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Electrify: Real-Time Analysis of Electricity Consumption and Bill Prediction

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Abstract:- In this scenario, it is essential to optimize power usage and promote efficient energy consumption. The increasing electricity demand has put a strain on natural resources and the environment. To address this, there is a need to optimize energy usage and reduce waste. The proposed system aims to help users achieve this by providing real-time analysis of electricity consumption and predicting monthly electricity bills using machine learning algorithms. The system employs a current sensor to track the energy consumed by each device in a house and estimates the monthly electricity bill. The user can set a monthly desired bill, and as the energy consumption approaches the set limit, the user is notified through the software application. The LSTM algorithm is used for predicting the monthly electricity bill based on the data collected from the current sensor. The algorithm takes into account various factors such as the energy consumed by different devices, time of day, and historical data to provide accurate predictions. Firebase is used as a cloud service for storing and processing data. It allows for efficient and secure storage of data and provides real-time updates, ensuring that users always have access to the latest information. The proposed system offers numerous benefits, including improved energy efficiency and cost savings.

I. INTRODUCTION

The ever-increasing demand for power has driven many natural resources to the verge of depletion. With the current technology of electricity meter, we need to go to the meter reading room and take down readings. Thus monitoring and keeping track records of your electricity consumption is a difficult task. In such a case, optimal power-sharing and efficient energy consumption are called into practice. So balancing the power supply and demand is one of the most fundamental problems for the operation and control of any electric power grid. To automate this, we can use the Internet of Things. IoT sensors can be used to monitor and optimize energy usage in buildings, reducing utility costs. In this project, we focus on one specific method to facilitate it: the prediction of electricity consumption and real-time analysis of electricity consumption. In this project, we will make IoT Based electricity energy consumption reading application using ESP32.

The purpose of this project is to develop a system for real-time analysis of electricity consumption and bill prediction. The project aims to address the problem of inefficient electricity usage and provide a solution through the implementation of machine learning algorithms. The project will involve the development of a system that utilizes data from a current sensor and a Wi-Fi module and incorporates various machine-learning techniques to analyze and predict electricity consumption patterns. The resulting system will be tested and evaluated through a series of user studies to ensure its accuracy and reliability.

II. LITERATURE SURVEY

The paper [1] analyses the benefits of demand response for utility companies and proposes prediction methods for households to determine whether changing to a time-of-use (TOU) rate plan from a progressive rate plan can reduce their electricity bill. The methods are developed using statistical learning techniques and tested using hourly electricity usage and bills obtained from ten apartment complexes through AMI, with one complex used for testing. The results show high decision accuracy and low root-mean-square error for the saving prediction. The proposed prediction methods only rely on historical data, which may not accurately predict future electricity usage and bill savings.

The paper [2] analyses the characteristics of electricity consumption data according to contract types and measures the performance of deep learning models in predicting future electricity consumption. The dataset includes hourly electricity consumption data over two years. The paper

applies three deep learning models (LSTM, GRU, and CNN) to the dataset. The results show that the LSTM model outperformed the other models for all contract types. The study only tests deep learning models and does not compare their performance to other predictive models.

The paper [3] proposes a machine learning-based technique to anticipate household electricity consumption using weather data. It is based on various machine learning algorithms and found that the Random Tree algorithm produced the best results, with a correlation coefficient of 75.7%. A potential limitation of this paper is that it only focuses on the relationship between weather conditions and electricity consumption.

In paper [4] reviews machine learning models for predicting energy consumption based on a one-year dataset from a shoe store. Linear Regression and Support Vector Regression achieved the best results with a success rate of 85.7%. The paper emphasizes the importance of predicting energy consumption for energy supply companies to adapt to customer behavior and plan supply chain adaptations. The limitation of this paper is the small size of the data set used for analysis.

III. EXISTING SYSTEMS

The existing system for monitoring electricity consumption in households typically involves manually reading the meter and calculating the usage. This can be a time-consuming process and can lead to inaccuracies. Smart meters have been introduced as an alternative to manually reading the meter, but they can be expensive to install and may not be available in all areas. In addition, there are several challenges in managing electricity consumption in households. Many households are not aware of their energy consumption patterns and do not know how to reduce their energy usage.

The existing system typically involves the use of traditional electricity meters, which do not provide real-time data on energy usage. Users are only able to view their electricity consumption after the end of each billing cycle and are not able to make adjustments to their consumption in real time. This can lead to wasteful energy consumption, which not only increases the electricity bill but also hurts the environment.

IV. PROPOSED SYSTEM

The system aims to address the limitations of the existing system by introducing a smart metering solution that continuously monitors the energy consumption of each device in a household and provides real-time feedback to the user. This is achieved by using a current sensor to measure the energy consumed by each device and then transmitting this data wirelessly to a microcontroller (ESP32) for processing. The processed data is then sent to a cloud-based backend (Firebase) for storage and analysis.

- *Energy Consumption Monitoring*

The energy consumption of each device is monitored using the SCT-013 current sensor, which is connected to the ESP32 microcontroller.

- *Data Preprocessing*

The raw energy consumption data is preprocessed to remove noise and prepare it for analysis. This involves filtering, normalization, and feature extraction.

- *Real-Time Analysis*

The preprocessed data is then used for real-time analysis using machine learning algorithms. The LSTM algorithm is used to predict the energy consumption for the upcoming period and estimate the monthly electricity bill.

- *User Notification:*

As the energy consumption approaches the user's set monthly bill limit, the user is notified through the software application, allowing them to adjust their energy consumption accordingly.

- *Cloud Storage*

The preprocessed data and analysis results are stored in Firebase cloud storage, allowing for easy access and retrieval.

- *Application Development*

The data and analysis results are presented to the user through a software application, allowing them to monitor their energy consumption and bill prediction in real time.

- *Continuous Learning:*

The machine learning algorithm is continually updated and refined based on new data, allowing for improved accuracy in energy consumption and bill prediction over time.

V. CONCLUSION

The proposed system of real-time analysis of electricity consumption and bill prediction using machine learning algorithms has several advantages over the existing systems. By continuously monitoring the energy consumption of each device, the system enables efficient energy consumption and optimal power-sharing, which can help in reducing energy costs and conserving natural resources. The use of a current sensor and machine learning algorithms for bill prediction makes the system accurate and reliable, providing users with an estimate of their monthly electricity bill.

The application developed as part of the system allows users to set a monthly desired bill and notifies them when energy consumption approaches the set limit. This feature can help users in budgeting their electricity costs and reducing unnecessary energy consumption. In addition, the use of cloud services such as Firebase for backend and training data storage provides scalability and flexibility to the system. This allows the system to handle large amounts of data and provide real-time updates to users.

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