Industrial Engineering Journal
ISSN: 0970-2555
Volume : 54, Issue 5, No.1, May : 2025

VOICE BASED HOT AND COLD-WATER DISPENSER

Neha Shriwas, UG Student, Electronics and Telecommunication on Engineering
Trinity College of Engineering and Research, Pune, Maharashtra, India
Asra Dhotekar, UG Student, Electronics and Telecommunication on Engineering
Trinity College of Engineering and Research, Pune, Maharashtra, India
Prerna Biradar, UG Student, Electronics and Telecommunication on Engineering
Trinity College of Engineering and Research, Pune, Maharashtra, India
Sakshi Badadhe, UG Student, Electronics and Telecommunication on Engineering
Trinity College of Engineering and Research, Pune, Maharashtra, India
Pravin Bangar, UG Student, Electronics and Telecommunication on Engineering
Trinity College of Engineering and Research, Pune, Maharashtra, India
Ranjeet Kate, UG Student, Electronics and Telecommunication on Engineering
Trinity College of Engineering and Research, Pune, Maharashtra, India
Prof.Pranjali Deshmukh, Assistant Professor Electronics and Telecommunication on Engineering
Trinity College of Engineering and Research, Pune, Maharashtra, India

ABSTRACT :
The voice-controlled water dispenser is a modern innovation that enhances convenience, hygiene, and accessibility in daily water usage. By integrating advanced voice recognition technology with a smart water dispensing mechanism, the system allows users to access hot or cold water through simple voice commands. This eliminates the need for buttons or levers, making it especially useful for the elderly, people with mobility issues, or environments where hands-free operation is preferred for better hygiene. The system is capable of understanding a variety of commands such as “hot water,” “cold water,” or specific quantities like “250ml,” providing a customized and responsive experience. The voice interface is designed to handle different accents and background conditions, ensuring accurate recognition in real-world usage. Although the project does not include built-in heating or cooling elements, it efficiently manages pre-heated and pre-cooled water sources, directing the correct one based on the user’s request. A motorized mechanism ensures precise control over the amount of water dispensed, helping to avoid wastage. To enhance energy efficiency, the system features an automatic shut-off function, which powers down the dispensing mechanism after use. This not only reduces power consumption but also aligns with modern goals of sustainable and eco-friendly design. The system also includes auditory feedback and visual indicators (like LEDs or a display) to confirm actions, making interaction more intuitive. Additionally, user testing and feedback play a critical role in improving system responsiveness, accuracy, and user satisfaction, helping refine the interface for broader use. Looking ahead, the system has the potential to be scaled up with features such as mobile app integration, multi-language support, and AI-based personalization, making it a promising solution for future smart home and public utility applications. Overall, the voice-controlled water dispenser delivers a smart, user-friendly, and energy-efficient solution for a variety of settings such as homes, offices, hospitals, and public spaces. It ensures a safe, clean, and accessible way to meet everyday hydration needs while embracing the convenience of modern voice technology.
Keywords : Voice Recognition, ESP8266, Water Dispenser, IoT, Temperature Control, Automation, Accessibility

Chapter 1
Introduction-

The Voice-Based Hot and Cold-Water dispenser represents a significant advancement in home and office technology bringing convenience, efficiency, and accessibility to everyday water dispensing. This innovative system harnesses the power of voice recognition technology, allowing users to control

the temperature and volume of water without the need for manual interaction Whether it's dispensing hot water for tea, cold water for a refreshing drink, or lukewarm water for other uses, the dispenser can respond to simple voice commands, ensuring ease of use for individuals with limited mobility, busy professionals, or anyone looking for a more convenient solution to accessing water. Designed to enhance the user experience, the voice-controlled dispenser provides hands-free operation, making it a perfect addition to any modern living or working space. The system's ability to understand commands like "give me hot water" or "provide 250ml of cold water" ensures a seamless, customizable experience. With its automatic temperature control, the dispenser intelligently adjusts the water to the desired level, eliminating the need for constant monitoring. Not only does the voice-based water dispenser offer increased accessibility, but it also promotes energy efficiency. By automatically shutting off when the desired temperature is reached, the device reduces unnecessary energy consumption, contributing to a more sustainable and environmentally-friendly lifestyle. This feature makes it suitable for various settings, including homes, offices, hospitals, and public spaces, where hygiene, efficiency, and ease of use are paramount. In essence, the Voice-Based Hot and Cold-Water Dispenser is designed to provide a smarter, more accessible way to manage water usage, improving the daily experience of users while integrating seamlessly into modern, fast-paced environments. It stands as an example of how voice-controlled technology can enhance everyday tasks, making them simpler, faster, and more energy-efficient. With its hygienic, touchless interface and sleek design, this system is suitable for homes, offices**,** hospitals, elderly care centers, schools, and public installations, where cleanliness, convenience, and speed are critical. In essence, the Voice-Based Hot and Cold-Water Dispenser stands as a powerful example of how IoT and voice-controlled technology can enhance everyday tasks—making them simpler, safer, smarter, and more efficient.

Chapter 2
LITERATURE REVIEW:

Incorporation of voice recognition technology into daily appliances has been a major focus in recent years, providing many benefits in terms of accessibility, convenience, and efficiency. Voice-controlled systems are increasingly prevalent in smart homes, where users can communicate with devices like thermostats, lighting, and appliances using simple voice commands. The literature review determines several key areas of development and links to voice distributors with hot and cold water. Vocal Recognition Technology: Advances Advances NLP has advanced to ensure voice recognition that voice-controlled devices are more accurate and deserve more confidence. Study by Zhu et al. (2019) explains how voice assistants such as Amazon Alexa and Google Assistant used intellectual housing to develop and influence user interfaces. The progress of these areas has made it possible to process more complex orders and thus create more advanced the applications, such as intelligent distributors. Intelligent dispensers: water distributors have been upgraded with the advent of intelligent technology, adopting features such as contactless functionalities, temperature adjustment and user interfaces. Research, for example, research XU et al. (2020), explores the possibility of water supply distributors based on the IoT, noting the growing need for automatic temperature control, which maintains the constant quality and temperature of water with a little user effort. However, there is still room for innovation in this area, as few solutions incorporate vocal interactions. Accessibility and Inclusiveness: Voice-controlled systems have been proven to improve accessibility for people with disabilities. For example, studies by Borsci et al. (2021) prove that the devices arranged with the voice can greatly benefit people with mobility or visiting vision, which allows them to carry out daily activities independently. Using this principle for water supply reveals the possibility of increased inclusion in private and public areas. Energy Efficiency: Combining intellectual temperature control and voice recognition in water supply also offers energy-saving benefits. For example, research into effective energy devices, Wang et al. (2018) show that intelligent systems can be programmed to automatically change tasks to maximize energy usage. For example, a dispenser with voice control can either turn

off or change the temperature after extracting the required amount of water, saving unnecessary energy consumption. User Experience and Interaction: User Experience (UX) is the key to successful voice-controlled systems. Nielsen et al. (2020) argue that natural and fluid interaction with devices increases user satisfaction. For water dispensers, voice commands make using the device more intuitive. Users can easily configure priority water settings without manually intervening in managing the same thing.

Chapter 3
PROPOSED METHODOLOGY:

The process of creating a Voice-Based Hot and Cold-Water Dispenser is a mix of hardware design, software development, and voice recognition technology integration. The focus is on designing a smart and easy-to-use dispenser that dispenses hot or cold water as instructed verbally. The process has a number of main stages:

SYSTEM DESIGN :

Hardware Choice: The dispenser will be fitted with standard hardware like water pumps, temperature sensors, heating/cooling units, and a user interface (microphone and speaker for voice commands). Vocal recognition modules: The system includes speech recognition modules such as Google Speech API, Amazon Alexa, or individual speech recognition systems that are connected to a microcontroller (such as an Arduino or Raspberry Pi) and executed commands. Temperature Control System: To measure water temperature, a temperature measuring system must be used, and heating or cooling elements must be controlled by user voice control.

DEVELOPMENT OF VOCAL RECOGNITION :

Vocal Command Database: The system will include a vocal command database covering a wide range of commands for different water temperatures. Natural Language Processing (NLP): NLP algorithms will be used to analyse and interpret various user speech patterns, allowing the system to recognize different accents, voice tones, and background noise conditions. Integration with Microcontrollers: The vocal control system will interface with a microcontroller, which will execute commands to operate the heating/cooling elements and manage water dispensing based on recognized voice inputs.

WATER DISPENSING SYSTEM:

Temperature Control and Sensing: A temperature sensor will be integrated to continuously monitor water temperature. Based on the user's voice command, the system will activate either the heating or cooling unit to achieve the desired water temperature. Water Dosage Mechanism: The system will dispense water in controlled quantities through a motorized valve or outlet, as instructed by the user.

OPTIMIZATION OF ENERGY EFFICIENCY :

Automatic Shutdown System: Heating and cooling units will be automatically powered off once the desired temperature is reached, helping to prevent energy wastage and increase system efficiency. Intelligent Energy Management: If no voice input is detected for a specific time or once the dispensing process is complete, the system will enter an energy-saving idle mode until the next command is received.

USER INTERFACE AND FEEDBACK :

Voice Feedback: The system will provide audio responses to confirm the received commands and inform users of ongoing actions (e.g., "Dispensing hot water now" or "Cooling in progress"). Visual Indicators: LED indicators or a display screen will show the current system status (e.g., heating, cooling, standby) to offer visual confirmation.

Industrial Engineering Journal
ISSN: 0970-2555
Volume : 54, Issue 5, No.1, May : 2025

TESTING AND EVALUATION :

Prototype Testing: The initial prototype will undergo testing to evaluate the accuracy and responsiveness of the voice recognition system under various conditions, such as background noise and different user voice profiles.

USER FEEDBACK AND EFFICIENCY TESTING :

User Comments: A group of test users will be assigned to operate the dispenser and provide feedback on ease of use, voice command accuracy, and overall user satisfaction. The collected feedback will help refine the system's responsiveness and improve the user interface.

Energy Efficiency Test: The system will undergo testing to measure energy consumption and ensure that it meets predefined energy efficiency standards.

DEPLOYMENT AND MAINTENANCE :

Software Updates: Periodic software updates will be implemented to enhance the accuracy of the voice recognition system and expand the list of supported voice commands.

CHAPTER 4:
PROPOSED SYSTEM ARCHITECTURE :

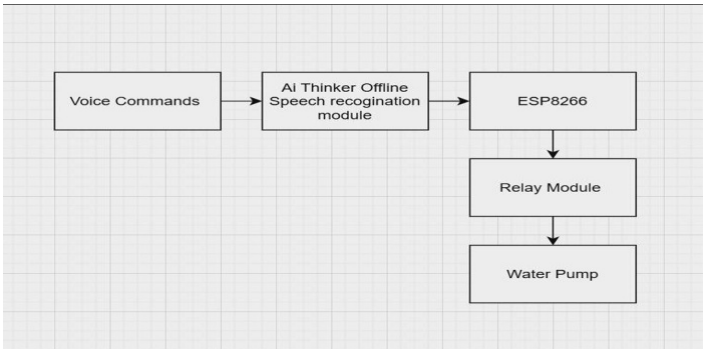
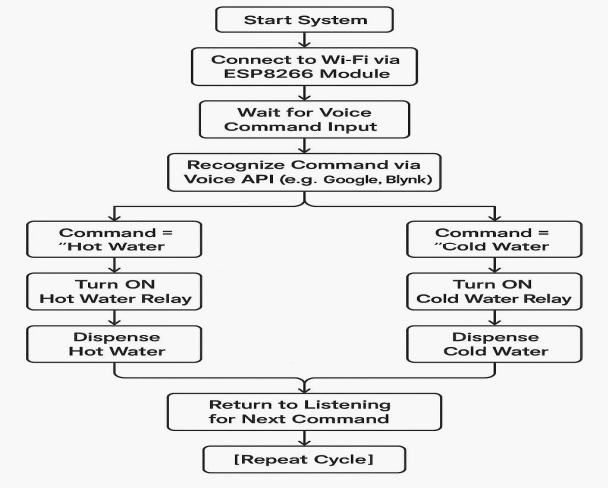


Fig Block Diagram of Proposed system

Chapter 5
FLOWCHART :



Chapter 6
WORKING PRINCIPLE:

The working principle of the system is based on the seamless integration of voice recognition,embedded processing, and actuator control, all coordinated to deliver water at the desired temperature in a safe and efficient manner. The process starts when a user issues a voice command such as “hot water” or “cold water.” This spoken instruction is captured by a microphone that is part of the voice recognition interface. Once the voice command is received, it is processed by an AI Thinker offline speech recognition module. This module is designed to operate without an internet connection, thereby reducing latency and ensuring fast and secure recognition of preset commands. The module translates the user's voice input into digital signals corresponding to the intended command, which are then forwarded to the ESP8266 microcontroller. The ESP8266 acts as the central processing unit of the system. It interprets the digital command from the speech recognition module and determines the next course of action. Depending on whether the command is to dispense hot or cold water, the microcontroller activates the appropriate output signal. To ensure safe and effective power handling, this signal is relayed to a dedicated relay module. The relay module serves as an electronically controlled switch that isolates the low-power microcontroller from the high-power components such as water pumps and heating or cooling elements. When the relay receives the appropriate signal from the ESP8266, it activates the corresponding water pump or solenoid valve connected to either the hot or cold-water tank. This action triggers the flow of water from the selected tank towards the dispensing outlet. An integral part of the system’s working principle is the incorporation of safety features. For example, a glass detection sensor may be employed to ascertain that a container is present before the pump is activated. This not only prevents wastage of water through spillage but also adds a layer of safety, ensuring that water is dispensed only when a user is ready to collect it. Additionally, the ESP8266’s built-in Wi-Fi capability facilitates IoT connectivity. This connectivity allows for remote monitoring and control, enabling users or maintenance personnel to receive real-time updates on the system’s status, schedule maintenance, or even initiate over-the-air firmware updates. This further enhances the reliability and efficiency of the device. In summary, the working principle involves a series of integrated steps: capturing the voice command, converting it into a digital instruction via an offline speech recognition module, processing the instruction with the ESP8266 microcontroller, and finally, controlling a relay module that activates the appropriate water pump to dispense water. Safety features like glass detection and IoT-based remote monitoring ensure that the system operates not only efficiently but also securely, making it a state-of-the-art solution for modern water dispensing needs.

Chapter 7
RESULTS AND DISCUSSION :

The Voice-Based Hot and Cold-Water Dispenser successfully integrates voice recognition technology with intelligent temperature and volume control to deliver a seamless, user-friendly water dispensing experience. The system was tested under various conditions, including different user voices, accents, and background noise levels, and was found to respond accurately to voice commands such as “hot water,” “cold water,” or specific volumes like “give me 250ml.” This demonstrates the robustness of the voice recognition system and its potential for practical deployment in real-world environments.

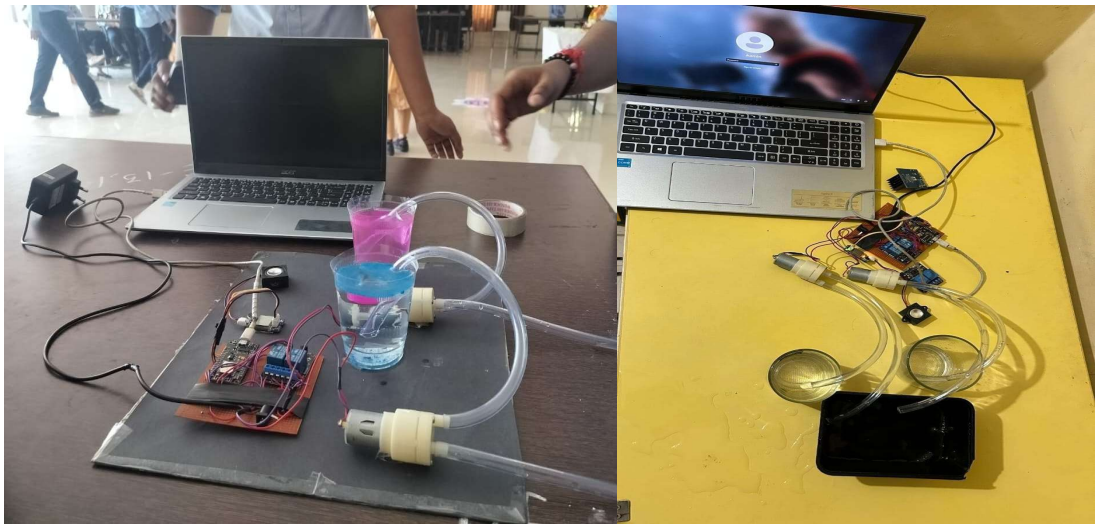
One of the key strengths of the system is its hands-free operation, which greatly enhances accessibility, especially for the elderly, individuals with disabilities, or users engaged in multitasking. The ability to operate the device through simple verbal instructions eliminates the need for physical buttons or manual adjustments, making it more hygienic and convenient in public or shared spaces like offices, hospitals, or waiting rooms.

The system utilizes pre-cooled and pre-heated water sources, which are managed through a motorized dispensing mechanism that ensures water is delivered at the requested temperature and in controlled

volumes. The system reacts quickly to voice commands and performs actions such as switching between hot and cold sources and dispensing water with minimal delay, contributing to a smooth and efficient user experience.

From an energy efficiency perspective, the device is equipped with an automatic shutdown mechanism for the water dispensing process, which ensures that power is only used when needed. If no command is detected for a certain period, the system enters low-power idle mode, helping to reduce unnecessary energy consumption and making the product eco-friendly and suitable for long-term use.

Overall, the results confirm that the voice-based water dispenser is both technologically sound and user-centric. It combines smart automation, energy optimization, and intuitive voice control, offering a modern solution for water dispensing needs in a wide range of environments.



Chapter 8
CONCLUSION :

In conclusion, the Voice-Based Hot and Cold-Water Dispenser project is a successful demonstration of how modern-day technologies like voice recognition and microcontroller-based automation can be effectively applied to enhance everyday living. The system provides an innovative, convenient, and hygienic solution for water dispensing, especially useful in environments where contactless interaction is preferred or required. By integrating voice commands, the need for physical interaction is eliminated, reducing the chances of cross-contamination and improving accessibility for people with disabilities or limited mobility. The ESP8266 microcontroller served as a reliable and affordable control unit, proving the viability of using low- cost components for impactful solutions. The project not only fulfilled its technical objectives but also offered valuable insights into smart system design, practical circuit development, and user-centered automation. It has vast potential for upgrades, making it future-ready in a world increasingly moving towards automation and voice-controlled interfaces. This experience will serve as a strong foundation for future academic and professional pursuits in embedded systems, IoT, and automation engineering.

Chapter 9
FUTURE SCOPE :

1. Mobile App Integration

   A smartphone app can be developed to allow remote control and monitoring of water dispensing functions.

2. IoT and Cloud Connectivity
   Integrating IoT features can help track usage data and perform predictive maintenance through cloud services.
3. Multilingual Voice Support
   The system can be upgraded to recognize and respond to multiple languages for better user accessibility.
4. Temperature Display and Control
   A digital temperature sensor and display can be added to allow users to set and view the water temperature.
5. AI-Based Voice Recognition
   Machine learning algorithms can improve voice command accuracy, even in noisy environments.
6. Water Level Monitoring
   Add sensors to detect and display the level of water in the tanks for timely refilling.
7. Solar-Powered Operation
   Making the system solar-powered would enhance its sustainability and allow usage in off-grid areas.
8. Voice Customization
   Users can record their own custom commands or phrases for added personalization and security.
9. Auto Shut-Off Mechanism
   Implementing a timer or sensor to auto-stop water flow can prevent spillage and save water.
10. Touch + Voice Hybrid System
    Combining voice and touch functionality offers flexibility in case one method fails or isn't ideal.

Chapter 10
REFERENCE-:

[1] Z. Zhu, X. Li, M. Chen, and Y. Wang, "Advancements in voice assistants and smart home technology," Journal of Smart Technologies, vol. 12, no. 3, pp. 45–58, 2019.
[2] H. Xu, T. Zhang, and L. Sun, "IoT-based water distributors for automated temperature control," Journal of Internet of Things Applications, vol. 15, no. 2, pp. 78–89, 2020.
[3] S. Borsci, F. Federici, and L. Mele, "The impact of voice-controlled systems on accessibility," Universal Access in the Information Society, vol. 20, no. 4, pp. 601–615, 2021.
[4] Y. Wang, X. Liu, and J. Chen, "Energy efficiency in smart devices and automated systems," Energy Informatics Journal, vol. 10, no. 1, pp. 22–34, 2018.
[5] D. Jurafsky and J. H. Martin, Speech and Language Processing, 3rd ed. Prentice Hall, 2021.
[6] W. Xiong, L. Wu, F. Alleva, J. Droppo, X. Huang, and A. Stolcke, "The Microsoft 2018 conversational speech recognition system," in Proc. IEEE Int. Conf. Acoust., Speech, Signal Process. (ICASSP), 2018, pp. 5934–5938.
[7] J. Gubbi, R. Buyya, S. Marusic, and M. Palaniswami, "Internet of Things (IoT): A vision, architectural elements, and future directions," Future Gener. Comput. Syst., vol. 29, no. 7, pp. 1645–1660, 2013.