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Energy Monitoring Device using Arduino

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Abstract: ***As the world is developing at a rate of speed of light, this development is causing more and more usage of energy. This need of energy will only increase in future as the population is growing too. This will need a backbone to support and that is the tracking of consumption of energy and management. So, we thought of creating a system to keep the track of every load or home appliance in the place. This system will be the advanced version of other metering system, consisting of Arduino, Relay and Current Sensor. The methodology followed to analyze the data of energy consumption is all based on studying the switching patterns of load using IoT. By this way we can bring down the human efforts of stealing the energy for personal uses. It can also be used for efficient use of the energy produced from renewable sources. As a result, we will be getting a meter that can keep track of power consumption of our household as well as any place like offices, malls, etc.***
Index Terms: Arduino, Component, formatting, style, styling, insert.

I. INTRODUCTION

Measuring energy consumption is important because it relates to the cost to run a system because technological advancements new products and services which however result in intensive resource (eg energy) consumption. Energy is defined, as the ability to do work utilitarian perspective of energy however, it is a useful definition for engineering where the aim of machines is to convert energy to work. As a more general description, we would say that energy is a fundamental entity whose availability and flow are required for all phenomena natural or artificial. The excessive consumption of energy lead to substantial damage to the environment high temperature and emissions of CO2 and expansion of the Ozone Layer and as a result, an increasing number of governments are encouraging policies for sustainable development and clever use of global energy resources. Their ultimate object is a significant reduction of the overall polluting emissions and the adoption of suitable strategies for reducing. Here come the role and importance of measuring energy consumption the understanding of how energy is generated and measured is central to our decisions concerning the use and conservation of energy.

Large-scale production of energy evolved over centuries but grew radically in the last 400 years and especially since the Industrial Revolution. A century of development and commercialization of electric power technology has ensured an easy supply and continuous measurement. We will show in these report strategies for measuring energy. Systems for energy monitoring can be classified according to different criteria, for example, the type of sensors they use, or the spatial granularity used for collecting data. With respect to sensors, it is possible to distinguish between direct, indirect, and hybrid monitoring systems. Direct monitoring systems use electricity sensors for directly measuring energy consumption, while indirect systems infer energy consumption by measuring other quantities such as temperature and/or noise.

Finally, hybrid systems rely on both approaches. Direct monitoring systems can be further classified into fine-grained, medium grained, and coarse-grained systems, depending on the level of spatial granularity they use in collecting data about electrical energy consumption. The rest of this paper is structured as follows: the following section reviews existing approaches for energy measurement based on Arduino. Presents how to configure the Arduino to use in the smart home that illustrates the system scenario and some images of the system interface and show how to use it in section 5 the planned future work for this project. As smart metering is one of the key points for the future smart grid and the way to improve energy awareness of homes, several commercial products monitoring the homes energy consumption exist.

For examples TED Pro Home and NEUR These commercial products are usually very limited in their applicability and lack of adaptability and Programmability. Do not recommend these commercial products because they do not inherently reduce energy usage, but only help indirectly.

There exist a few, non-commercial open-source metering solutions such as the open-energy-monitor.This monitoring solution offers an open-source metering solution, where the monitoring shield is operated either with an Arduino board or individually and this last one –Arduino board- that is our theme in measurement energy consumption. Systems for energy monitoring can be classified according to different criteria, for example, the type of sensors they use, or the spatial granularity used for collecting data. With respect to sensors, it is possible to distinguish between direct, indirect

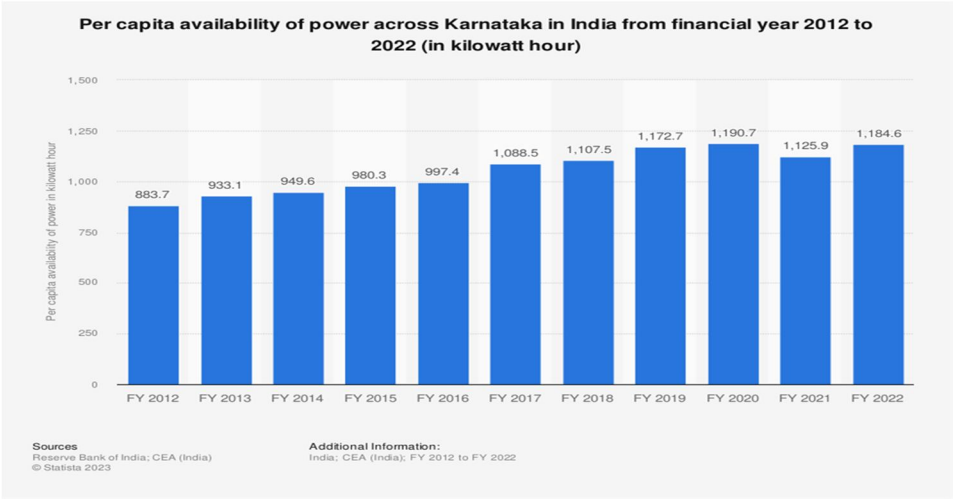


Figure N.o 1.1: Average Energy Consumption in Karnataka up to Year 2022

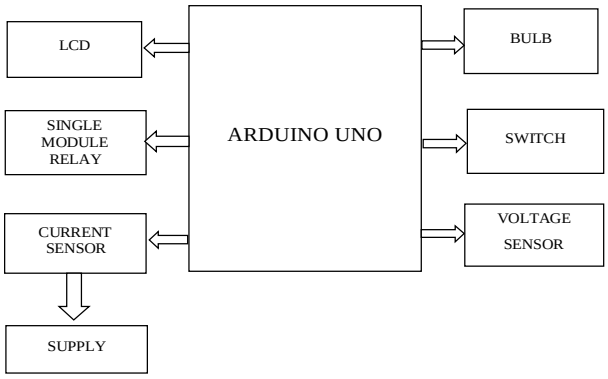
And hybrid monitoring systems. Direct monitoring systems use electricity sensors for directly measuring energy consumption, while indirect systems infer energy consumption by measuring other quantities such as temperature and/or noise. Finally, hybrid systems rely on both approaches. One of the states of artwork in monitoring home energy usage is Non-Intrusive Load Monitoring (NILM).The NALM approach proposed a system for measuring current and voltage at the root of the energy distribution network .This approach requires detailed knowledge of each branch of the energy distribution network, and this may seem very complex. In the feedback of devices and Effect of external factors like noise and ambient temperature. That leads to difficulty in determining the machine running. With developing the smart sensor, it has become available, easy to use, and determining data accurately. In described our energy monitoring system, CSK Energy, which provides tailored feedback for different environments.

II. OBJECTIVES

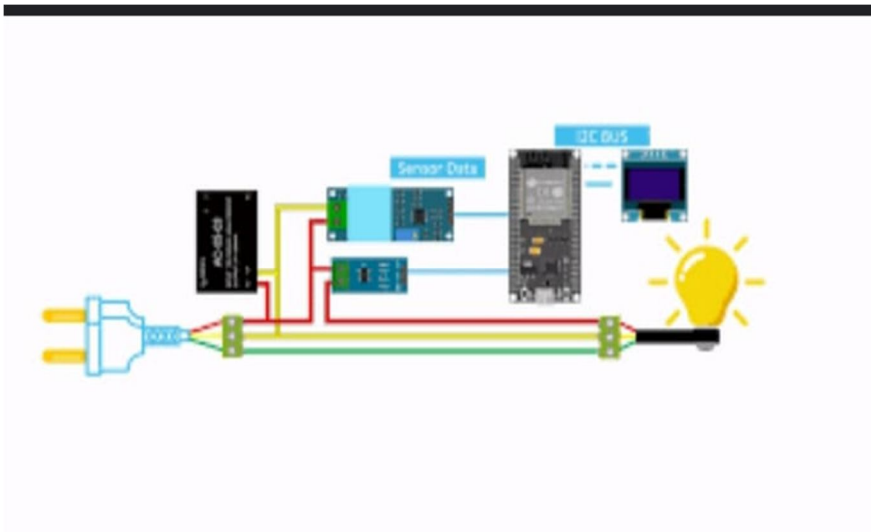
1) The main objective of the system is to get rid of the electricity crisis that is being faced by the people all over the world.
2) Improve energy efficiency an energy monitoring system can provide insights into energy consumption patterns, allowing for identification of opportunities to improve energy efficiency and reduce energy waste
3) Reduce consumption cost ,By reducing energy consumption an energy monitoring system can help individuals and business save on energy costs.
4) To limit energy consumption when it is known that the household electricity consumption has exceeded the relevant units, thus saved energy as well as controlled the power consumption

III. BLOCK DIAGRAM AND DISCRIPTION

The block diagram in which the current and voltage sensors are used to measure the current and voltage respectively. LCD is interfaced with ardunio uno. LCD helps to show the measured values to the consumer



IV. CIRCUIT DIAGRAM



1) *Current Sensor:* Current sensors are used to measure the current consumtion of the electrical circuit.
2) *Voltage Sensor:* Voltage sensors are used to measure the voltage of electrical circuit.
3) *Arduino Microcontroller:* The Arduino microcontroller receives the data from CT sensors and voltage sensor through analog input. It perform necessary calculation to calculate power consumption and sends the data to LCD display.
4) *LCD Display:* An LCD display used to show the power consumption data that is calculated by the Arduino microcontroller.
5) *External Power Supply:* An external 40v and 60v power supply is used to power the Arduino microcontroller

The circuit diagram shows the connection between the components ,including the current sensors, voltage sensors, Arduino microcontroller, LCD display. In summary the current sensor and voltage sensor provide information on the Energy consumption of the monitored circuit, which is then processed by the Arduino microcontroller. The calculated data is then displayed on the LCD display.

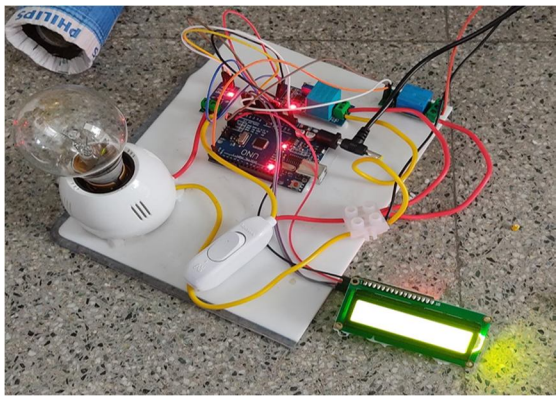
V. WORKING PRINCIPLE

The working principle of energy monetring involves energy meters, it is used to measure the voltage ,current ,power,power factor and such usefull information .

Eneregy monitoring systems provide users with data about their consumption patterns so they can make informed energy management decisions and maximize savings

The intelligent energy monetring sytem can flag any faults in real time and indicate what enery saving measure will solve the problem.

VI. RESULTS



After proper study of each and every type of hardware and software out there, we started working on this design. Not only it is user friendly but the manufacturing of this system will be handy and the modifications that can be done in future with this device is quite immense.

The Households are supplied with 220V/230V, 50Hz AC; let us consider it as Main supply. The Power supply is also switched on at the same time for our System to work which is negligible. A current sensor of 30A current handling capacity is connected to the live wire coming from the mains. Live and neutral wires will be connected to our Loads or Appliances via Relay. This relay is connected to the Driver IC. Our system uses basic signals from current sensor. In the sensor the applied current flowing through a copper conduction path generates a magnetic field which is sensed by the integrated Hall IC and converted into a proportional voltage. A precise, proportional voltage is provided by the low-offset, to the Arduino. For every separate load we have used the relay, as it will act as switch. The driver is connected between the Relays and arduino to amplify the input signals from the arduino. Now these relays will be operating with a little technological help called IoT. When a load is on current sensor will sense the current and send the value to arduino. Now the embedded code will come in part and the current sensed will be converted to power using the formula $P=V*I*\cos(\varphi)$ and sent to server. For example if one load say a cabin fan is switched on by the user, as soon as this is done the server will receive the values by the Arduino, through our Wi-Fi model (Node MCU). Power consumed will be displayed on the LCD, as well as the application build inside the user's phone will display power consumed and utilization of energy if the load in on for a specified time instance(eg.3hrs ie.180 min). As we go on switching on different loads the energy used by each load will be displayed respectively with proper annotations with an intelligent algorithm. This real time data can be accessed anywhere, even from outside the house. This meter also helps to control the switch of any Load via Phones that will have our in build Application. Final setup of Energy monitoring system .

VII. CONCLUSION

The scheme here is to create a system which can measure the proper values for energy with minimal human errors. This technology will be compatible with the old as well as new metering systems. The applications of this technology in the near future are very likely to increase. The system involves wifi module for bidirectional communication. This is the best way of billing system that can exist today because the comparison of the server's data and user's data can be done and in this way if there is a loss in some way then we can have a solid proof of energy theft. This system enables to keep the track of the power consumption in the household or an office.

VIII. FUTURE SCOPE

Some benefits of the energy meter includes, an end to estimated bills, which are a major source of complaints for many customer and tool to help consumers better manage their energy purchases, stating that our meters with a display inside the homes could provide real time information on electricity consumption and in doing so help people to manage their energy use and reduce their energy bills. Electricity pricing usually peaks at certain predictable times of the day and the season.

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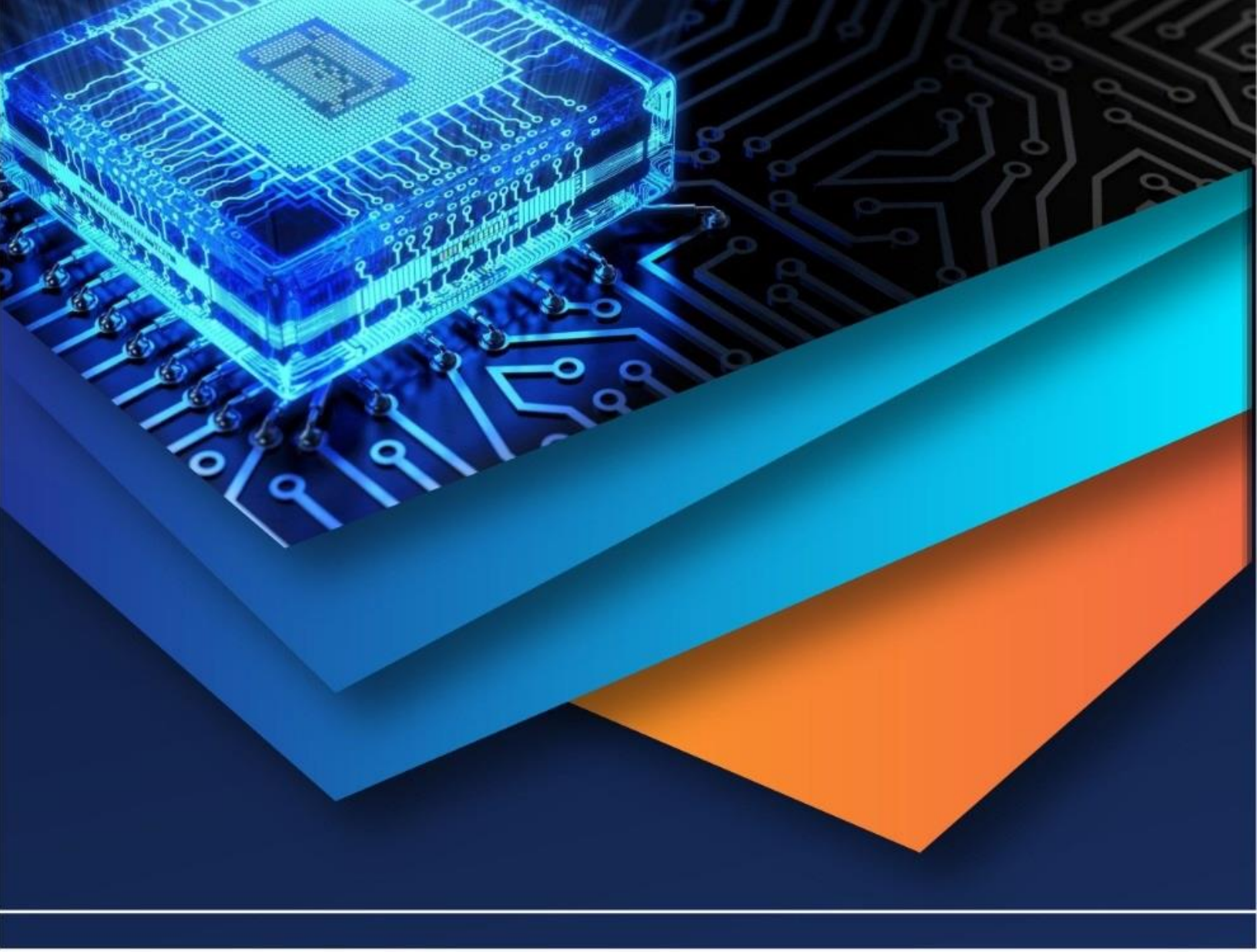

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