# IOT BASED TEMPERATURE CONTROLLED SMART WATER HEATER

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## ABSTRACT

Water heaters are generally required in homes, hostels, hospitals, & industries. However, conventional water heaters consume high electricity & do not give accurate temperature control. This project displays an IoT-based temperature controlled smart water heater system that automatically monitors & controls water temperature. The system needs a temperature sensor to constantly measure the water temperature. The microcontroller processes the temperature data & controls the heating element through a relay module. When the water reaches the set temperature, the heater automatically turns OFF to avoid overheating & conserve energy. Using IoT technology, the temperature data can be monitored remotely through a mobile application or cloud platform. This assures safety, energy productivity, & user convenience.

## INTRODUCTION

The IoT Based Temperature Controlled Smart Water Heater is developed to monitor & control water temperature automatically. The system uses a temperature sensor to measure water temperature regularly. A microcontroller processes this data & controls the heating element through a relay module. IoT connectivity permits remote monitoring & control via mobile applications or cloud platforms, increasing energy efficiency, safety, & user convenience.

Water heaters are generally used in residential buildings, hostels, hospitals, & industrial environments for supplying hot water. Traditional water heating systems operate individually & often lack precise temperature control, leading to energy loss, excessive heating, & potential safety threats. With enhancing energy demands & the need for smart automation, integrating IoT technology into water heating systems has become necessary.

## LITERATURE SURVEY

Recent advancements in smart home automation systems highlight energy conservation & intelligent appliance control. Different studies have executed microcontroller-based water heater systems using temperature sensors such as DS18B20 & LM35 for enhanced precision & digital output stability.

IoT-allowed temperature monitoring systems using platforms like Blynk & ThingSpeak have illustrated real-time data logging & remote control abilities. Research reveals that integrating Wi-Fi modules such as ESP8266 and ESP32 increases system flexibility and decreases hardware complexity.

Earlier systems mainly dedicated on monitoring temperature but lacked automatic shutoff mechanisms & cloud integration. Some designs executed basic ON/OFF control without energy optimization. The introduced system increases existing methods by integrating automatic temperature regulation, IoT-based monitoring, energy-saving control logic, & real-time safety alerts into a united framework.

## PROPOSED SYSTEM

The proposed system is an intelligent water heating unit that automatically controls and monitors water temperature using sensor feedback and IoT communication. It ensures precise temperature regulation and remote accessibility.

### A. System Overview

The system contains a temperature sensor mounted inside the water tank to constantly measure water temperature. The microcontroller processes the sensor data & compares it with a predetermined temperature setpoint. Based on the comparison, the controller performs a relay module to switch the heating element ON\OFF.

When the temperature lowers below the desired value, the heater is started. When the temperature achieves the setpoint, the system automatically turns OFF the heater to avoid

excessive heating. The temperature data is forwarded through a Wi-Fi module to a cloud platform, enabling users to monitor real-time temperature via a smartphone application or web dashboard. Optional LCD display & buzzer indicators give local monitoring & alert signals.

## B. Key Components

- **Microcontroller (Arduino / ESP8266 / ESP32)**

Performs as the main processing unit. It reads temperature data, implements control logic, adjusts Wi-Fi communication, & regulates the relay module.

- **Temperature Sensor (DS18B20 / LM35)**

Measures water temperature precisely & converts it into electrical signals for processing.

- **Relay Module**

Acts as an electronic switch to regulate the high-power heating element securely.

- **Buzzer / Indicator LED**

Gives alerts when temperature arrives at a critical or preset level.

- **Power Supply**

Gives regulated voltage to all system components.

- **Breadboard / PCB & Connecting Wires**

Used for circuit assembly & electrical connections.

- **Heating Element**

Produces heat to enhance water temperature.

- **Wi-Fi Module**

Permits wireless data transfer to cloud platforms for remote monitoring.

- **LCD Display (Optional)**

Shows real-time temperature & system status.

- **Cloud Platform (Blynk / ThingSpeak)**

Stores & displays temperature data for remote access & monitoring.

## C. Working Principle

1. The system is energized using a regulated power supply.

2. The temperature sensor constantly measures water temperature.

3. The sensor transmits analog/digital data to the microcontroller.

4. The microcontroller compares the measured temperature with the preset setpoint.

5. If the temperature is under the setpoint, the relay module switches ON the heating element.

6. The heating element improves water temperature.

7. When the temperature arrived at the preset value, the microcontroller switches OFF the relay.

8. Temperature data is sent to the cloud platform via Wi-Fi.

9. Consumers monitor current temperature through a mobile application.

10. LED or buzzer gives visual/audible alerts for system status.

11. The process repeats regulartly for constant temperature control.

### D. Advantages

- Ensures accurate & automatic temperature control
- Gives real-time temperature logging
- Reduces  manual intervention
- Avoids overheating & enhances safety
- Enhances heater lifespan
- Suitable for smart home integration
- Decreases electricity consumption
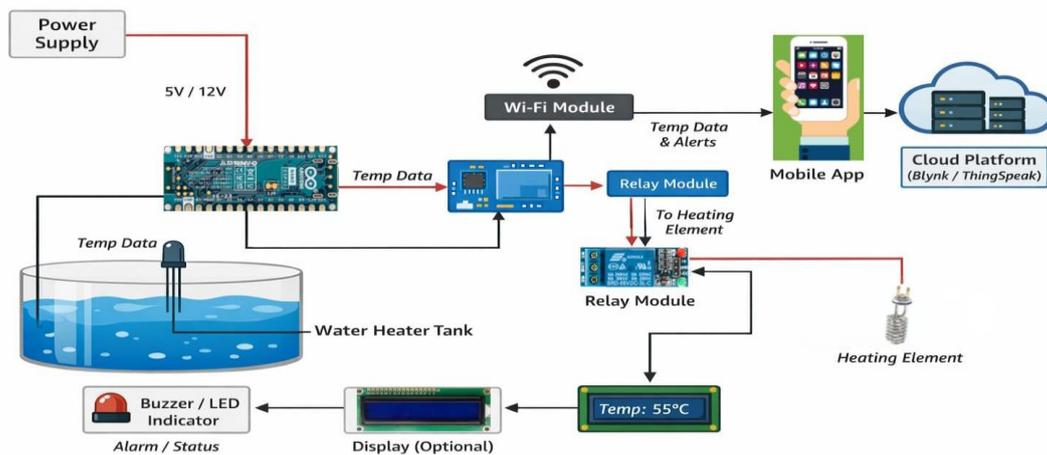- Allows remote monitoring & control

### E. Application

- Industrial water heating processes
- Smart home automation systems
- Hospitals & healthcare facilities
- Hotels & commercial buildings
- Residential water heating systems
- Hostels & apartments

**Block Diagram:**
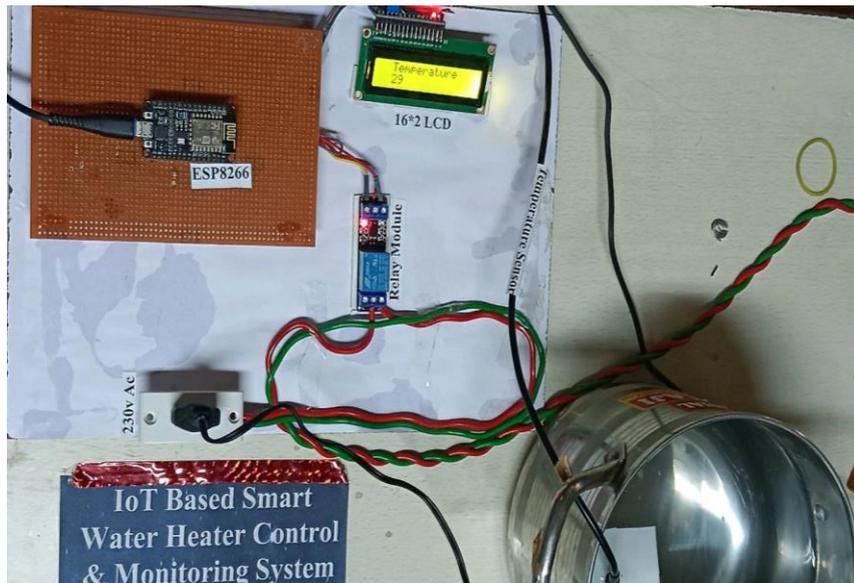


**Fig. Hardware Prototype of IoT Based Temperature Controlled Smart Water Heater.**

**Circuit Diagram:**



**IOT- Based Temperature Controlled Smart Water Heater**

## RESULTS

The designed IoT Based Temperature Controlled Smart Water Heater system performed successfully under testing conditions. The temperature sensor precisely measured water temperature & sent the data to the microcontroller devoid of significant error. The controller effectively compared the measured temperature with the preset value & controlled the relay module accordingly. The heating element switched ON and OFF individually at the desired threshold, avoiding excessive heating & decreasing unessential power consumption. Real-time temperature data was successfully transmitted to the cloud platform & displayed on the

mobile application, allowing remote monitoring. Overall, the system displayed reliable performance, enhanced safety, & increased energy efficiency compared to conventional manual water heaters.

## CONCLUSION

The IoT Based Temperature Controlled Smart Water Heater system successfully displays an intelligent & energy-efficient method to water heating applications. The project effectively integrates a temperature sensor, microcontroller, relay module, heating element, and IoT communication platform to attain automatic temperature monitoring & control. The system constantly measures the water temperature & compares it with a predetermined setpoint, ensuring accurate regulation through automatic ON/OFF control of the heating element.

One of the major achievements of this system is the precaution of overheating & unessential energy consumption. By automatically turning OFF the heater once the desired temperature is achieved, the system decreases electricity wastage & increases overall safety. The integration of Wi-Fi connectivity & cloud platforms allows real-time monitoring & remote access through a mobile application , enhancing user convenience & operational flexibility.

The experimental results confirmed constant performance, precise temperature sensing, reliable relay switching, & effective IoT communication. Even in the lack of internet connectivity, the local automatic control mechanism persists to function correctly, ensuring secure & reliability. Compared to conventional manual water heaters, this system offers better efficiency, automation, & intelligent control.

## FUTURE WORK

In future advancements, the system can be increased by executing advanced control algorithms such as PID control for more accurate temperature regulation. Additional secure features like water level sensors can be integrated to avoid dry heating conditions. The project can also consists mobile app-based temperature setpoint adjustment for better user control. Integration with restorable energy sources such as solar water heating systems can further increase energy efficiency. Voice assistant compatibility & AI-based energy usage analysis may also be added to make the system more intelligent & suitable for advanced smart home environments.

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