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Real Time Efficiency and Temperature Monitoring Using IOT

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ABSTRACT: Energy efficiency has been increasing its importance over the years National and international laws have been introduced to reinforce that concept. The Internet of Things (IoT) is a concept created to define the technological revolution of the devices used in day-to-day connected to the global Internet network. Thereby associating the need for monitoring of energy consumption to the paradigm of the Internet of Things, we intend to design and build an automatic system that allows monitoring and control of electrical devices connected to the Internet via Wi-Fi Hotspot This paper presents a comprehensive review of recent advancements and methodologies employed in real-time efficiency and temperature monitoring systems. We survey sensor technologies, data acquisition techniques, and analytical methods used for monitoring and controlling efficiency and temperature in diverse environments The device also lets you know whether the outlet is on or off, change your status, and access to consumption data through a Web portal

INDEX TERMS: Temperature sensor, LCD Display, Transformer, Node MCU

I. INTRODUCTION

Energy efficiency as a policy objective refers to commercial, industrial competitiveness and energy security benefits, as well as increasingly to environmental benefits such as reducing CO₂ emissions.

Energy efficiency is a concern with two main motivations. On one hand the environmental motivation, related to the reduction of wastes that aims to reduce CO₂ emissions. On the other hand, the economic motivation, which stems from the reduction of costs sustained by the operators to keep the network up and running at the desired service level and their need to counterbalance ever-increasing cost of energy.

A conclusion that energy efficiency investment offers a high payoff in induced jobs and is generally the least cost and often the most readily implementable approach and that more energy efficiency can diminish the need for both additional fossil fuel plants and new renewable energy sources

A study presented by. Kneifel, J.: Life-cycle carbon and cost analysis of energy efficiency measures in new commercial buildings. Energy Build. 42(3), 333-340 (2010) concludes that conventional energy efficiency technologies can be used to decrease energy use in new commercial buildings by 20-30% on average and up to over 40% for some building types and locations

An application of enterprise energy monitoring system which is based on IoT (Internet of Things) architecture and incorporates several technologies, such as digital instrumentation, communications networks, centralized management, decentralized control and remote monitoring

We outline the key challenges faced in monitoring efficiency and temperature, such as the need for accurate data collection, integration of diverse sensor technologies, and scalability for large-scale systems. Additionally, we emphasize the critical role of advanced sensor technologies, data analytics, and control strategies in addressing these challenges and achieving optimal performance.

Through this research paper, we aim to provide a comprehensive overview of recent advancements and methodologies in real-time efficiency and temperature monitoring. By synthesizing existing literature and identifying gaps in current research, we seek to contribute to the development of more robust and reliable monitoring systems that can drive efficiency, sustainability, and competitiveness across industries

II. LITERATURE REVIEW

1. Sensor: Many modern temperature and humidity sensors come with digital interfaces (e.g., I2C, SPI) for easy integration with microcontrollers and IoT devices.

Temperature and humidity sensors play a vital role in various applications by providing real-time monitoring of environmental conditions, enabling efficient control and management of temperature and humidity levels for optimal performance and comfort.

2. The integration of IoT with sensors: It enables real-time monitoring and control of energy consumption and environmental conditions. Temperature sensors measure ambient temperature, while power sensors monitor electrical parameters like voltage and current. Data collected by these sensors is transmitted wirelessly to an IoT gateway or cloud platform for analysis and visualization. Advanced analytics techniques can identify patterns and anomalies in temperature and power consumption data, facilitating proactive energy management and predictive maintenance. Users can remotely monitor and adjust temperature and power levels through web or mobile applications, optimizing energy efficiency and ensuring optimal environmental conditions.

III. HARDWARE DESCRIPTION

1. Node MCU ESP8266:

NodeMCU is an open-source Lua based firmware and development board specially targeted for IoT based Applications. It includes firmware that runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which is based on the ESP-12 module.

NodeMCU ESP8266 Specifications & Features

- Microcontroller: Tensilica 32-bit RISC CPU Xtensa LX106
- Operating Voltage: 3.3V
- Input Voltage: 7-12V
- Digital I/O Pins (DIO): 16
- Analog Input Pins (ADC): 1
- UARTs: 1
- SPIs: 1
- I2Cs: 1
- Flash Memory: 4 MB
- SRAM: 64 KB
- Clock Speed: 80 MHz
- USB-TTL based on CP2102 is included onboard, Enabling Plug n Play
- PCB Antenna
- Small Sized module to fit smartly inside your IoT projects

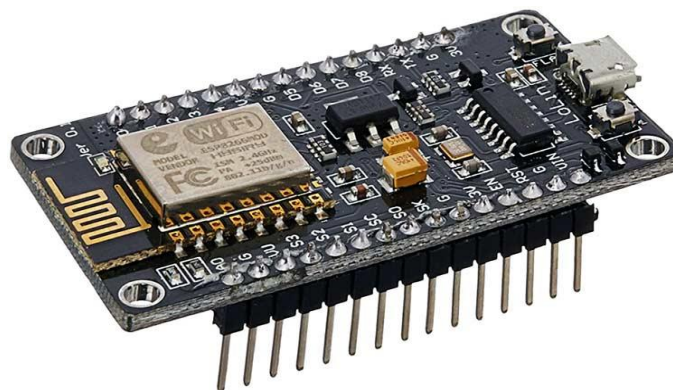


Fig 1: Node MCU ESP8266

2. DHT11 Combination Temperature and Humidity Sensor:

This sensor is commonly used in weather-station projects and for keeping tabs on internal device environments in larger projects.

Description and Technical Data

The KY-015 / DHT11 temperature and humidity sensor module comprises a DHT11 digital humidity and temperature sensor with an integrated 1k ohm resistor. The onboard DHT11 uses an internal capacitive humidity sensor and thermistor to determine environment conditions, and digital I/O integrated circuit for creating the serialized digital output.

Due to its small size, the combination sensor is great for many projects, however it does come with one fairly serious drawback for use in some applications. It offers a sampling rate of a painfully slow 2 seconds. Applications that need more timely measurements should use a separate thermistor that can be sampled on a faster refresh interval.

Tech Specs for the KY-015 / DHT11 temperature and humidity sensor:

Operating Voltage: 3.3V to 5V
Current Consumption: 1.5mA
Temperature Measurement Range: 32°F to 122°F (0°C to 50°C)
Temperature Measurement Accuracy: $\pm 2^{\circ}\text{C}$
Temperature Measurement Resolution: 1°C
Humidity Measurement Range: 20% to 90% RH
Humidity Measurement Resolution: $\pm 5\%$ RH
Digital Out Signal Transmission Range:
Dimensions: .75in X 1.77in (2cm x 4.5cm)

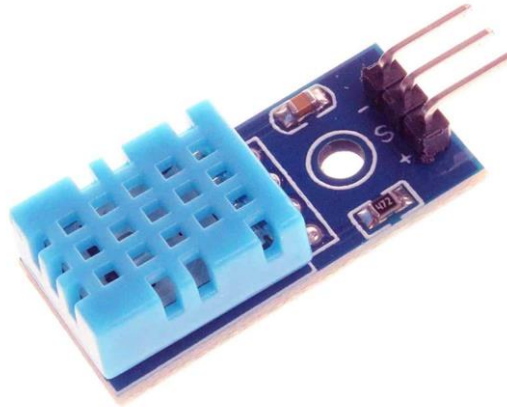


Fig2: DHT11 Combination Temperature and Humidity Sensor

3. 0-12 Volt 1 Amp Transformer, AC Step down power supply:

The transformer is a static electrical device that transfers energy by inductive coupling between its winding circuits. A varying current in the primary winding creates a varying magnetic flux in the transformer's core and thus a varying magnetic flux through the secondary winding.

Input Voltage: 230V AC
Output Voltage: 0-12V AC
Output Current: 1 Amp
Mounting: Vertical mount type

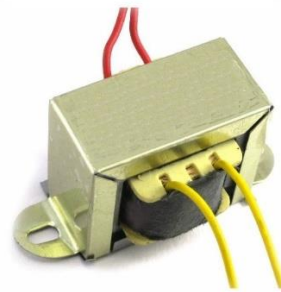


Fig 3: Current transformer

4. *L7805CV Triac* : The L7800 series of three-terminal positive regulators is available in TO-220, TO-220FP, TO-3 and D2PAK packages and several fixed output voltages, making it useful in a wide range of applications. These regulators can provide local on-card regulation, eliminating the distribution problems associated with single point regulation. Each type employs internal current limiting, thermal shut-down and safe area protection, making it essentially indestructible. If adequate heat sinking is provided, they can deliver over 1A output current. Although designed primarily as fixed voltage regulators, these devices can be used with external components to obtain adjustable voltage and currents.

- OUTPUT CURRENT TO 1.5A
- OUTPUT VOLTAGES OF 5; 5.2; 6; 8; 8.5; 9; 12; 15; 18; 24V
- THERMAL OVERLOAD PROTECTION
- SHORT CIRCUIT PROTECTION
- OUTPUT TRANSITION SOA PROTECTION

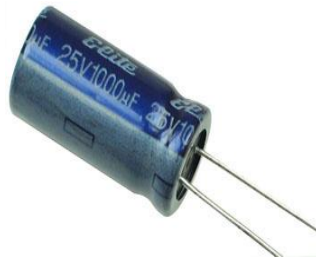


5. *Variable Resistor*: The variable resistor is an element that offers variable resistance to the circuit. By adjusting its internal configuration, we can obtain variable resistance at the load side. This element is frequently used in electrical and electronic circuits to



vary the current flowing in the circuit. Apart from varying current, this element is also used to control some basic parameters like speed, temperature for commonly used electrical loads. A simple example would be, the speed control of single phase induction motor (ceiling fan) through a potentiometer (variable resistor).

6. *Capacitor Electrolytic 1000uF 25V*: These are high quality 1000uF, 25V radial leaded miniature aluminum electrolytic capacitors from manufactures such as Nichicon, KEMET, NIC and Panasonic. Aluminum electrolytic caps are the go-to general purpose capacitors that can be used in most applications that require larger capacitance values of $\geq 1\mu\text{F}$ and can handle a polarized capacitor.



7. *Resistors*: There are five different kind of resistors installed in the circuit of Automatic Temperature Based Fan Speed Control with different kind of values which are 1k ohm, 220ohm, 1ohm, 1k ohm, 1ohm.



8. *Diode*: There are total nine diodes are used in the circuit and eight of them are used to make bridge rectifiers. Total two bridge rectifiers are made in the circuit.



IV. ARDUINO SOFTWARE

Integrated Development Environment (IDE):

Here the Arduino IDE is used on computer (picture following) to create, open, and change sketches (Arduino calls programs as “sketches”) .The Mega 2560 board can be programmed with the Arduino Software (IDE) [13]. The ATmega2560 on the Mega 2560 comes pre-programmed with a boot loader that allows you to upload new code to it without the use of an external hardware programmer. It communicates using the original STK500 protocol (reference, C header files). You can also bypass the boot loader and program the microcontroller through the ICSP (In-Circuit Serial Programming) header using Arduino ISP . The ATmega16U2(or 8U2 in the rev1 and rev2 boards) firmware source code is available in the Arduino repository.

The Arduino Software (IDE) uses this capability to allow you to upload code by simply pressing the upload button in the Arduino environment. This means that the bootloader can have a shorter timeout, as the lowering of DTR can be wellcoordinated with the start of the upload. This setup has other implications. When the Mega 2560 board is connected to either a computer running Mac OS X or Linux, it resets each time a connection is made to it from software (via USB).

CIRCUIT DIAGRAM

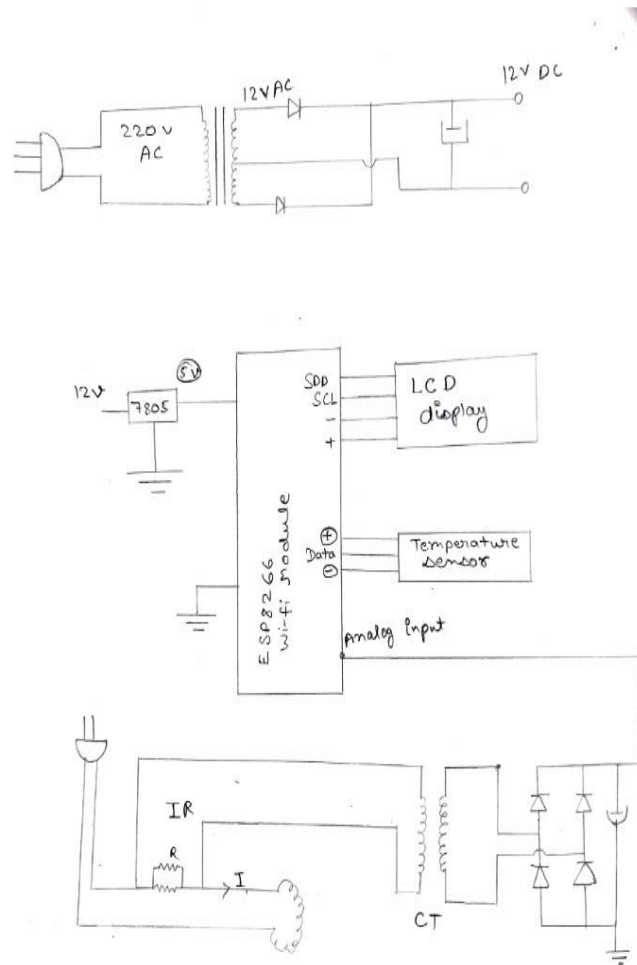


Fig4: Circuit diagram

V. WORKING

The device is an automatic energy monitoring system that allows the user, such as the building manager, to know, in real time, the energy consumption of the electrical device connect to the system.

The data collected is shown in a SQL SERVER database using browser service and the end user can access the data from the Web portal Web built in the same technologies. After login, the end user can access the server and get all the energy monitoring information. The monitoring data is shown as numeric values and the system helps the user to analyse precisely and detailed the use and consumption of electrical devices. This can give important data to decide on possible interventions to improve energy efficiency in the building. The wireless communication is implemented using the

ESP8266 module which implements the IEEE 802.11 b/g/n networking protocol a family of specifications developed by the IEEE for WLANs. The IEEE 802.11 standard supports transmission within the 2.4 GHz band.

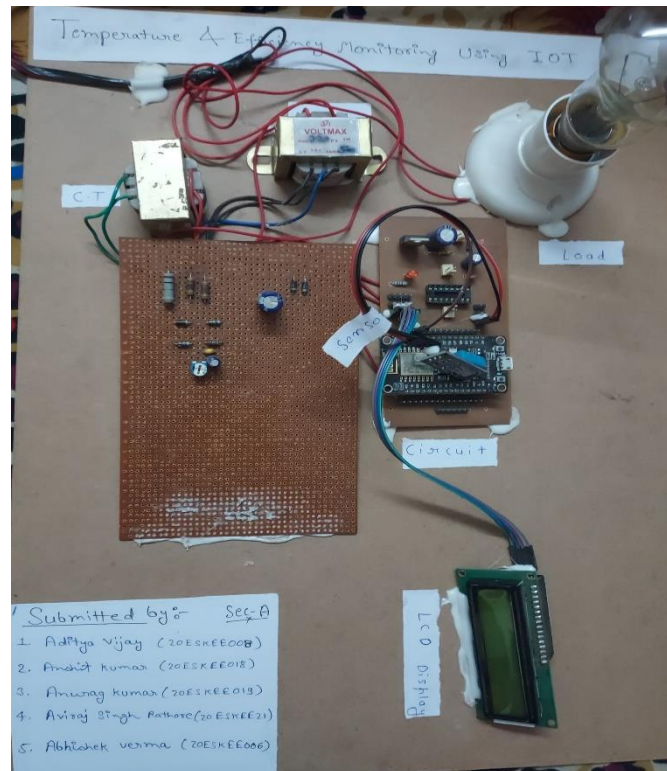


Fig 5: Hardware circuit

VI. CONCLUSION

This paper presents an energy monitoring system that aims to improve energy efficiency. This system is developed with open-source technologies. The hardware is developed with an Arduino microcontroller as processing unit and an LM 35 as a temperature sensor. The sensing unit is composed by a Current transformer and Voltage transformer

The results obtained are very promising, representing a significant contribution to energy monitoring systems based on Internet of things. In addition to this validation study, physical system and Web portal and mobile app improvements have been planned with a view to adapt the system to specific cases.

In despite of all the advantages in the use of IoT architecture the still exist many open issues as scalability, quality of service problems and security and privacy issues, The system should study ways to respond to these problems

From a cost-effectiveness standpoint, the monitoring device enables proactive maintenance scheduling based on predictive analytics, minimizing downtime and reducing maintenance costs. Additionally, by optimizing energy usage and resource allocation, organizations can achieve significant cost savings over time.

Moreover, the environmental benefits of the monitoring device are substantial. By optimizing energy efficiency and reducing waste, organizations can lower their carbon footprint and contribute to sustainability efforts. Additionally, proactive maintenance practices help extend the lifespan of equipment, reducing the need for replacements and minimizing environmental impact.

In conclusion, the integration of real-time efficiency and temperature monitoring device with IoT and web-based software, supported by microcontroller hardware, offers a holistic solution for achieving cost-effectiveness and environmental benefits. By leveraging advanced technology and data-driven insights, organizations can enhance their operational efficiency, reduce costs, and contribute to a greener, more sustainable future.



VII. FUTURE SCOPE

The future of real-time efficiency and temperature monitoring for home appliances is characterized by increased integration, intelligence, and accessibility. By leveraging emerging technologies and addressing consumer needs, monitoring systems have the potential to play a significant role in promoting energy efficiency, enhancing comfort, and creating sustainable homes of the future.

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