IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 5, November 2025
Impact Factor: 7.67

Integrated Multi-Utility Smart Meter with Home Automation

Naveenkumar H[1], Likhith E[2], Linganagouda A M[3], Pavan Shyavi [4], S G Manoj[5]
[12]Professor, CS&E Dept, Proudhadeveraya Institute of Technology, Hosapete, Karnataka, India
[345]Students, CS&E Dept, Proudhadeveraya Institute of Technology, Hosapete, Karnataka, India

Abstract: *This paper presents the design and development of theIntegrated Multi-Utility Smart Meter with Home Automationa Smart Meter system offers an integrated and intelligent solution for monitoring and controlling electricity, water, and gas consumption using an ESP32 microcontroller. The system provides a user-friendly approach to household resource management and operates in two modes—Auto and Manual—selectable through a push-button interface. Users can recharge their utility balances through a Telegram-based payment system, after which the corresponding loads, such as an AC bulb (electricity), DC fan (water), and DC LED (gas), are automatically activated. This unified design enhances automation, convenience, and efficiency in smart home utility management.*

Keywords: Smart Meter, IoT-Based Monitoring, Integrated Utility Management, ESP32, Auto and Manual Mode, Telegram Payment System, Smart Home Automation, Electricity Water Gas Control

I. INTRODUCTION

The project presents an integrated IoT-based smart metering system that monitors electricity, water, and gas using a single ESP32 controller. It enables real-time usage tracking, prepaid balance deduction, safety alerts, and remote control through Telegram. Auto and Manual modes allow flexible operation while gas and fire sensors enhance safety. The system reduces manual readings, prevents wastage, and brings automation to modern households.

II. LITERATURE SURVEY

Rajesh, M., & Kumar, A. [1] (2022)This paper introduces an IoT-based smart energy meter for accurate power monitoring. It focuses on real-time data collection to improve consumption visibility. Cloud connectivity ensures continuous access to usage information. The system reduces manual errors and enhances efficiency. Overall, it demonstrates how IoT modernizes traditional energy metering.

Kaur, P., & Sharma, D. [2] (2021)This study presents a multi-utility smart meter built using the ESP32 controller. It integrates electricity, water, and gas monitoring into a single device. Wireless communication enables real-time tracking of consumption. The design focuses on cost-effectiveness and user convenience. The work highlights ESP32 as an efficient platform for multi-utility systems.

Bhatia, R., & Singh, S. [3] (2020) This paper explores integrating gas and fire sensors into IoT home automation. The system provides real-time alerts for hazardous situations. Sensor data is transmitted to improve home safety and responsiveness. Remote notifications ensure users are informed instantly. The study emphasizes the role of IoT in enhancing safety mechanisms.

Alvi, A. N. [4] (2023) This study examines controlling IoT devices through the Telegram platform. A Telegram bot is used for switching, monitoring, and receiving alerts. The approach simplifies interaction using a familiar messaging interface. It reduces the need for a separate mobile application. The work shows that messaging apps can effectively manage IoT systems.

Kumara, S. [5] (2022) This paper presents an IoT-based water flow monitoring system. Flow sensors measure real-time water usage and send data wirelessly. The system helps users understand and reduce water consumption. Alerts improve awareness of abnormal usage patterns. The study highlights IoT's role in efficient water resource management.

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 5, November 2025
Impact Factor: 7.67

OBJECTIVES

- To develop a unified smart meter that monitors electricity, water, and gas usage.
- To enable Telegram-based recharge, notification, and control functionalities.
- To integrated fire and gas sensors for real-time safety detection.
- To implement auto and manual operational modes for user flexibility.
- To design a cost-effective, energy-efficient, and scalable smart home solution.

III. SYSTEM DESIGN

Hardware Components

The hardware architecture of the 3-in-1 Smart Meter includes several sensing and control modules connected to the ESP32 microcontroller. The **Water Flow Sensor**, **Gas Sensor (MQ Series)**, and **Fire Sensor Module** continuously monitor water usage, gas leakage levels, and fire or high-temperature conditions. These sensors send real-time signals to the ESP32 for further processing. A **Mode Selection Push Button** allows users to switch between Auto and Manual operation, while the **LCD Display** provides feedback on system status, balance, alerts, and consumption data. The system is powered through a **regulated Power Supply Unit**, which delivers stable 5V/12V DC required for the ESP32, sensors, and relays. A **3-Channel Relay Module** is used to control the connected loads such as the AC bulb (electricity indicator), DC fan (water load indicator), and DC LED (gas load indicator), enabling automated ON/OFF switching based on system logic.

Software Components

The software architecture integrates IoT-based communication and automated control using the ESP32 microcontroller. The **Wi-Fi Network** serves as the communication medium, allowing the ESP32 to send and receive data packets securely over the internet. Through this network, the system interfaces with the **Telegram Bot API**, which acts as the user-interaction platform. Using Telegram, consumers can recharge balances, control loads, and receive instant notifications for events such as gas leakage, fire detection, or balance depletion. The ESP32 firmware is developed using Arduino-based programming, which manages sensor data acquisition, decision-making logic, relay control, and message handling. This combination of embedded software and cloud-based communication ensures seamless monitoring, automation, and user accessibility.

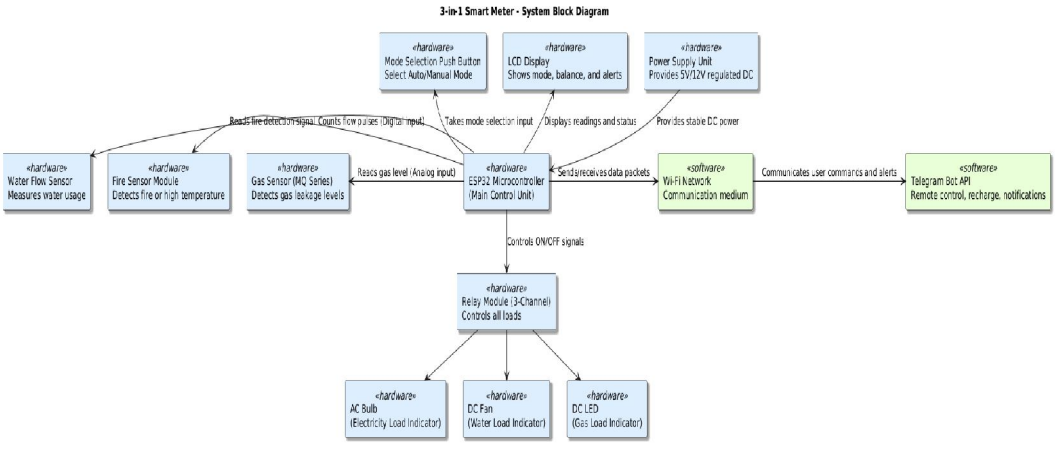


Fig: Flow diagram

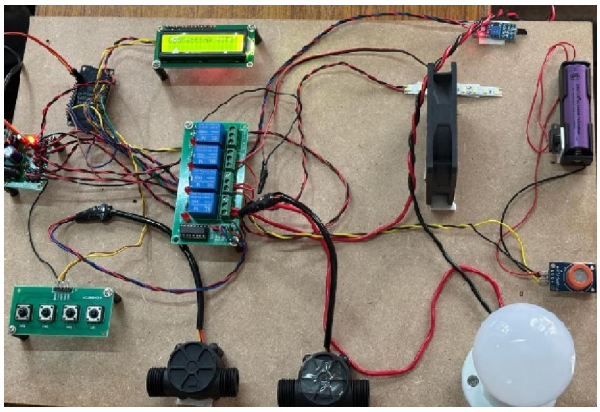
IV. RESULTS AND DISCUSSION

The results prove that the *3-in-1 Smart Meter* is not only functional but also highly adaptable for future smart home applications. Compared to traditional individual meters, this integrated system offers several key benefits:

- monitoring of three utilities.

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 5, November 2025
Impact Factor: 7.67

- Smart prepaid balance management system.
- Automatic disconnection of loads to prevent overuse.
- Safety automation through fire and gas detection.
- Remote control and monitoring via Telegram — eliminating the need for physical access.



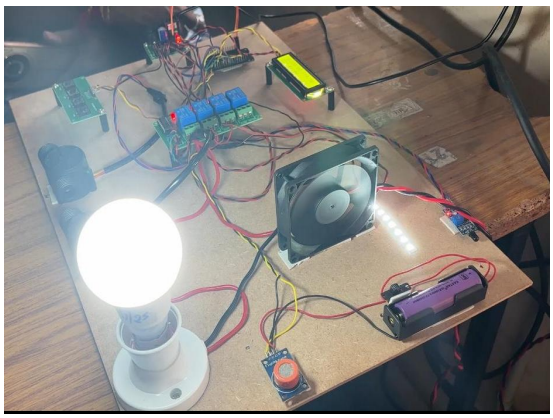


Fig. Working and wire connections

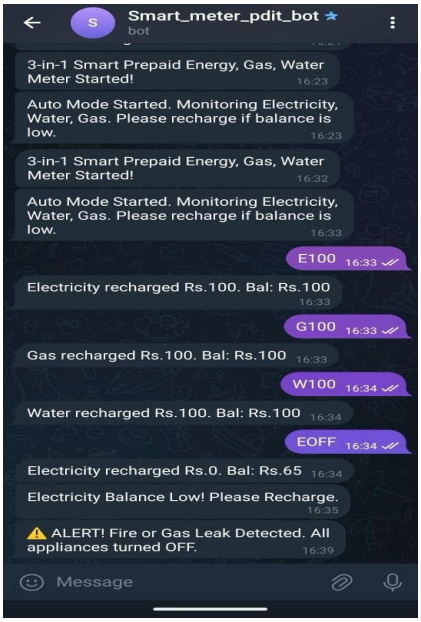


Fig. Results of 3 in 1 smart prepaid meter and selection of mode

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 5, November 2025
Impact Factor: 7.67

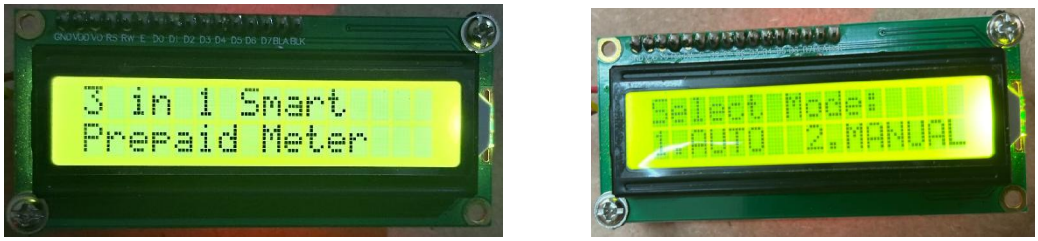


Fig. Image showing recharge and alert notification through telegram bot

V. CONCLUSION

The project successfully integrates multi-utility monitoring with automation, safety, and IoT communication. It improves resource management, prevents hazards, and offers scalable potential for smart home applications.3-in-1 Smart Meter provides an integrated solution for monitoring electricity, water, and gas using ESP32.Combines IoT communication and automation for efficient and cost-effective utility management. Solves issues of manual readings, delayed billing, and lack of real-time monitoring. Features smart recharging, automatic load control, and instant safety response to hazards. Telegram integration enables real-time alerts and remote control, enhancing convenience and safety.

REFERENCES

[1] Rajesh, M., & Kumar, A. (2022). IoT-Based Smart Energy Meter for Efficient Power Monitoring. IEEE Access.
[2] Kaur, P., & Sharma, D. (2021). Design of Multi-Utility Smart Meter Using ESP32. International Journal of Engineering Research.
[3] Bhatia, R., & Singh, S. (2020). Integration of Gas and Fire Sensors in IoT-Based Home Automation Systems. IJETT.
[4] Alvi, A. N., . (2023). Telegram-Based IoT Device Control and Monitoring. Journal of Embedded Systems.
[5] Kumara, S. (2022). Smart Water Flow Monitoring Using IoT. International Journal of Advanced Research in Electronics and Communication.