CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND OF THE STUDY

The global demand for electricity continues to rise with population growth, rapid industrialization, and the increasing reliance on electrical and electronic appliances. Efficient energy consumption and management are more important than ever to meet these demands while reducing environmental impacts and operational costs.

Traditional electricity metering systems primarily rely on analog or digital meters that are manually read by utility personnel. This process is often slow, labor-intensive, prone to errors, and incapable of providing real-time insights into energy consumption. Furthermore, delayed billing and inefficiencies in energy distribution have further contributed to power loss, increased utility costs, and revenue leakages for utility companies.

In recent years, the Internet of Things (IoT) has emerged as a powerful paradigm, revolutionizing the way data is collected, processed, and acted upon. By embedding sensors and communication modules in physical systems, IoT enables remote monitoring, data-driven automation, and proactive management across various industries—including the power sector.

Combining IoT with smart energy metering allows for:

- Real-time energy monitoring.
- Automated billing.
- Instant notifications on anomalies or excessive consumption.
- Remote access via mobile applications.

This project seeks to design and construct a functional prototype of an IoT-based energy meter that allows users to monitor their power consumption in real-time using an Android application. This integration not only improves transparency and reliability but also empowers users to adopt energy-saving habits, thereby contributing to a sustainable energy ecosystem.

1.1.1 DEFINITION OF TERMS

IoT (Internet of Things): A system of interrelated computing devices capable of transferring data over a network without requiring human interaction.

i. Energy Meter: A device that measures the amount of electrical energy consumed.
ii. Smart Meter: An advanced version of an energy meter with communication and control features.
iii. kWh (Kilowatt-hour): Standard unit for electrical energy usage.
iv. Microcontroller: A compact integrated circuit that controls electronic devices.
v. Android App: A software application designed to run on devices using the Android operating system.

1.2 PROBLEM STATEMENT

The traditional methods of energy monitoring and billing come with multiple shortcomings:

- Manual readings are time-consuming and susceptible to human errors.
- Lack of real-time monitoring makes it difficult for consumers to track consumption and control usage.
- Inefficiencies in billing systems lead to estimated charges, delays, or overbilling.
- Inability to promptly detect power theft or system faults contributes to revenue losses and service disruptions.
- No proactive user engagement—consumers often receive feedback only after billing, by which time energy-saving opportunities may have been lost.

This project aims to address these issues by providing a smart, accurate, and user-friendly energy monitoring solution that ensures timely feedback, remote accessibility, and greater efficiency for both end-users and utility providers.

1.3 AIM AND OBJECTIVES

Aim:

To design and construct an IoT-enabled energy meter integrated with an Android application that enables real-time monitoring, usage alerts, and data analytics.

Objectives:

- Design and build a reliable energy metering circuit using appropriate sensors.
- Integrate a microcontroller (e.g., ESP32) with IoT communication modules.
- Interface the system with cloud services for data storage and retrieval.
- Develop an intuitive Android application for users to track energy usage in real time.
- Implement alert systems to notify users about abnormal usage or thresholds.
- Ensure accuracy, stability, and security of the system during operation.

1.4 Significance of the Study

This study contributes to both academic research and practical implementation by empowering users to monitor and control their electricity usage habits, leading to reduced costs, while also enhancing operational efficiency for utility providers through improved load management, faster fault detection, and reduced reliance on manpower. It showcases innovation in the power sector by demonstrating how embedded systems and mobile platforms can revolutionize traditional electricity management. Additionally, the system promotes environmental sustainability by encouraging energy efficiency and reducing carbon footprints. Its scalable design allows for adaptation across various settings, including homes, schools, industries, and national power grids, with appropriate modifications.

1.5 SCOPE OF THE STUDY

This project focuses on:

Real-time measurement of electrical energy using current and voltage sensors.Transmission of data to a cloud platform using Wi-Fi or GSM.Development of an Android mobile application to display live consumption data and usage history.Alert generation based on user-defined thresholds.The project does not cover prepaid billing integration, advanced tariff structures, or industrial-grade load analysis.