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Energy Monitoring and Theft System using IoT

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Abstract: ***In today's environment without internet living and working is very difficult in daily life. The Internet of things is the major technology by which we can produce various useful applications. The paper describes the digitization of load energy usage and power theft updated over the internet using hardware and software. The designed system reduces the involvement of human interference in electricity maintenance. It uses the wireless technology for automatic meter reading system. The user can monitor energy consumption from a webpage by providing a channel id for the load. The webpage utilizes the ThingSpeak to analyze the energy usage and theft update and visualization and energy usage statistics. Raspberry Pi was chosen due to built in Wi-Fi chip. The Wi-Fi unit performs the IOT operation by sending the load data to the webpage. The power theft detection is monitored by IR sensor and is fed to the Raspberry Pi which indicates it to the webpage. So the consumer can do power management and theft detection.***

Index Terms: Internet of Things, Energy monitoring, Theft detection

I. INTRODUCTION

The IOT system consists of computing devices, digital and mechanical objects. People with unique identifiers potentially transfer information over a network without human to human interaction. The physical world objects are no longer disconnected from the virtual world [1]. Lot of research was involved to increase the demand of internal of things and its applications.

Now-a -Days the demand for electricity is increasing at a constant rate and is being utilized for various purposes i.e. agriculture, industries, household purposes, hospitals etc. An immediate requirement is to save as much electricity as possible. The technology development [2, 3] is needed along with the demand for electricity. The project implemented to securely monitor the energy and theft using IOT technology from any place.

II. INTERNET OF THINGS

This new technology connects the devices from any place with the internet protocols to collect the data. The information exchange and communications helps to achieve a particular application. The research and development of this technology create enormous applications and becoming smart. In the real world, this helps to create smart environments [3]. The Figure 1 shows the impact of Internet of things in real world applications.

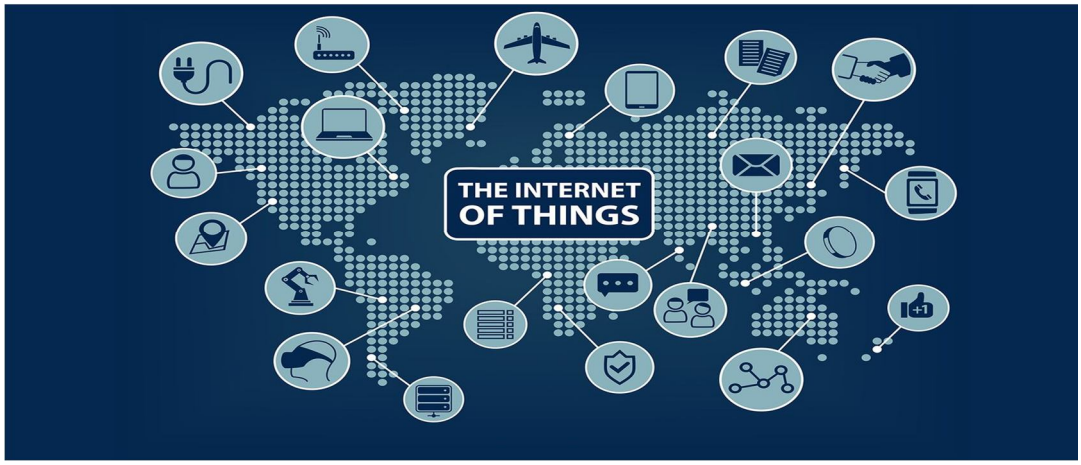


Figure 1: Internet of Things

The various components to be required for this project briefly described below. The Raspberry Pi model B was used in this project. It has the built in capabilities and Wi-Fi capabilities. The processor chip set of raspberry Pi 3 model B as shown in Figure 2. The Broadcom BCM2837 64 bit ARMv7 quad core processor powered single board computer running at 1250 MHz. The General Purpose Unit of this Raspberry Pi is video core 4.

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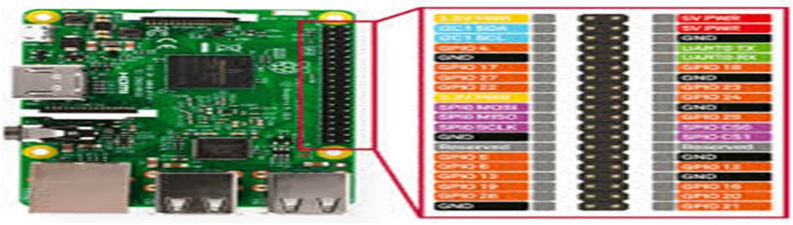


Figure 2: GPIO of Raspberry Pi 3model B

The Storage is microSD and GPIO. GPIO the Raspberry Pi 3 features the same 40 pin general-purpose input-output (GPIO) header as all the Pi s going back to the Model B+ and model A+. Any existing GPIO hardware will work without modification. But the GPIO's pins, that's handled internally by the operating system. Model B is the higher spec variant of the Raspberry Pi compare to the previous models. It operates in the same way as a standard PC Requiring a keyboard for command entry.a display unit and power supply.

III. METHODOLOGY

The system of energy was monitoring and theft detection using Wi-Fi module described in two parts [1]. The hardware and software are the two parts of this project.

A. Existing System

The existing wireless communication system of energy meter has been done utilizing ZIGBEE and GPRS. This method is mainly used to secure the communication channel and ZIGBEE for the transmission of data in a serial process. The drawback of this system is that real-time monitoring of the load is not possible and theft updated is not determined [1].

B. Proposed System

In this proposed system an inbuilt Wi-Fi unit performs IOT operation and it is implemented for send data of the energy meter readings and power theft detection to the cloud through the webpage [5]. The IOT components allow for the usage of data from each unit and stored in cloud. By this the consumer get the data from anywhere in the world. This system is being interfaced with the Raspberry Pi and the sensors also interfaced with the Raspberry Pi to sense the values. This will prevent the electrically theft as much as possible. The designed system solved the problem like power theft.

IV. HARDWARE IMPLEMENTATION

The following Figure 3 explains the hardware implementation of energy monitoring and theft detection using IOT. The below figure contains the raspberry pi, energy meter, regulated power supply, sensors, relay, current transformer and load.

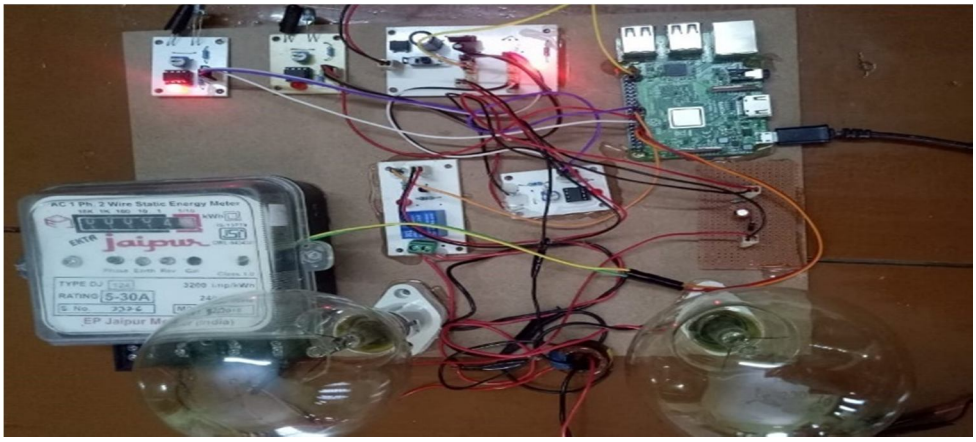


Figure 3: Hardware implementation

The Energy meter measures the amount of electric energy consumed by the by the residence or a business or a electrical device. The signal output from current transformer was converted to digital signal by attaching it to a breadboard. From that breadboard to raspberry pi in built Wi-Fi values update to the cloud. The graph curve formula was implemented within the python code on the Raspberry Pi for monitoring purposes.

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The Figure 4 shows the block diagram of energy monitory and theft system using IoT, in which all the necessary hardware components are shown, the software component is python programming language.

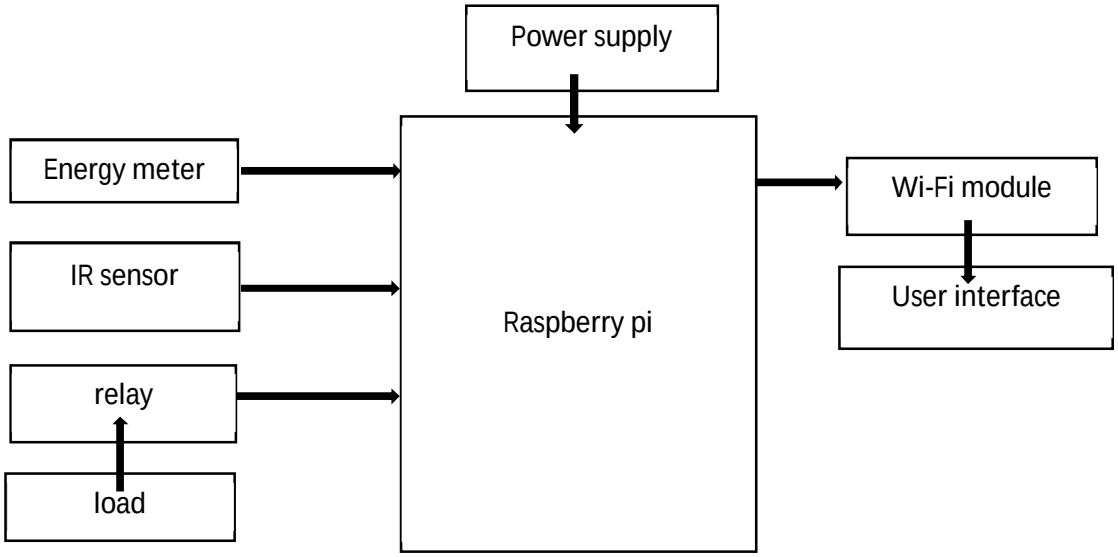


Figure 4: Block diagram of energy monitoring and theft system

A Relay is an electrically operated switch. Many relays use an electromagnet to operate a switching Mechanism. Relays find applications where it is necessary to control a circuit by a low-power signal, or where several circuits must be controlled by one signal. All digital circuits require the power supply. Its main function is to supply the voltage to a circuit or a device that must be operated within certain power limits. If there is an obstacle the light will indicate on the circuit board. An infrared sensor is provided to measure the light radiation of the objects around.

V. THINGSPEAK INTERFACE

The IoT technology has access to many embedded systems and webpage services. ThingSpeak is an open data platform for IoT that enables you to collect, store, analyse, visualize, and act on data from sensors or actuators, and other hardware. The main key element of this thing speak is channel which contains the data fields, location fields, and a status field. After the ThingSpeak channel is created, you can store data to the channel, and view the data

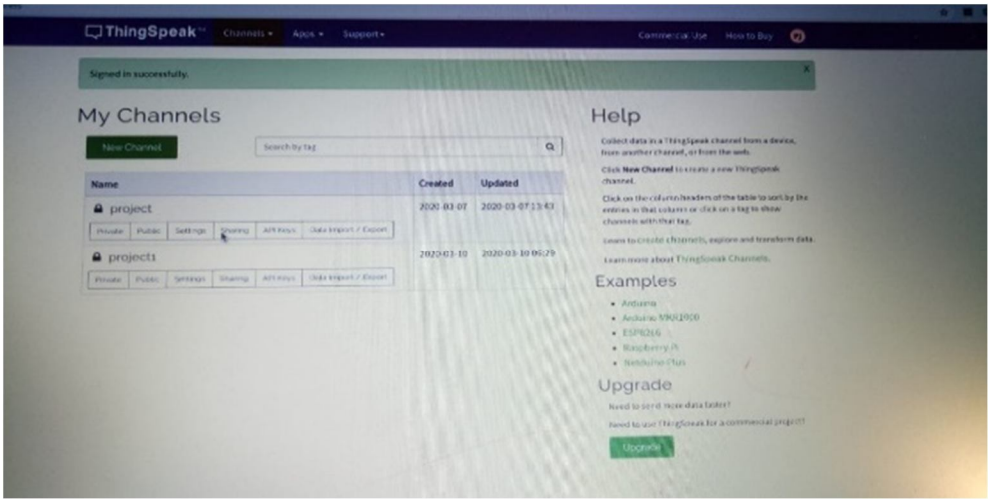


Figure 5: ThingSpeak webpage

The project displays the energy consumed by the load in terms of units. The data can be known to everybody at any place. The ThingSpeak webpage shown in Figure 5 helps to present the data in a more detailed description and visualization. The user can provide any number of channels to the account.

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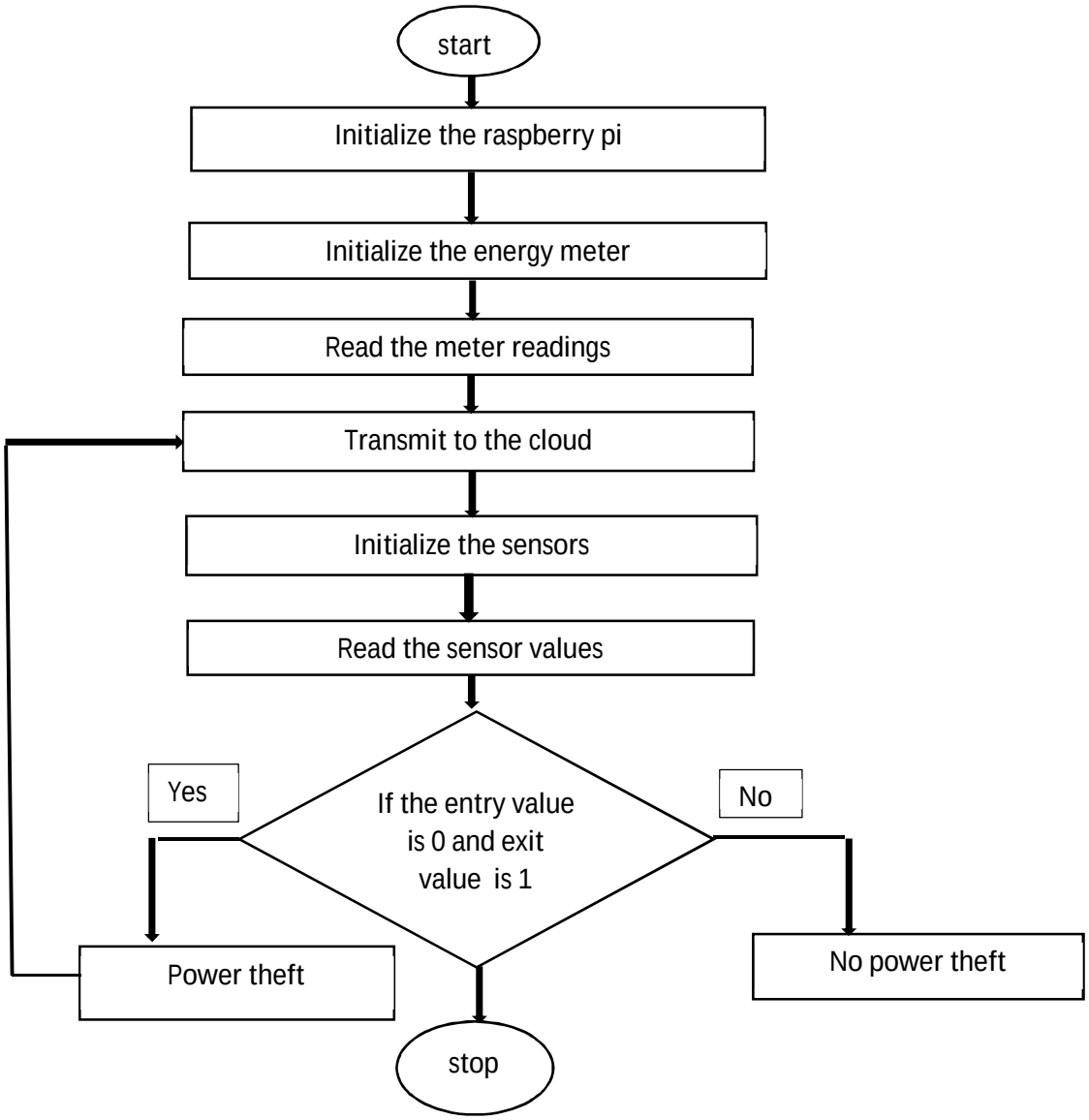


Figure: 6 Flowchart of energy monitoring and theft system

The analysis can be viewed by both the consumer and service provider. The flow chart of the information processing by Raspberry Pi as shown in Figure 6; which uses the python programming language to computations.

VI. RESULTS & DISCUSSION

Firstly we have to switch on the supply. Then the energy meter starts measures amount of electricity is consumed. The load energy usage readings the IR sensor starts sensing the power detection it is updated or not. This data is stored on the cloud THINGSPEAK. By using webpage we can analyse the data from anywhere.

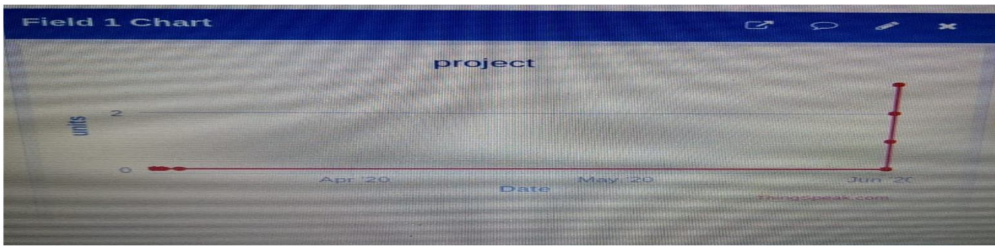


Figure 7: The power utilized by load in terms of units.

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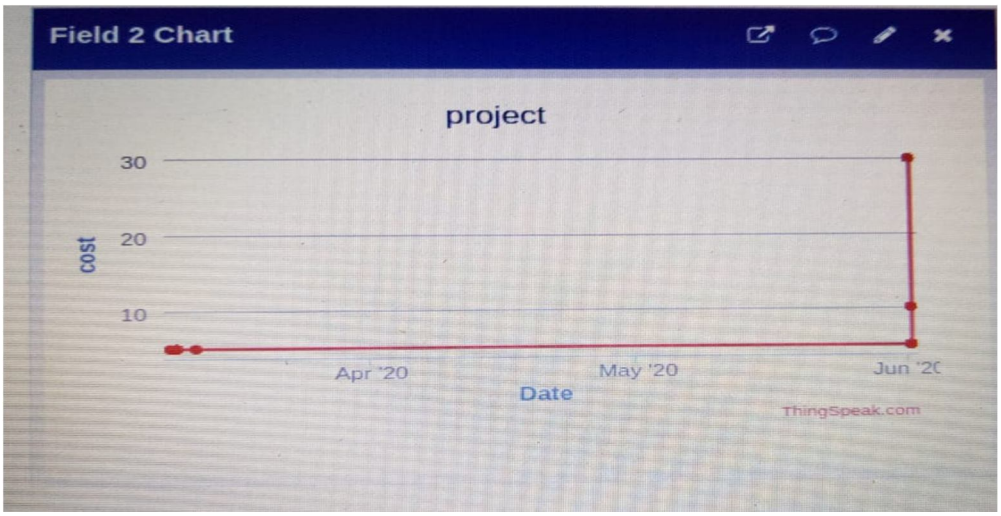


Figure 8: This graph explains the cost of the utilized load usage energy.

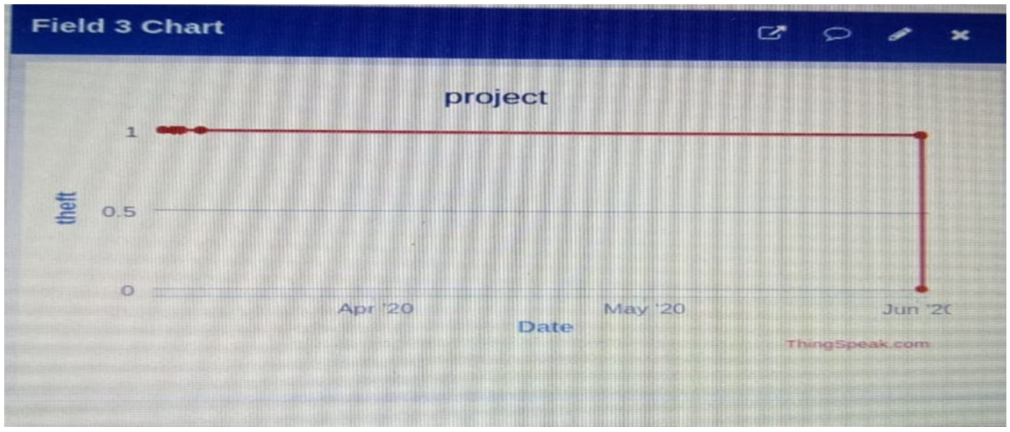


Figure 9: This chart explains the theft detection information. Tampering 1 graph.

The above Figures 7-9 shows the graphical charts shows the units and cost of the load energy usage and last one theft detection, the data stored in the cloud. The data in the Figure 10 below displayed in the personal computer.

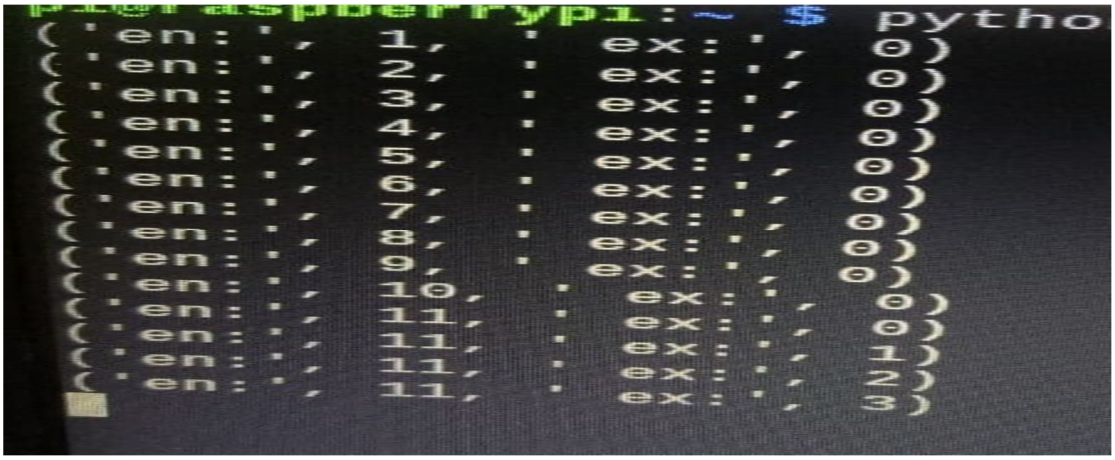


Figure 10: Entry and exit data on personal computer

The IR sensor starts readings the values counting the number of persons in the entry and exit. If the entry value is one 1 and exit vale is 0 hence there is no power theft. If entry value is 0 and exit value is 1 means power theft so it gives the result on display theft updated.

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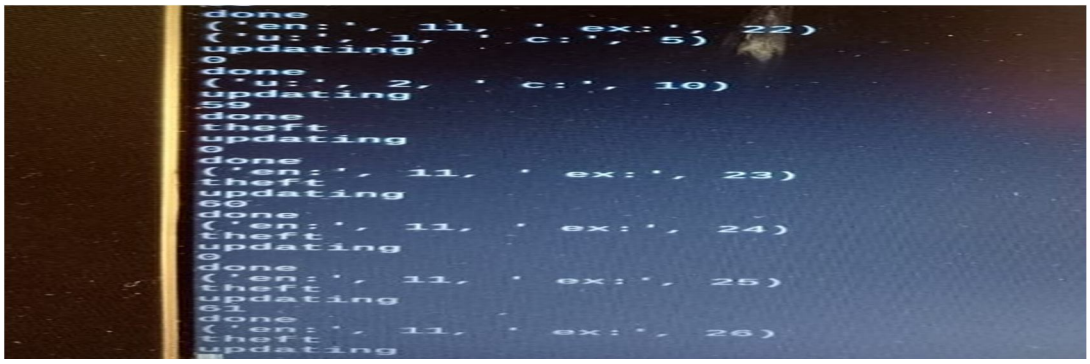


Figure 11: Theft data displayed on the personal computer

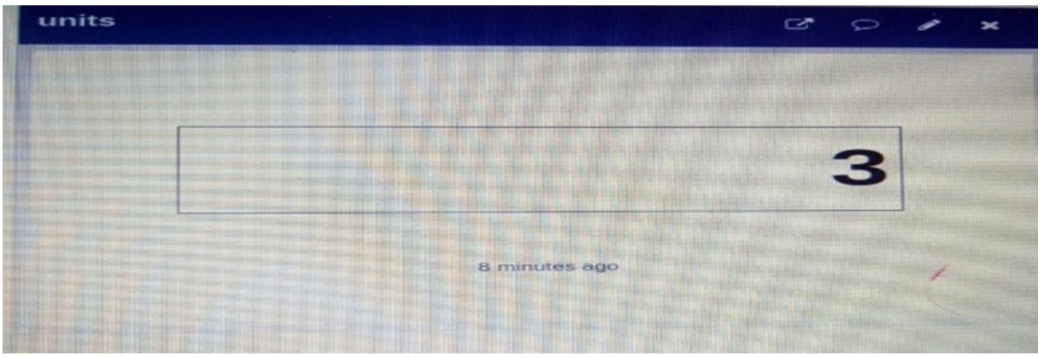


Figure 12: Units of electricity consumed by the load

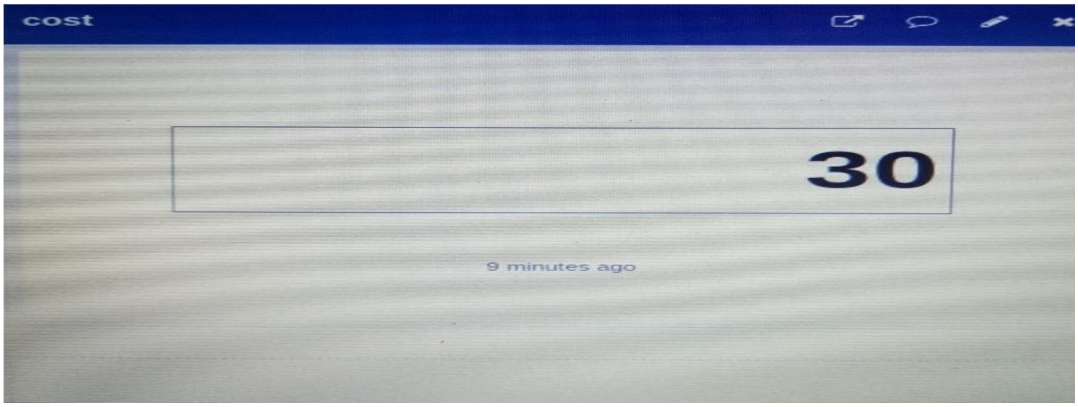


Figure 13: Cost of the consumed load energy usage

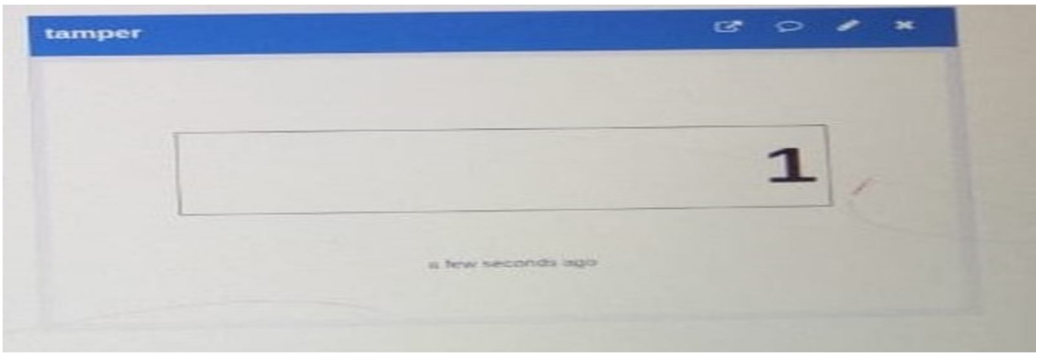


Figure 14: This image explains the Tampering

The below Figures 12-14 explains the numerical values of load usage energy consumed values and cost of that particular consumed energy and theft detection

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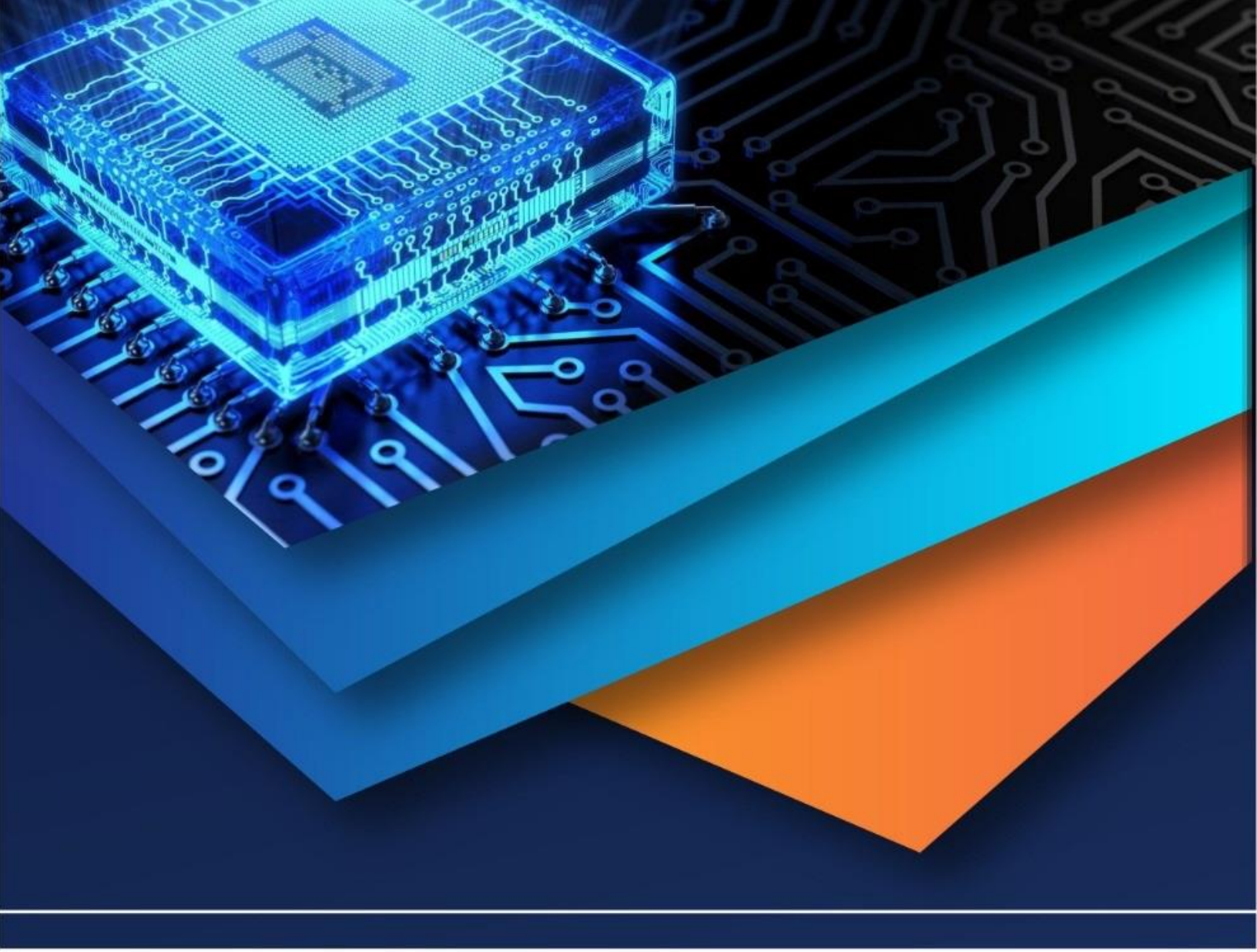
VII. CONCLUSION

A wireless electricity theft detection and monitoring system has been designed and developed with proper integration of both the hardware and the software. Without any human interface this system provides an effective and easy way to detect electrical theft and energy monitoring. The use of IoT helps in achieving the numerous advantages of wireless network communications.

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