Kiran Damodhar Phad [1], Pratiksha Kisan Pawar[2], Pratik Rajendra Lokhande[3], Tanish Yogesh Pahilwan[4], Mr.M.R.Raktate

Diploma in Mechatronics Sanjivani K.B.P. Polytechnic, Kopergaon, India[1]

Diploma in Mechatronics Sanjivani K.B.P Polytechnic , Kopergaon, India[2]

Diploma in Mechatronics Sanjivani K.B.P Polytechnic , Kopergaon, India[3]

Diploma in Mechatronic Sanjivani K.B.P.Polytechnic Kopergaon, India[4]

Diploma in Mechatronics Sanjivani K.B.P Polytechnic ,Kopergaon, India[5]

ABSTRACT: The project describes the design and implementation of TITAN OCTAPICK, an Arduino robot controlled by gestures of the user's hands, incorporating an octopus soft robotics arm. The main idea and objective of the research and development project are to overcome and obviate the need for conventional wired controllers and joystick control systems and instead use biologically natural mediums like gestures. The project consists of two main components: a transmitting unit and a receiver unit. The receiving unit includes an MPU6050 sensor utilizing hand position and processing it with an Arduino Nano, which then uses an Arduino Uno for wireless control. The project introduces an innovating gripping mechanism modeled on an octopus muscle hydrostat structure with adaptive wrapping and gripping abilities. The experiment shows successful response times and safety for manipulating objects**.**

KEYWORDS : Hand Gesture Control, Soft Robotics, Arduino, Octopus-Inspired Arm, MPU6050.

I. INTRODUCTION

The rapid evolution of robotics is shifting control paradigms away from rigid, pre- programmed systems toward intuitive, human-centric interfaces. The following paper presents an innovation at the juncture of the forefronts of gesture-controlled robotics and bio-inspired soft robotics-TITAN OCTAPICK. Traditional robotic systems use a complicated physical interface, which limits their flexibility and accessibility. The TITAN OCTAPICK makes use of a simple, natural interface-a Gesture Glove with an MPU6050 sensor. The capture of human hand motions (tilt, roll, and acceleration) is done in a wireless manner by an Arduino Nano and sent to the robotic platform controlled by an Arduino Uno. The core innovation is the Octopus-Inspired Robotic Arm. Drawing inspiration from the extraordinary flexibility of an octopus tentacle; this manipulator makes use of soft materials and cable-driven actuation based on the muscular hydrostat principle. The arm is now capable of accomplishing adaptive, 360° gripping, thus enabling the safe handling of fragile, irregular, or complex objects with much better results compared to conventional rigid grippers. TITAN OCTAPICK is a significant proof of concept demonstrating real-time, responsive control for safe human-robot collaboration using soft actuation. This work explores low-cost, open-source innovation and provides the foundation for next- generation intelligent robots that easily adapt to human intent.

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

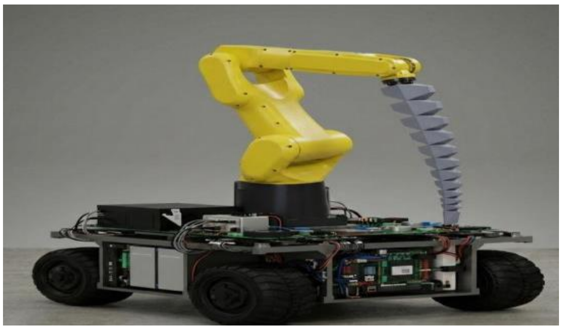


Figure 1: TITAN OCTAPICK

II. LITERATURE REVIEW

- **Dynamic Model of the Octopus Arm. I. Biomechanics of the Octopus Reaching Movement**

Author :- Yoram Yekutieli, Roni Sagiv-Zohar, Anit Aharonov, Yaakov Engel, Binyamin Hochner, and Tamar Flash Department of Neurobiology and 2Interdisciplinary Center for Neural Computation, Hebrew University, Jerusalem; and 3Department of Computer Science and Applied Mathematics, Weizmann Institute of Science, Rehovot, Israel

Summary :- The study showed that an octopus can reach out simply by sending a wave of muscle contractions down its arm. This wave stiffens and straightens the arm while minimizing resistance from water — no bones needed.

- **Control of Octopus Arm Extension by a Peripheral Motor Program**

Author :- German Sumbre ,Yoram Gutfreund ,Graziano FiTamar Flash Binyamin Hochner

Summary :- Researchers found that even when the arm is disconnected from the brain, it can still extend normally if it's stimulated mechanically or electrically. This means
the basic movement pattern (motor program) is already built into the arm's own nerves, not just the brain.

- **Motor control of flexible octopus arms**

Author :- Germán Sumbre, Graziano Fiorito, Tamar Flash & Binyamin Hochner

Summary :- Animals with rigid skeletons can rely on several mechanisms to simplify motor control.

- **Dynamic Model of the Octopus Arm. II.**

Author:- Yoram Yekutieli, Roni Sagiv-Zohar, Binyamin Hochner and Tamar Flash Department of Neurobiology and 2Interdisciplinary Center for Neural Computation, Hebrew University, Jerusalem; and 3Department of Computer Science and Applied Mathematics, Weizmann Institute of Science, Rehovot, Israel

Summary :- The octopus controls its arm by sending a wave of muscle activation along it . Only two factors matter , signal strength and speed.
Stronger signals make the arm more stable, while speed controls how it moves, allowing smooth and precise reaching. Arrangements, a concept central to the TITAN OCTAPICK's gripper design.

III. METHODOLOGY

The system architecture includes two main modules: the Transmitter or the Gesture Glove and the Receiver or the Robot Base plus Arm.Hardware Architecture The hardware setup is shown in Figure 1.

Transmitter Unit: The user will wear a glove interfaced with an MPU6050 sensor (6- axis accelerometer and gyroscope). This sensor detects tilt, pitch, and roll from the hand. Further, an Arduino Nano processes this data and sends commands through the wireless module (nRF24L01 or Bluetooth HC-05).

Receiver Unit: The robot base is equipped with an Arduino Uno, which receives the data. It uses an L298N motor driver for DC motors that are responsible for the movement of the vehicle. Simultaneously, it controls the servo motors driving the robotic arm with the octopus-inspired gripper.

Circuit Structure The system block diagram shows that the power supply consists of a 12V battery for the motors and a regulated 5V for the servo motors and microcontrollers. Signal flow goes from the MPU6050, to Arduino Nano, across the wireless link, to Arduino Uno, and finally to the actuators.

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

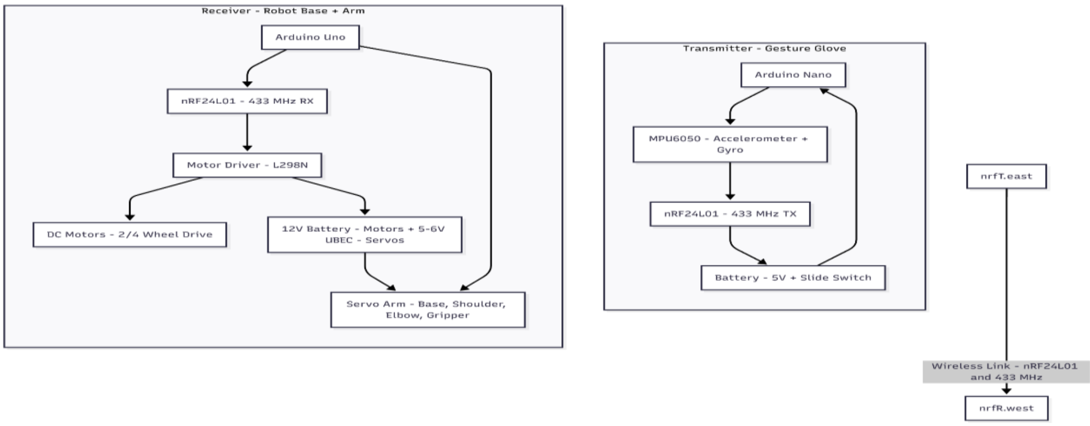


Figure 2: Block Diagram of Transmitter and Receiver Units

Octopus-Inspired Arm Design: This arm works on the principle of the muscular hydrostat. The cable-driven mechanism used by the servo motors pulls the cables to curl the arm and releases them to straighten the arm. It allows 360-degree freedom in the range of motion and flexible wrapping around objects. Software Algorithm The software is developed in the Arduino IDE, and the algorithm goes as follows:

MPU6050 and wireless communication initialization. Read the sensor values (orientation) continuously. Compare data against the predefined thresholds to determine the gesture. Send the command to the receiver, instructing it to drive certain motors

IV. RESULTS AND DISCUSSION

TITAN OCTAPICK was tested for response time, gripping capability, and operational range. Performance Analysis The system interpreted hand gestures into robotic motion with a negligible delay, proving the effectiveness of the MPU6050 and wireless link. The octopus-inspired gripper successfully displayed how it could wrap around irregular objects like bulbs or fruits, which most rigid grippers fail to hold securely. System Specifications The operational parameters of the developed prototype are summarized in Table 1.

Table 1: System Specifications

Parameter	Component / Value
Microcontrollers	Arduino Uno (Receiver), Arduino Nano (Transmitter)
Motion Sensor	MPU6050 (Accelerometer + Gyro)
Motor Driver	L298N
Actuators	DC Motors (Base), Servo Motors (Arm)
Power Source	12V Battery
Battery Life	Approx. 30-40 minutes

- **Gesture control: an emerging paradigm.**

This research legitimates the transition to natural, intuitive HRI by removing dependence on conventional controllers. Control by gestures simplifies operation and opens robotics to non-experts, making further applications possible in domains such as assistive technologies, industrial automation, and defense in hazardous environments. The utilization of Arduino microcontrollers provided a low-cost, open-source platform, hence this advanced system is highly accessible for educational and research use

- **Innovation in Soft Robotics**

The most significant novelty is the Octopus-Inspired Robotic Arm. Based on the principle of a muscular hydrostat, movement by contraction of muscles rather than by rigid linkages, the soft arm realizes 360° adaptive gripping. This bio-inspired design enables safe human-robot collaboration due to soft actuation and overcomes the drawbacks of traditional rigid manipulators in handling fragile materials such as fruits or bulbs.

V. CONCLUSION AND FUTURE WORK

TITAN OCTAPICK successfully demonstrates a functional prototype: the intuitive, wireless hand gesture control merged with an octopus-inspired soft robotic arm.

- **Future work will focus on**

AI Gesture Learning: Incorporate deep learning-integrated gesture recognition, such as CNNs, or even vision-based tracking, to enable the detection of more complex dynamic hand gestures with high accuracy for better control and user experience. IoT-based control systems involve migration to an IoT architecture, such as MQTT/Cloud, that would enable long-range teleoperation and remote monitoring in hazardous or distant environments.

Actuation Upgrade: Replacing cable-driven actuation with SPAs would greatly enhance the payload capacity of this robot while retaining its gentle and adaptive gripping.

Endurance: Improved battery management for extended operating time.

REFERENCES

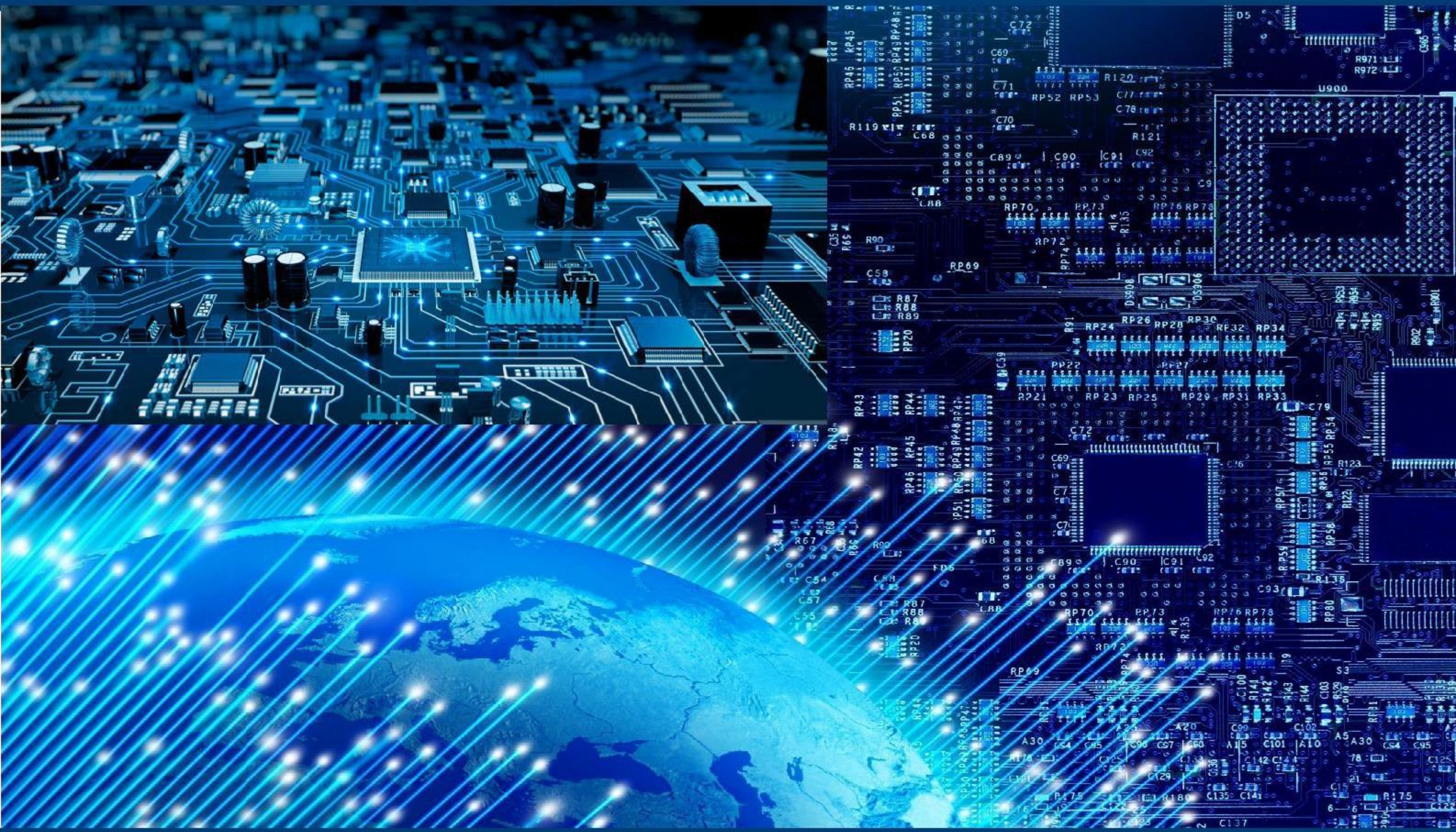
1. Y. Yekutieli, R. Sagiv-Zohar, R. Aharonov, Y. Engel, B. Hochner, and T. Flash, "Dynamic Model of the Octopus Arm. I. Biomechanics of the Octopus Reaching Movement," Journal of Neurophysiology, vol. 94, no. 2, pp. 1443–1458, 2005.
2. G. Sumbre, Y. Gutfreund, G. Fiorito, T. Flash, and B. Hochner, "Control of Octopus Arm Extension by a Peripheral Motor Program," Science, vol. 293, no. 5536, pp. 1845– 1848, 2001.
3. Y. Yekutieli, R. Sagiv-Zohar, B. Hochner, and T. Flash, "Dynamic Model of the Octopus Arm. II. Control of Reaching Movements," Journal of Neurophysiology, vol. 94, no. 2, pp. 1459–1468, 2005.
4. G. Sumbre, G. Fiorito, T. Flash, and B. Hochner, "Motor control of flexible octopus arms," Nature, vol. 433, pp. 595–596, 2005.
5. S. Kim, C. Laschi, and B. Trimmer, "Soft Robotic Grippers Inspired by Biological Muscular Hydrostats," Trends in Biotechnology, vol. 31, no. 5, pp. 287–294, 2013.
6. N. H. Prasad and A. M. Richard, "Hand Gesture Controlled Robot," International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, vol. 3, no. 4, 2014.
7. W. M. Kier and K. K. Smith, "The functional morphology of the tentacle of the squid... and the octopus," Journal of Morphology, vol. 185, no. 3, pp. 263–287, 1985. (Foundation of the "Muscular Hydrostat" principle mentioned in your Introduction).
8. C. Laschi, M. Cianchetti, B. Mazzolai, L. Margheri, and P. Dario, "Soft robot arm inspired by the octopus: I. From biological functions to artificial requirements," Bioinspiration & Biomimetics, vol. 7, no. 2, 2012. (Major reference for octopus-inspired arms).
9. M. Cianchetti, et al., "Design and development of a soft robotic octopus arm exploiting embodied intelligence," IEEE International Conference on Robotics and Automation (ICRA), 2011.
10. Arduino AG, "Arduino Documentation and Language Reference," [Online]. Available: https://www.arduino.cc/reference/en/.
11. TDK InvenSense, "MPU-6000 and MPU-6050 Product Specification Datasheet," Revision 3.4, 2013.

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

12. "Gesture Controlled Robot Projects," Instructables & GitHub Repositories, [Online]. Available: https://www.instructables.com.
13. IEEE Xplore Digital Library, "Search Results: Soft Robotics and Gesture Control," [Online]. Available: https://ieeexplore.ieee.org.



INNO SPACE
SJIF Scientific Journal Impact Factor

INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

निस्केयर
NISCAIR

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH IN SCIENCE, ENGINEERING AND TECHNOLOGY

| Mobile No: +91-6381907438 | Whatsapp: +91-6381907438 | ijmrset@gmail.com |

www.ijmrset.com