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APP DEVELOPMENT FOR ENERGY MONITORING AT DEPARTMENT

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Abstract: This white paper presents the development of a real-time energy monitoring system installed at Level 17, Tower 2, Engineering Complex, University Tektology MARA (UiTM), Malaysia. The device and programming uses an Arduino microcontroller board, an ESP8266 Wi-Fi module, sensors, and the Emoncms.org web server to record and display real-time energy and power consumption, as well as energy costs. The device enables a three-phase measurement of energy consumption at the building level, where the main power source has been divided into several receivers, such as: B. lighting, socket. The device is able to download data at set intervals via Wi-Fi communication and connect directly to the local SD card for further analysis. The device was calibrated at the same time with a FLUKE 485 power meter to get a good, reliable result with less tolerance. The unit was installed and tested during a weekday and weekend test period to determine hourly energy efficiency by building level. The device was found to provide a reading with an average error of 2.04% compared to a commercial meter during the week-long test period.

Keywords: App Development, Energy Monitoring, Real-time, Power and Energy, Consumption, Energy Cost,Microcontroller,Arduino,ESP8266 Wi-Fi module,Sensors,Emoncms.org web server,3 Phase Measurement, Lighting, Power Plug, Wi-Fi Communication, SD Card, Calibration, Testing, Energy Performance, Error Tolerance, Energy Sources, Steam Engine, Electricity, Energy Conservation

INTRODUCTION

Throughout history, people have used available energy sources in their daily lives. For a long time, this was mostly limited to easily available sources such as wind, water or muscle energy, in both humans and animals. This changed from about 1760 to sometime between 1820 and 1840 with the Industrial Revolution. The most important factor in this change was the invention of the steam engine. The invention and widespread use of the steam engine enabled mass production of theon an unprecedented scale.This meant a significant drop in the price of all goods that could be made this way, and made them available to many more people than before.

The discovery of electricity and the invention of the turbine and internal combustion engine continued this trend and, combined with the nascent oil industry in the United States in the late 19th century, enabled many changes. They contribute significantly to the availability of automobiles and the availability of electricity.This relatively rapid change has made our current way of life possible. The use of electricity is so widespread in western countries that it is almost obvious what counts as a good.Food preservation, for example, is facilitated by electric machines, and without electricity many current medical procedures would be very difficult or impossible: the MRI scanner simply doesn't work without electricity.To use a similar but simpler example, the availability of bright light sources greatly facilitates medical examination. The availability and use of so much energy in our daily lives is relatively new. The period in which we utilize the energy sources that provide us with energy and their benefits, beginning with the end of the Industrial Revolution around 1830 compared to the period from the peak of the Roman Empire around AD 150.

Exactly. So far, it accounts for only 10% of the longer period of. However, recent news has raised concerns about fossil fuel depletion.While there is still nuclear power and natural energy sources that can be used to generate electricity, this underscores the need to ask ourselves whether we really need to use all the energy we currently have. Saving energy Saving energy is a very general issue and can be addressed in a number of ways. While they are all geared towards the same idea of getting something or someone to use less energy, the methods are different. One way to save energy is to simply buy new devices that use less energy, such as aenergy-saving light bulb instead of a traditional incandescent

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bulb. Another option is to find out which devices are using power at times when they're not really needed, or are running more than they need at the time, and turn them off at those times.Of course, these two methods are not mutually exclusive in the room.

However, all energy saving methods have one thing in common: they all assume that the consumer who should use them is motivated to do so. To decide if you want to save energy, you first need to determine how much energy you're using and, more importantly, how much energy each device is using. The energy consumer must be able to see where in his home or office more energy is being used than is actually needed. While it's important to know how much energy your entire home or office uses, this information isn't necessary to identify devices that use a lot of power or use power at times when they actually aren't. necessary. Although electricity is not the only form of energy used by household appliances, it is the most common in homes.
Natural gas is also used, for example, to heat houses. While it's widely used, it's not hard to see where it's commonly used and how savings can be made. A good way to save energy is to simply lower the temperature in the house when no one is around, for example heating the house to just 19 instead of 20 degrees Celsius.

COMPONENTS LIST

Components	Specification	Qua.
Diodes	IN-4007	9
Capacitors	1000µF16V	4
Voltage regulator	7805	1
LED	5mm red	3
transformers	0-12V 1A 230-230V 1A	2
IC Base	40 pin	1

Table 1 Components List

GOALS

Whether it's turning off the lights when you leave a room, checking your car's tire pressure, or insulating your attic, every effort to save energy helps conserve the earth's finite natural resources. Protection also helps slow down the effects of climate change. The world relies on energy, most of which comes from burning fossil fuels, which release harmful gases. Reducing energy consumption and using it more efficiently results in feweremissions into the atmosphere.

THEORY

Works has developed a system that uses a microcontroller to control energy use in the home.The project focused on the following observations/assumptions:

(i) that the current drawn by an AC load is directly proportional to power and inversely proportional to voltage and power factor. (ii) The power factor of a household load is almost constant and assuming that voltage fluctuations are minimal, the current is directly related to the power drawn by the load. Therefore, the energy consumption can be kept within the recommended value ofby controlling the house electricity. In this approach, the total current consumed by the house consumption is converted into a DC voltage V, which is measured by a converter and compared to a reference voltage (V ref), which can be set to any value. Vref represents the maximum power that a household consumer can absorb and by changing it it is possible to reduce the total energy consumption. If V measured > V ref, a signal is sent to the microcontroller informing it that the utility's energy consumption is higher than the set value and that some equipment connected to the system needs to be shut down.

The microcontroller automatically checks the ON/OFF status. these devices via relay switches. Each device is assigned a priority level such that the lowest priority device is disabled first, then the next lowest priority device, and so on, up to V measured The document proposes a system that reduces electricity demand in the residential and industrial sectors.

Thanks to their technology, the electricity was controlled and delivered according to a priority concept using a Zigbee network for long-distance communication. When the power threshold was exceeded, the current was switched off; Switching was done via relays. The power was measured using a power measurement system that was connected to the microcontroller via the power pack, in which the programs were integrated. ZigBee was used to communicate with sockets. The various sockets can be switched on and off electrically using the infrared remote control. With this technique, different power consumers can be switched off in the order of their priority.

COMPONENTS DESCRIPTIONS

Step-Down Transformer

The step-down transformer is the first element of the regulated power supply. A step-down transformer is required to step down the mains voltage from 230 VAC. Here are the main characteristics of an electronic transformer.

1. Power transformers are typically designed to operate from a low impedance source at a single frequency.
2. Adequate insulated construction with the required dielectric strength is required.
3. Transformer ratings are given in volt-amperes. The voltmeter of each secondary winding or windings is added to the total secondary VA. Added to this are the load losses.

Rectifier Unit

Rectifier unit is ckt. which converts alternating current into pulsating direct current Generally, a semiconductor diode is used as the rectifying element because it can only conduct current in one direction. There are basically two types of rectifiers.

1.Half-wave rectifier 2.Full wave rectify
In Half-wave rectifier Only half a period of the alternating current in the half-wave rectifier. It's fixed, so performance is very poor. Then we use a full wave rectifier with four diode bridges. In each half cycle, two diodes conduct simultaneously and maximum efficiency is achieved at O/P. Here are the main advantages and disadvantages of KT type full wave bridge rectifier.

Filter Circuit

A rectifier is usually required to produce pure D.C. Power supplies for use at various points in the electronic system. However, the rectifier is o/p pulsed, i.e. if such a D.C. is applied to an electronic circuit, it generates noise, i. H. it contains alternating current. And DC components. THE items are undesirable and should be kept away from the cargo. A filter circuit is used for this purpose, which rejects (or filters) the AC components going to the load. Of course, a filter circuit is installed between the rectifier and the voltage regulator. In our design, we used condenser filter because of its low cost, small size and light weight and good characteristics. The capacitors are in parallel with the O/P rectifier because it passes AC but not DC.at all.

Three terminal voltage regulator

The voltage regulator is defective. which supplies a constant voltage regardless of changes in the charging current. Voltage regulator ICs are versatile and relatively inexpensive. The 7800 Series is a three terminal positive voltage regulator.

These integrated circuits are designed as constant voltage regulators and can supply operating currents in excess of 1A with a suitable heatsink. These devices do not require any external component. This IC also features internal thermal overload protection, as well as internal short circuit and current limit protection. For our project we will use the 7805 voltage regulator IC.

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Design of Step down Transformer

The following information must be available to the designer before he commences for the design of transformer.

1) Power Output.
2) Operating Voltage.
3) Frequency Range.
4) Efficiency and Regulation

System Testing

System is critical element of measure of assurance and represents the review of specification ultimate review of specification and design. The system is tested during above methods as a theoretical and practical verification of the results. An effort is made to compare the system with traditional one.

Some Potential Use Cases And Activities

Energy Consumption Monitoring: Users can monitor and monitor the energy consumption of their service in real- time. The app can provide information about energy usage patterns such as peak times or days and allow users to identify areas where energy saving measures can be implemented. Data Visualization: The app can present energy data in visually appealing and easy-to-understand formats such as charts, graphs, and dashboards. Users can analyze trends, compare energy consumption over time, and identify anomalies or inefficiencies.

Alerts and Notifications: The app can send alerts and notifications to users when certain energy thresholds or targets are exceeded. For example, when power consumption exceeds a certain limit, users can be notified to take corrective action or investigate the problem.

Cost Analysis: The application can provide a cost analysis based on energy consumption data. Users can understand the financial impact of their department's energy use, track cost trends over time, and make informed decisions to optimize energy efficiency and reduce costs.

Benchmarking and comparison: Users can compare their department's energy performance against industry benchmarks or similar departments within the organization. This can help identify areas for improvement and set targets for energy conservation initiatives.

Historical Analysis: The app can store historical energy usage data, allowing users to analyze long-term trends, seasonal variations, and the impact of past energy-saving initiatives. This data can be useful for reporting, forecasting and decision making.

User Management: The application can support user management functions, allowing administrators to grant access permissions to different people or departments. This ensures stakeholders have access to the energy monitoring data and reports they need. Tips and recommendations for saving energy: The app can give tips and recommendations for saving energy based on the service descriptions. Users can get personalized recommendations to reduce energy waste and improve efficiency.

reports and documentation: The application can create customized reports and documentation on energy consumption, economic savings, and environmental impact. These reports may be used for internal reporting purposes, for compliance purposes, or to share information with interested parties.

Integration with other systems: The app can be integrated with other systems or devices such as smart meters, IoT sensors or building management systems to collect real-time energy consumption data. This integration increases the accuracy and completeness of the energy monitoring process.

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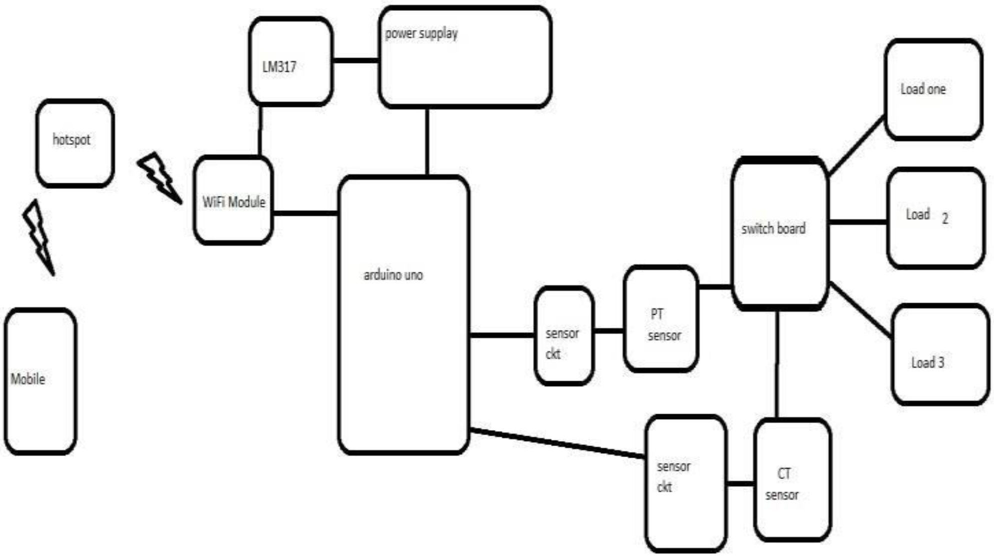
BLOCK DIAGRAM



CONCLUSION

Energy management is an increasingly important aspect of system design. Our previously proposed energy model provides a framework for an operating system to manage energy as a prime resource. This article shows that the Currentcy model can be used to define power management policies that span multiple devices and different applications.With our ECOSystem prototype, we implement several policies based on current frequency, including: current value-saving planning algorithms that reduce remaining battery capacity, proportional power delivery, automatic timing to smoothly vary response times, and energy-efficient disk management. Our results demonstrate that the current situation model provides a powerful platform for formulating energy management policies, and that our situation-based policies provide greater coherence in system-level energy management by capturing aspects of global energy consumption. Do other activities until the tank is full.Hence the idea that it detects and displays the water level in order to switch off the pump in good time, thus saving water, electricity and time. Therefore, the Automatic Water Level Controller with LoRa project can definitely be useful on a large scale due to the minimal staff required and the simpler installation process that makes it more compatible for everyone.

FUTURE SCOPE

Absolutely Huge! The development of "Big Data" and the Internet of Things should quickly bring new aspects of energy management to the fore that will be difficult to imagine in a few years. Remember when IT pros doubted there ever was a market for personal computers!I suspect that we are at a similar stage when it comes to energy management. Demand management, local generation and microgeneration, storage and demand pricing are not just around the corner, they are actually there in one way or another. Connected and widespread, they make every residential and commercial building a hub for energy management, and those who can't keep up with the technology can overpay for energy and be uncompetitive. This will cause problems aspeople who don't have internet or email are struggling today and society needs to work to ensure that the remaining people do not experience a rise in fuel poverty. However, I believe that this will be the cornerstone of our transition to a low-carbon economy and therefore a major positive force.

Energy Efficiency: With growing concerns about climate change and the need to reduce energy consumption, businesses and organizations are actively seeking ways to improve energy efficiency. An energy monitoring app can help departments track and analyze their energy usage, identify areas of high consumption, and implement measures to optimize energy efficiency. This focus on sustainability is expected to continue in the future, leading to an increased demand for energy monitoring solutions.

Cost Savings: Energy costs represent a significant portion of operational expenses for many departments. By monitoring energy usage in real-time and providing insights into consumption patterns, an app can help identify opportunities for cost savings. This can include adjusting usage during peak hours, identifying energy wastage, and optimizing energy consumption based on occupancy and usage patterns. As energy prices continue to rise, the ability to

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track and manage energy usage efficiently will become even more valuable.

Regulatory Compliance: Governments and regulatory bodies are imposing stricter energy efficiency and reporting requirements on businesses and organizations. An energy monitoring app can help departments ensure compliance with these regulations by providing accurate and detailed energy usage data, facilitating reporting and audits, and supporting sustainability initiatives. As regulations become more stringent, the demand for solutions that simplify compliance will increase.

Integration with Smart Devices: The proliferation of smart devices and the Internet of Things (IoT) presents opportunities for integrating energy monitoring apps with various sensors and devices. For example, smart thermostats, lighting systems, and occupancy sensors can provide real- time data on energy usage, which can be seamlessly integrated into the monitoring app. This integration allows for more comprehensive and granular monitoring, enabling departments to make data-driven decisions for energy optimization.

Data Analytics and Machine Learning: Energy monitoring apps can leverage data analytics and machine learning algorithms to provide deeper insights into energy usage patterns, identify anomalies, and make accurate predictions. By analyzing historical data and combining it with other factors like weather conditions, occupancy, and operational schedules, the app can offer recommendations for optimizing energy consumption and reducing waste. As machine learning and AI technologies advance, the app's predictive capabilities will improve, enhancing its value in energy management.

Sustainability Reporting: Many businesses and organizations are now publishing sustainability reports to showcase their commitment to environmental responsibility. An energy monitoring app can provide the necessary data and metrics for sustainability reporting, including carbon footprint calculations, energy efficiency ratios, and progress toward energy reduction goals. As sustainability reporting becomes a standard practice, the demand for energy monitoring apps with robust reporting capabilities will increase.

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