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SMART VOLTAGE, CURRENT AND TEMPERATURE MONITORING BY USING IOT IN POWER DISTRIBUTION SYSTEM

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ABSTRACT

An innovative approach to weather monitoring, the suggested system makes use of the Internet of Things to make its real-time data readily available across a vast area. This system uses a network of sensors to track a wide range of environmental variables, including but not limited to: air temperature, humidity, wind speed and direction, precipitation, light intensity, ultraviolet radiation, and even amounts of carbon monoxide. The web page receives data from these sensors, which are then shown graphically as statistics. Accessible from any location in the globe, the data posted to the website is readily available. The information acquired from these websites may also be used for reference purposes in the future. An app that notifies users of impending weather changes is also part of the project. This serves as an effective alarm mechanism. We use an API that evaluates the data gathered by the sensors and produces an accurate prediction when it comes to more complicated weather forecasts that sensors alone are unable to handle. Using this API, you may save data for later use and retrieve it from anywhere at any time with reasonable simplicity. There is less wear and tear on this design because of its small size and lack of moving components. Some of the parts of this project can even be run off of solar energy because of how little electricity they need. In terms of price and efficiency, the smart weather monitoring system outshines competing products.

I. INTRODUCTION

Electricity is distributed to all homes via the Electricity Grid, a network of intermediary managed power transmission hubs, by energy producing corporations. Sometimes issues develop as a result of power grid breakdown, which causes a complete blackout of a region that was receiving power from that system. The goal of the project is to find a solution to this problem by using the Internet of Things (IoT) as a communication medium. It will also address additional concerns that a smart system can handle in order to prevent energy operations from wasting energy. AT mega family controller is the foundation of IOT smart energy grid and regulates the system's numerous functions. Using Wi-Fi technology, the system is able to communicate over the internet. Throughout the course of this research, a bulb serves as both a legitimate and an invalid customer. Re-establishing communication between the operational grid's transmission lines is the project's primary goal. In the event that one energy grid has a malfunction and a backup grid is available, the system will redirect the transmission lines to the backup grid, sparing the area in question from a power outage. And the authorities may check the IOT Gecko portal to see which grids are operational and get the latest updates. In addition to keeping an eye on the power system, this initiative can track energy use and even identify instances of power theft. The IOT Gecko homepage updates not only the energy information but also the quantity of power utilised and the predicted cost of consumption. We came up with a suggested method that works of energy meter over IoT to address the faults that arise due to manual power billing. Energy meters, Arduino Uno boards, Wi-Fi modules, sensors, and a supplied display unit make up the bulk of this system.

II. LITERATURE SURVEY

The Internet of Things (IoT) has reached several different participants and received greater awareness one year following the prior version of the Cluster book (2012). Smart Cities (and regions), Smart Cars and mobility, Smart Homes and assisted living, Smart Industries, Public safety, Energy and environmental protection, Agriculture, and Tourism as components of an IoT Ecosystem in the future have garnered significant interest among the many possible Internet of Things application areas. This trend is consistent with the fact that most governments throughout the Americas, Europe, and Asia increasingly see the Internet of Things as a potential growth and innovation sector. Larger companies in certain industries have yet to see the possibilities, but many others are paying close attention, and some are even speeding up the process by coming up with new words to describe the Internet of Things and adding more components to it. In addition, both individual and corporate end-users have become quite proficient in using smart gadgets and apps that are connected to the internet. The future of the Internet of Things is being predicted by combining it with other relevant technological techniques and ideas, such as robots, cloud computing, big data, the future of the internet, and semantic technologies. The notion is not novel in and of itself, but it is becoming more apparent as related ideas begin to show signs of synergy when combined.

But there are a lot of things that are holding the Internet of Things back from reaching its full potential, so it's still in its early stages of development. The most important of these difficulties is the lack of a universally accepted method for assigning and tracking distinct identities to different types of permanent and transient objects. -The adoption and advancement of IoT reference designs will not be expedited. -Heterogeneous environment sensor data exchange has seen less progress in semantic interoperability. -Security and privacy concerns in an increasingly complicated environment make it hard to define a clear strategy for fostering innovation, trust, and data ownership in the IoT. Creating a company that uses the Internet of Things to its maximum capacity is challenging. -The lack of extensive testing and learning settings, which enhance the ability to experiment with intricate sensor networks and inspire new ideas via introspection and practical application.

1], details the installation of a non-invasive current-based energy meter. One benefit of noninvasive current sensing is its flexibility in terms of placement relative to the power source. In this scenario, the data on energy use is shown on a smartphone. For data transmission via the internet, an ENC28J60 Ethernet module was used. An AMR that relies on power line communication (PLCC) was developed by S.H. Ju et.al. [3]. Data transmission across electrical wire lines is the essence of PLCC. This potential necessitates making the necessary adjustments to the home's electrical wiring. As an added bonus, it detects the mains current using an intrusive approach. The user is unable to track the power consumption of specific devices, which is a drawback of this kind of system.

[2] details the integration of the ubiquitous GSM/GPRS network into a wireless automated meter reading system (WAMRS). A microcontroller is part of the system, and it communicates with a master station using an existing GSM/GPRS network to provide power consumption figures that are computed from the voltage and current measurements that are observed. This technology's biggest drawback is the distance problem. One potential drawback is slow operating speed, while another is the lack of significant long-distance GPRS or GSM network coverage.

III. DESIGN OF HARDWARE

In this chapter, we will take a quick look at the hardware. It goes into great depth on the schematic of every module.

ARDUINO UNO

One such microcontroller board is the Arduino Uno, which uses the ATmega328 (datasheet). There are 14 I/O digital pins (with 6 being PWM outputs), 6 analogue inputs, a USB port, a power connector, an ICSP header, a reset button, and a 16 MHz ceramic resonator. All you need is a USB cable, an AC-to-DC converter, or a battery to get it going; it comes with everything you need to support the microcontroller.Unlike all of its predecessors, the Uno doesn't have the FTDI USB-to-serial driver chip. Instead, it has a USB-to-serial converter coded into the Atmega16U2 (or Atmega8U2 up to version R2). A resistor on the Uno board pulls the 8U2 HWB line to ground, simplifying the process of entering DFU mode. Here are some new features of the Arduino board:

The 1.0 pin out includes two more pins—the IOREF, which enable the shields to adjust to the board's voltage—near the RESET pin, as well as two additional pins—the SDA and SCL—near the AREF pin. Eventually, shields will be backwards-compatible with both the 5V AVR boards and the 3.3V Arduino Due boards. The second pin is retained for future use and is not yet connected.

The RESET circuit is now stronger.

The 16U2 is an upgrade over the 8U2.

In honour of the impending release of Arduino 1.0, the name "Uno" was chosen since it means "one" in Italian. As of this point on, the Uno and version 1.0 will serve as the Arduino reference versions. See the Arduino board index for a comparison with earlier generations; the Uno is the most recent USB Arduino board and the platform's base model.

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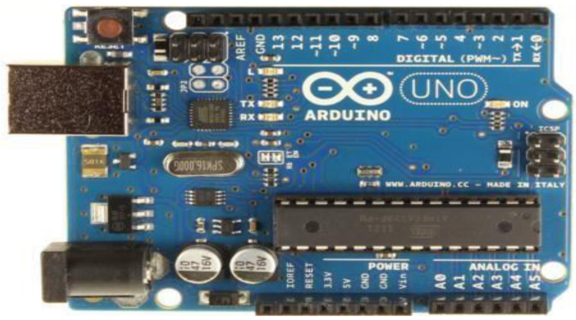


Fig: ARDUINO UNO

POWER SUPPLY:

Electrical circuits and other equipment rely on low-voltage power supplies, which transform high-voltage AC mains energy into a more manageable form. Dissecting a power supply into its component parts reveals that each one is responsible for a certain task. Regardless of changes in the alternating current (a.c.) mains or changes in the load, a "Regulated D.C. Power Supply" will keep the output voltage constant.

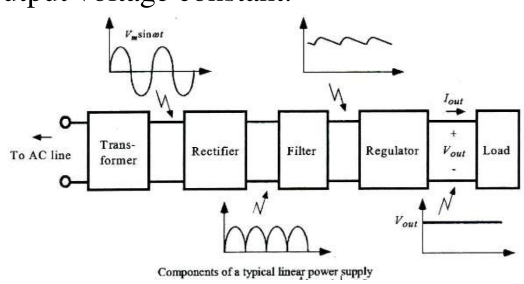


Fig: Block Diagram of Power Supply

LCD DISPLAY

The most popular model in practice is the one detailed here because of its cheap price and wide possibilities. It uses the Hitachi HD44780 microprocessor and has a 16-character message display capability on each of its two lines. It shows every letter of the alphabet, every Greek letter, every punctuation mark, every mathematical symbol, and more. Additionally, user-generated symbols may be shown. Among the most helpful features are those that automatically change the display's message (left and right shift), pointer appearance, lighting, and so on.

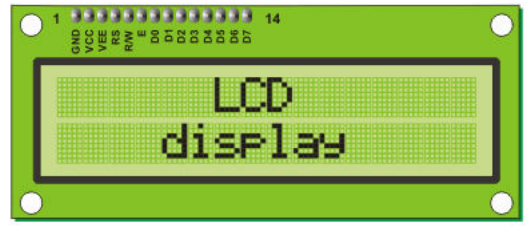
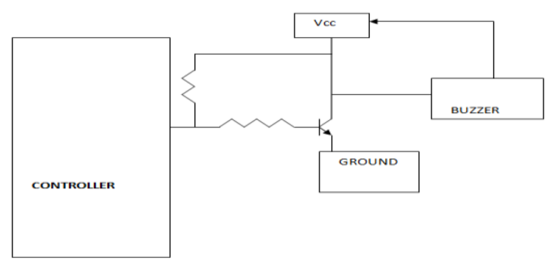


Fig: LCD

BUZZER

Not enough current is flowing via digital systems and microcontroller pins to power the circuits (buzzer circuits, relay circuits, etc.). Although these circuits have a current need of around 10 milliamps, the pin on the microcontroller can only provide 1-2 milliamps. This is why the microcontroller and buzzer circuit are separated by a driver, such a power transistor.



WIFI MODULE:

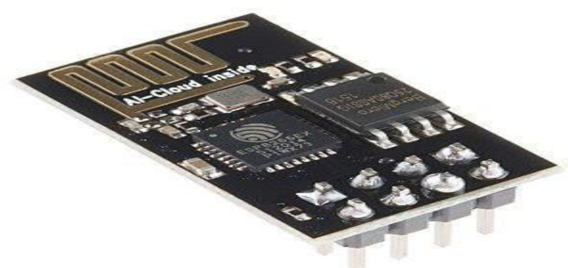
Chinese firm Espressif Systems makes the ESP8266, an affordable Wi-Fi microprocessor that can function as a microcontroller and has a complete TCP/IP stack.[1]

Ai-Thinker, a third-party producer, brought the chip to the attention of western OEMs in August 2014 with their ESP-01 module. With this little gadget, microcontrollers can establish basic TCP/IP connections using

Hayes-style instructions and connect to a Wi-Fi network. Unfortunately, there was a severe lack of English-language information on the chip and the orders it could process back then.Many hackers were interested in the module, chip, and software on it, and they translated the Chinese documentation, because of the cheap pricing and the fact that there were very few external components on the module, which indicated that it may someday be extremely affordable in volume.the third

As an ESP8266 with 1 MiB of on-chip flash, the ESP8285 enables single-chip devices to establish Wi-Fi connections.[4]

The ESP32 is the chipset that will replace these microcontrollers.



LED:

One kind of semiconductor that can produce light is known as a light-emitting diode (LED). When turned on, this p-n junction diode produces light.[5] By applying an appropriate voltage to the leads, the device enables electrons to recombine with electron holes, resulting in the release of energy as photons.

This phenomenon is known as electroluminescence, and the semiconductor's energy band gap dictates the light's colour, which is proportional to the photon's energy. LEDs often have tiny surfaces (less than 1 mm2) and may have optical components built in to control the beam's angle of incidence.

Indicator lights for electrical equipment often used early LEDs, which succeeded tiny incandescent bulbs. Digital clocks and other numeric readouts quickly began to incorporate them into seven-segment displays. Modern advancements have produced LEDs that are well-suited for both ambient and task illumination. Because of their rapid switching rates, LEDs have found usage in cutting-edge communications technology and have spawned new kinds of displays and sensors.Lower energy usage, longer lifespan, increased physical robustness, smaller size, quicker switching—these are just a few of the numerous benefits that LEDs provide over incandescent light sources. Aviation lights, car headlights, advertising, general illumination, traffic signals, camera flashes, and illuminated wallpaper are just a few of the many uses for light-emitting diodes. On top of that, they use much less energy and, ostensibly, pose less disposal-related environmental risks.

DHT TEMPERATURE & HUMIDITY SENSORS.

These sensors aren't fast or sophisticated, but they're perfect for amateurs who just want to record the bare minimum. A thermistor and a capacitive humidity sensor are the two main components of a DHT

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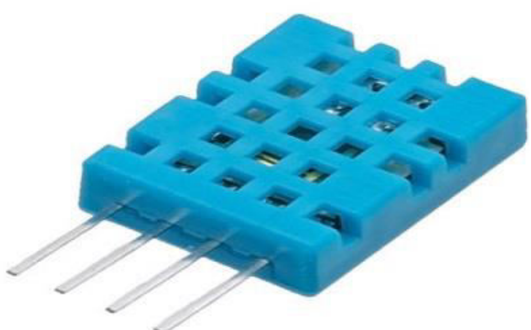
sensor. In addition, a simple internal chip converts analogue signals to digital ones and then puts out a digital signal including the environmental variables (heat and humidity, for example). Any microcontroller should have no trouble deciphering the digital stream.

The amount of water vapour in the air is called humidity. Numerous physical, chemical, and biological processes are impacted by the atmospheric humidity level. Humidity has the potential to impact product costs, worker health, and safety in industrial settings. Therefore, humidity measurement is crucial in the semiconductor and control system sectors. Gases may be a combination of water vapour, nitrogen, argon, or pure gas, and the quantity of moisture in them can be determined by measuring their humidity. The units of measurement distinguish between two main kinds of humidity sensors. There are two types of humidity sensors: absolute and relative. The digital humidity and temperature sensor DHT11.

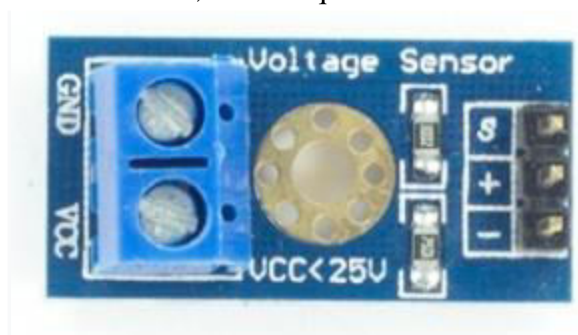


CURRENT SENSOR

A device that can measure the electric current flowing through a wire and provide a signal proportionate to that current is called a current sensor. The output signal could be digital or analogue voltage or current. An ammeter can show the current reading, a data gathering system may store the signal for future study, or it can be utilised for control. For further details on modern sensors, see here.

VOLTAGE SENSOR:

The red terminal's input voltage may be reduced by a factor of five thanks to this module, which operates on the concept of resistance points pressure.The maximum voltage that this module can accept as an analogue input from an Arduino is 5 V, which means that it cannot accept an input voltage higher than 25 V (5 V x 5 = 16.5 V if operating on a 3.3 V system).Due to the 10-bit AD on the Arduino AVR processor, the simulation resolution of this module is 0.00489 V (5 V / 1023), and the input voltage for this module should be more than 0.00489 V x 5, which equals 0.02445 V.



Voltage sensor

The **Smart Voltage, Current, and Temperature Monitoring System** using **IoT** in a power distribution system enables real-time monitoring of electrical parameters, providing critical data for ensuring the safety, stability, and efficiency of power distribution. The system consists of an **Arduino microcontroller**, sensors (voltage, current, and temperature), and an IoT module (e.g., ESP8266 or GSM) to transmit the data to a cloud platform or mobile application for remote monitoring.

1. Components Overview:

- **Arduino**: Serves as the central control unit, collecting data from various sensors and processing the information.
- **Voltage Sensor**: Measures the voltage level in the power distribution lines.
- **Current Sensor**: Detects the current flow to ensure it is within safe operational limits.
- **Temperature Sensor**: Monitors the temperature of power components (like transformers or switches) to prevent overheating.
- **IoT Module (e.g., ESP8266 or GSM)**: Sends the monitored data (voltage, current, temperature) to a cloud platform or a remote server for real-time monitoring and analysis.
- **LCD/LED Display**: (Optional) Shows real-time voltage, current, and temperature readings on-site.
- **Buzzer or Alarm**: (Optional) Provides an audible alert in case of critical conditions like over-voltage, over-current, or overheating.

2. Key Functions of the System:

1. **Voltage Monitoring**:
   - The voltage sensor continuously measures the voltage level in the distribution system.
   - If the voltage exceeds or drops below predefined safety limits, an alert is generated, and the system sends a notification via the IoT module.
2. **Current Monitoring**:
   - The current sensor tracks the flow of electricity in the system.
   - Any abnormal increase or decrease in current (e.g., due to faults or overloads) triggers an alert, and protective measures may be activated to avoid damage.
3. **Temperature Monitoring**:
   - The temperature sensor monitors critical components such as transformers, switches, or other electrical parts that may overheat.
   - If the temperature crosses a threshold, the system sends an alert to warn operators of a potential hazard, preventing fires or equipment failure.
4. **Data Transmission via IoT**:
   - All measured data (voltage, current, temperature) is transmitted via the IoT module to a cloud platform for real-time remote monitoring.
   - Users can access this data through a mobile app or web interface to monitor the status of the power distribution system in real-time.

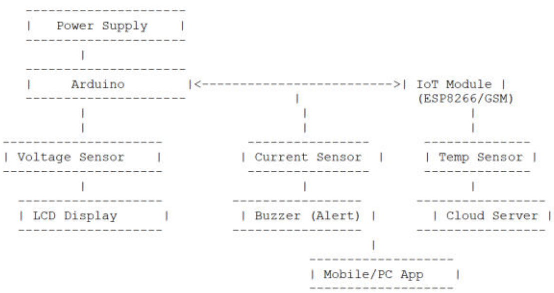
5. **Alerts and Notifications**:
   - If any sensor detects abnormal levels of voltage, current, or temperature, the system triggers an alarm, both locally (through a buzzer or display) and remotely (via notifications sent over the IoT network).
6. **Cloud Monitoring and Data Logging**:
   - The system sends real-time data to a cloud platform where it is logged for future analysis.
   - This helps in diagnosing issues, predicting maintenance needs, and optimizing power distribution.

3. Working Flow of the System:

1. **Initialization**:
   - Once powered on, the Arduino initializes and reads the input from the voltage, current, and temperature sensors.
2. **Data Collection**:
   - The sensors collect voltage, current, and temperature data from the power distribution system and send this information to the Arduino.
3. **Data Processing**:
   - The Arduino processes the raw data, comparing the readings to predefined safety thresholds.
4. **Local Alerts**:
   - If the sensor data indicates an unsafe condition (e.g., voltage or current out of range or overheating), the Arduino activates a buzzer or displays the issue on an LCD panel.
5. **IoT Data Transmission**:
   - Simultaneously, the Arduino sends the processed data to the IoT module (such as ESP8266), which transmits the information to a remote server or cloud platform.
6. **Remote Monitoring**:
   - The data can be accessed remotely using a mobile app or web interface, allowing operators to monitor the system in real-time.
7. **Continuous Monitoring**:
   - The system operates continuously, ensuring the power distribution system remains within safe operational limits.
   - Any faults or abnormal conditions are immediately reported, enabling quick intervention to prevent damage.

IV. BLOCK DIAGRAM:

The block diagram visually represents the system components and their interconnections, as described below.



5. Operational Flow:

1. **Power is supplied** to the Arduino and sensors.
2. The **voltage, current, and temperature sensors** measure the corresponding parameters from the power lines.
3. The **Arduino processes** the sensor data and sends it to the IoT module.
4. The **IoT module** transmits the data to a **cloud server** for real-time monitoring.
5. If any parameters are out of range, an **alert is triggered**, and data is displayed locally on the LCD while being sent to the cloud.
6. Users can monitor the system via a **mobile app** or web platform for remote access.

V. CONCLUSION:

An effective and real-time solution for guaranteeing the safety and dependability of power distribution networks is this smart system that monitors voltage, current, and temperature using Arduino and the Internet of Things. Preventing equipment failure, reducing downtime, and optimising power grid performance are all made possible with remote access enabled by monitoring crucial metrics and the Internet of Things (IoT).

The reduction of human effort and the enhancement of transformer efficiency is our primary goal in designing this gadget. Examine the transformer's electrical and physical parameters in real time using a monitoring system.

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