Section A-Research paper
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PREDICTING ENERGY USAGE FOR SMART HOME USING SMART SWITCH

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ABSTRACT

The Smart switch is a switch that measures the future trends of electricity consumption, it is a product that is much needed in today's world where electricity plays an important role that is being consumed by industries and domestics on regular basis. The demand and supply of the relationship of electricity are always at troubles in critical times. It raises power cuts. The main reason for this problem is that prediction of the electricity consumption trend is not well predicted. Presently, we use the human expertise of senior members of the electricity board to predict the trends. However, it may not be well in a situation where the demands are changing dynamically. Hence, we need to analyse the prediction trends through computing models. Machine learning is a computing model that uses existing data to predict the future trends of existing data. This project presents a smart switch to predict the load trends of electricity in domestic using machine learning. This agent comes with hardware and software components. The hardware component is a programmed switch that supplies the current to the appliances. This switch is programmed in such way that it measures the current flow consumption and duration using Arduino and Current Sensors. The measured information will be sent to the database. The database will keep collecting information 24x7(until the switch is ON). The software component brings a backend processing unit that is connected to the databases. The collected Dataset is then processed through a machine learning analyzer to predict the trends of load consumption.

KEYWORDS: Machine Learning, Regression, Electricity prediction, ACS712Current Sensor.

I.INTRODUCTION

The Smart switch is a normal switch which is connected to current sensors. The current sensors collects the power consumption of the equipment which is connected to the switch.

This project brings an awareness to the people using the smart switch about their own consumption of electricity. This will help themselves saving money and the society in saving the resources. The supply and demand issues will also come to an end when people are more aware about their daily consumption of power. The supply and demand issues arise when the demand is more than the supply. The supply and demand issues in the recent times troubles us a lot, this happens when the people are not aware about their electricity usage patterns, added to, the people are paying more charges for their electricity than for what they use, this becomes a loss for them too. So, our plan is to devise a smart electrical switch that automatically reads the power consumption information, load it in a database, analyze and forecast the future trends of power consumption which will help the domestic people in their daily usage.

II. LITERATURE SURVEY

Smart grid and smart metering technologies allow residential consumers to monitor and control electricity consumption easily. [1]The real-time energy monitoring system is an application of the smart grid technology used to provide users with updates on their home electricity consumption information. This paper aims to forecast a month ahead of daily electricity consumption time-series data for one of the real-time energy monitoring system named beLyfe. Four separate multistep Long Short Term Memory LSTM neural network sequence prediction models such as vanilla LSTM, Bidirectional LSTM, Stacked LSTM, and Convolutional LSTM ConvLSTM has been evaluated to determine the optimal model to achieve this objective. A comparison experiment is performed to evaluate each multistep LSTM model performance in terms of accuracy and robustness. Experiment results show that the ConvLSTM model achieves overall high predictive accuracy and is less computationally expensive during model training than remaining models.

[2]With increasing of distributed energy resources deployment behind-the-meter and of the power system levels, more attention is being placed on electric load and generation forecasting or prediction for individual residences. While pre-diction with machine learning based approaches of aggregated power load, at the substation or community levels, has been relatively successful, the problem of prediction of power of individual houses remains a largely open problem.[3] This problem is harder due to the increased variability and

uncertainty in user consumption behavior, which make individual residence power traces be more erratic and less 6 predictable

[4]Prediction of electric power consumption has recently become one of the important domains, not only for the electrical utilities, but also for the consumers of the electricity. In the recent time, the demand of accurate electric power consumption prediction has been increased and is considered as an integral part for electric utility in planning and scheduling of electricity distribution from the power system. Accurate prediction enabled to better manage of electric usage[5]. A review of the recent electric consumption prediction techniques will be presented in this paper in the context of different power consumption prediction applications. [6]This study focusses a comprehensive survey of the existing methods employed for power consumption prediction process and a comparative study has been performed on different models based on the three methods. [7]The predicted results of the models are evaluated by using the performance metrics such as Mean Square Error (MSE), Root Mean Square Error (RMSE), Mean Absolute Error (MAE), and Mean Absolute Percentage Error (MAPE) metric

III. PREDICTION AND METHODOLOGIES

The real time data is generated using python programs in a .csv format, the real time data are collected using ACS712 sensors, which is a current sensor that is used to monitor the power consumptions of the connected equipment.ACS712 is an AC or DC current sensor, it is connected to a switch, when the switch is powered on the current sensor starts to read the raw data of the connected equipment, the Arduino IDE is used to convert the raw data into power and energy. The reading are recorded in an excel sheet in the .csv format.

Recurrent Neural Network (RNN) is a part of Artificial Neural Network which will be primarily work for time series data or sequential data. Standard Neural Networks algorithms only work for the data points that is independent of each other. If we have the series of data thatrely on the past data, then we have to make changes in the neural network. Recurrent Neural Network (RNN) has the idea of “memory” which helps to store the old states to predict next output order.

Long Short-Term Memory (LSTM) is an Recurrent Neural Network (RNN) Algorithm

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whichwas used in domain of Deep Learning. Long Short-Term Memory Model was not like the standard feed forward neural networks, It has feedback connections. LSTM can process both single data points (e.g. Images) and entire sequences of data (e.g. speech or videos). LSTM units contains input gate, output gate, forget gate and a cell. These gates is to regulate the information flow in and out of cell. LSTM Networks were used to classify, process and to makepredictions using the time series data.

The Real time data collected from the current sensor with Arduino is in the format, date with time and the power usage that was calculated from the raw current sensor output. The dataset is then evaluated for duplicate entries and it will be removed. The time series data is then trainedand tested. The forecasting is done for 'n' steps ahead using the full data that is dataset has. If the dataset contains huge data then the predicted data will have more accuracy when comparedto the less data in data set. The training set is observed for loss and accuracy by providing optimal epoch number. If the epochs were higher, then the data training data will take more time and the accuracy will also be affected. The output of the model is the forecasted power usage which is actually seven days from the date of last value in the data set and the train data which was compared with actual data set that shows the accuracy of the predicted data. The outputs will be in the form of graph. By using those predicted values the Bill for power consumption is generated.

IV. WORKING & IMPLEMENTATION

The load (bulb) is connected to the socket having the smart switch which is connected to the current sensor. The current sensor readings are recorded which Arduino and using the desktop/laptop and the Machine Learning algorithms are used to predict the future trends. Then the predicted electricity consumption is calculated and the respective bills are generated and sent to the end user via e-mail. Figure 1 shows the System Architecture

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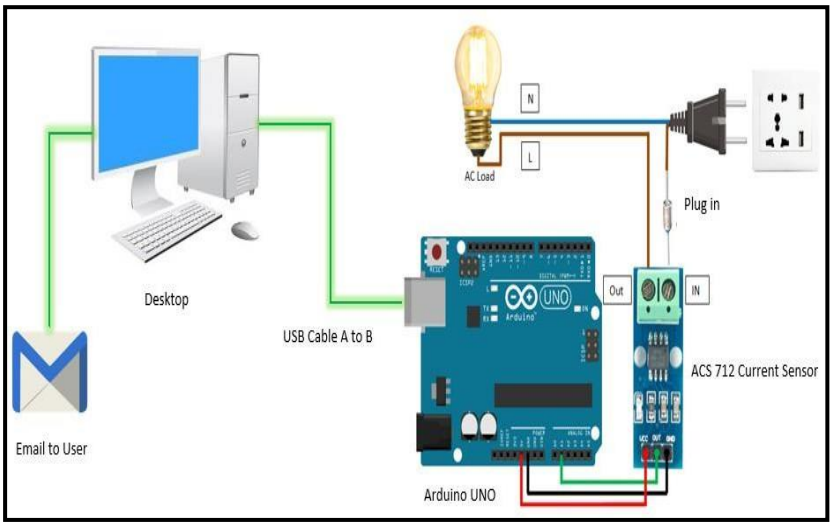

Figure 1 System Architecture

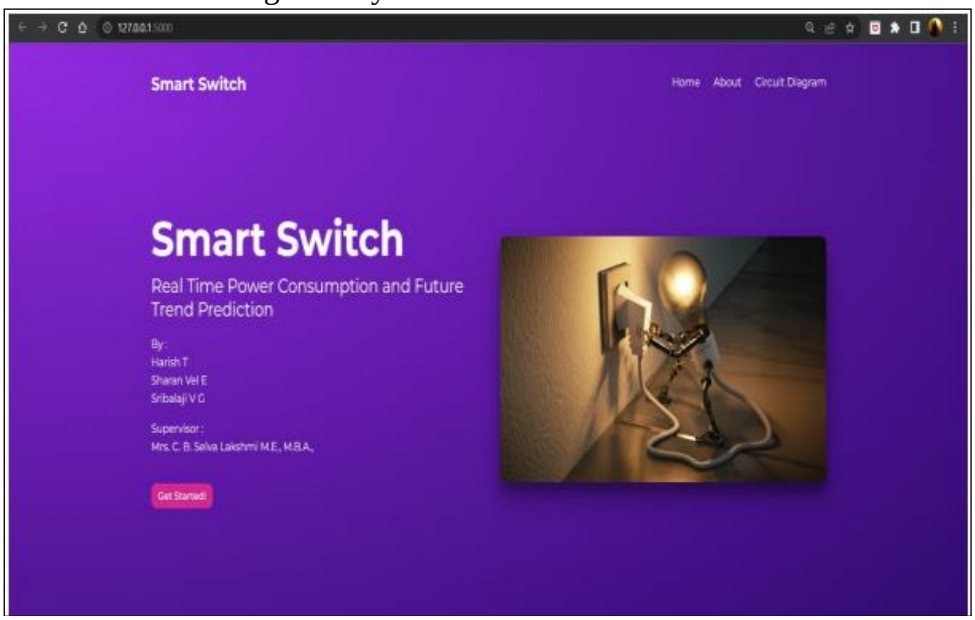

Figure 2 Home Page

Figure 2 shows the home page is the first page that appear while project gets executed. It starts from here, this page consists of the title, team member names along with the get started button

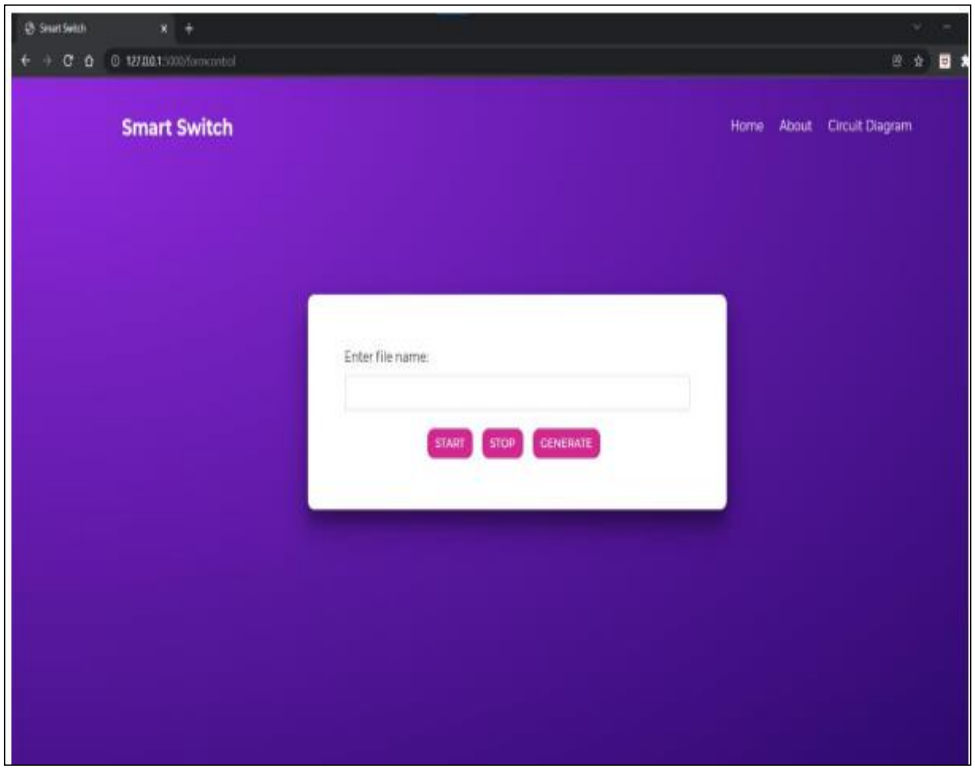

Figure 3 Get Started Page

Figure 3 shows the Get Started page where the operations of the project take place. The following steps are to be followed:

1. The file name of the excel should be given in the textbox given

2. After entering the file name the start button should be clicked (Note: Ensure that the sensors and Arduino are well connected and plugged in)

3. Once the start button is clicked the readings of the equipment are measured and recorded in the created excel sheet.

4. After enough readings are taken the Stop button is clicked to stop the recording of the consumption

5. Click the generate button to start the analysis of the dataset collected, once the analysis is done by the algorithm, the prediction is displayed in the form of graph

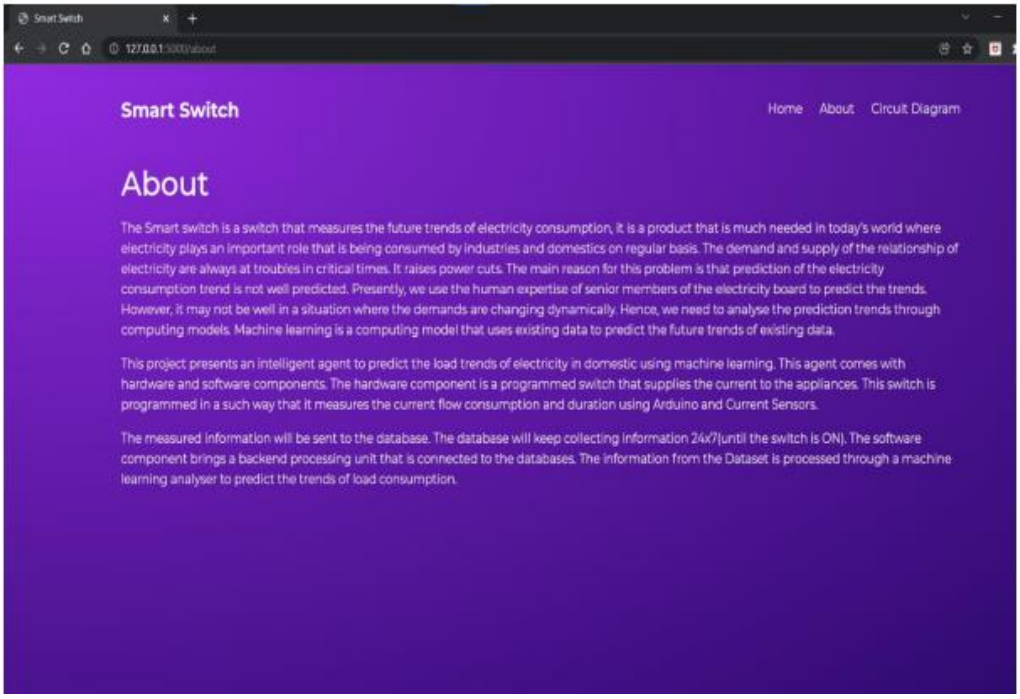

Figure 4 About Page

this page consists of the circuit diagram of the project, this can be used to ensure the connections before clicking the start button in the get started page. Figure 4 shows the About Page

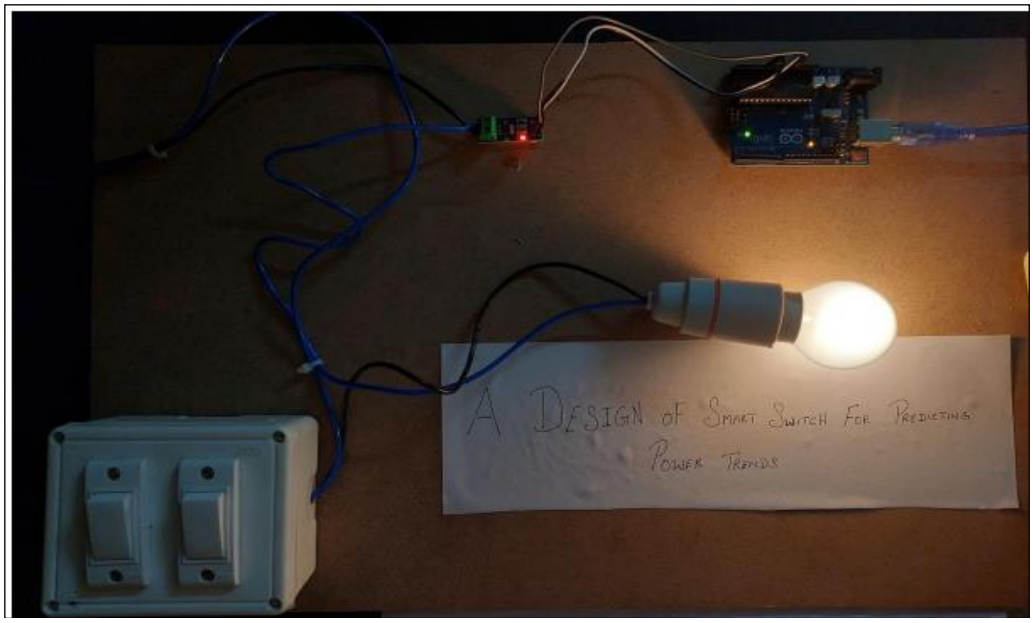

Figure 5 Prototype

Figure 5 shows the prototype which consists of the following:

- Arduino
- Switch
- Plug
- Current sensor
- USB-B TO USB-A cable
- Bulb (Load)

V.PREDICTION AND BILL GENERATION

Once the generate button is pressed in the Get Started page the prediction starts and the bill is generated. Below are the images of the predicted values and the bill generated.

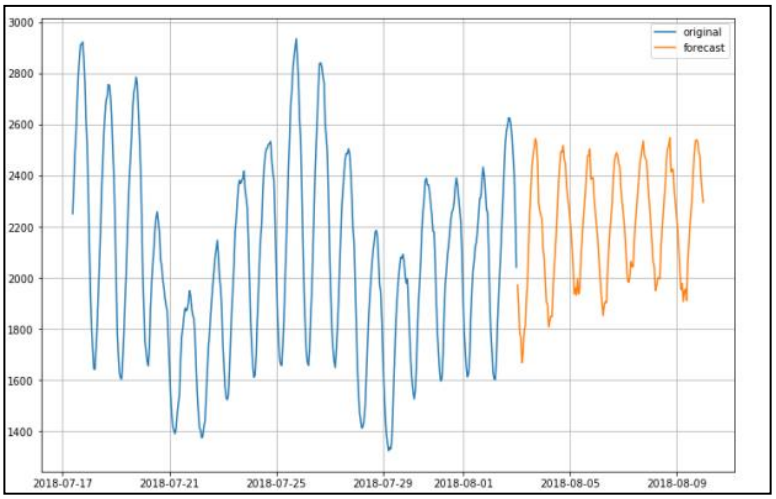

Figure 6 Predicted Graph

The orange line shows the predicted values of the equipment's and below is the sample of the predicted bill has been calculated. Figure 6 shows the Predicted calculations made is generated as a bill and sent it via e-mail to the users.

VI. CONCLUSION

aims to bring awareness about the electricity consumption to people and people can use it in their homes to predict their electricity consumption trends and reduce their electricity usage to save electricity costs. This also helps the electricity board to control the supply and demand issues, since the people will limit their usage to certain level. The user will get a predicted bill

so that he/she can have a idea about their own consumption of power. This can help to reduce the charges of electricity.

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