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# IOT Based Smart Energy Meter

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**ABSTRACT:** The "IOT BASED SMART ENERGY METER" project is an example of an Internet of Things application. A cutting-edge home energy management system that offers real-time information and control over household energy consumption is the "Smart Energy Meter" project. The Utilizing cutting-edge sensors, the system continuously tracks power consumption and transmits the information to the Blynk IoT platform, enabling customers to view their energy consumption data from a distance. Additionally, the device has an LCD display that offers local access to real-time data on power utilization. The automated load-cut-off mechanism is one of the "Smart Energy Meter" project's primary characteristics. In order to avoid overload and save the electrical infrastructure, the system immediately disconnects power-hungry devices when it senses an excessive power load.

**KEYWORDS:** IoT-based application, Smart Energy Meter, Smart Home solutions , IOT Based Smart Meter

## I.INTRODUCTION

Home power management is being revolutionized by the "Smart Energy Meter" initiative, granting you control and real-time insights. Consider it as a system of "eyes" (sensors) that continuously monitors the amount of energy used in your house. Next, this information is sent to a "brain" (Blynk). platform that you can view live consumption on and even remotely control gadgets from your phone. For fast glances, an LCD panel serves as a local "dashboard". Additionally, the system protects your house and appliances by automatically turning off power-hungry equipment like a superhero if a power outage occurs. This project is an advocate for smart homes and energy efficiency, demonstrating how embedded technology can revolutionize domestic energy management.

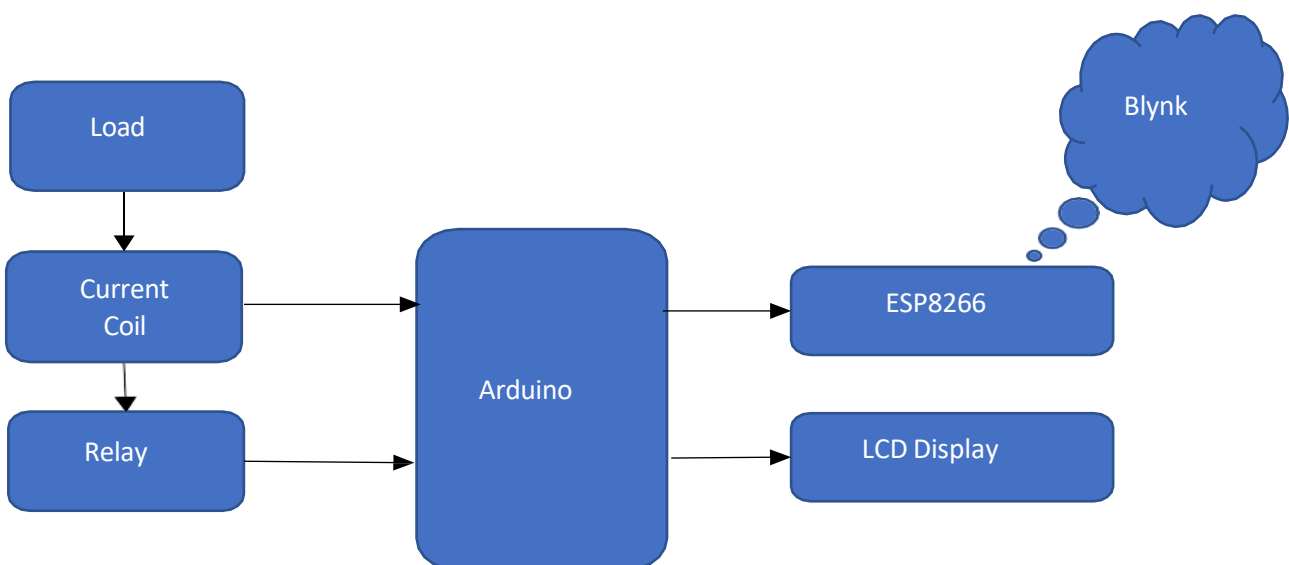


Figure 1: Illustrates the block diagram of this project

Innovation in the field of home energy management has been fueled by growing public awareness of energy consumption and its effects on the environment. Smart metering technologies are replacing outdated, opaque ones, enabling people to better understand, manage, and maximize their energy use. Leading this change is the "Smart Energy Meter" initiative, which promises automated safety measures, remote control, and real-time analytics.

## II. PROPOSED SYSTEM

Smart energy meters go beyond simply measuring current usage. They continuously monitor electricity flow, collect detailed data over time, and communicate wirelessly with the outside world. Think of them as the brain and nerve center of your home's electrical system, constantly providing insights and enabling control. A new era of automation and connectivity has been brought about by the Internet of Things (IoT), which has provided creative ways to improve many parts of our daily lives. In this regard, the creation of an Internet of Things-based automatic exhaust fan system is the main goal of our project. The main goal is to use IoT technologies to create an exhaust fan with more intelligence and responsiveness that can easily adjust to changing conditions. Our system attempts to offer an effective and user-friendly solution for ventilation demands in residential and commercial environments by integrating sensors and connection elements. This project's scope includes designing and implementing a smart exhaust fan that can be remotely controlled and seen via a specialized application. By integrating environmental sensors, the system will automatically modify fan speed in response to variables like humidity.

## III. SYSTEM OVERVIEW

The "Smart Energy Meter" revolutionizes home power management. Sensors capture real-time usage, processed by a chip and displayed on Blynk's remote interface or a local LCD. This data empowers users to control devices, analyze historical trends, and optimize consumption. An automatic load-cut protects against overloads. This symphony of hardware and software promotes efficiency, safety, and sustainability, transforming how we manage household energy.

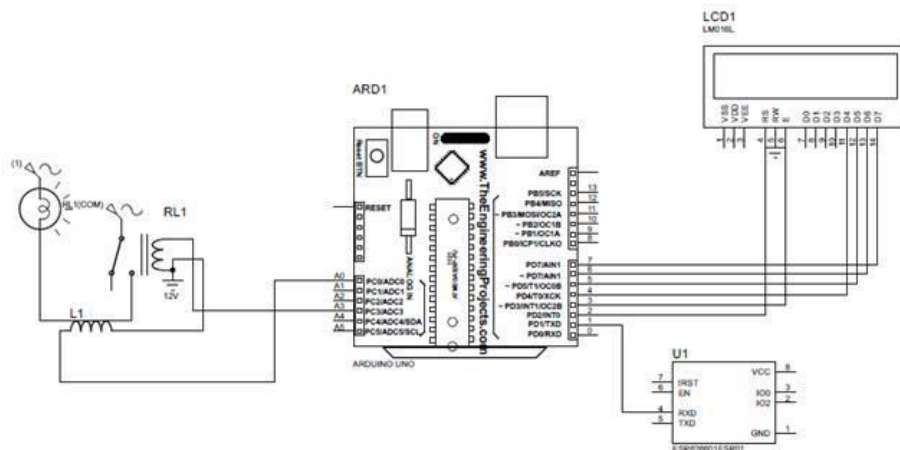


Figure 3: System Circuit Diagram

#### IV. HARDWARE DESCRIPTION

##### ARDUINO UNO

UNO is an Italian word for "among". To distinguish the initial release of Arduino software, it was given the designation UNO. Additionally, it was the first Arduino-released USB board. It's regarded as the influential board that works on numerous projects.



Figure 4.1: Arduino Uno

Using microcontroller kits, Arduino is an electronic software and hardware corporation, project, and community of users that creates interactive things and digital devices that are capable of controlling and sensing real-world items. The Free Software Foundation's General Public License (GPL) or the GNU Lesser Public License (LGPL) are the licenses under which the project's hardware and software are available, allowing anybody to share the software and build Arduino boards. Commercial preassembled Arduino boards are available, as well as DIY kits. The project's board designs make use of several controllers and microprocessors. These systems include sets of input/output (I/O) pins, both digital and analog, that may be interfaced with other expansion boards (also known as "shields") and other circuits. The boards provide serial communications ports for loading software from personal computers, including Universal Serial Bus (USB) on certain variants. A variant of the C and C++ programming languages is mainly used to program the microcontrollers. The Arduino project offers an Integrated Development System (IDE) based on the Processor language project in addition to utilizing conventional compiler toolchains.

The Arduino project began as a course for students at the Interaction Design Institute Ivrea in Ivrea, Italy, in 2005. Its goal was to give both experts and beginners a simple and affordable approach to designing gadgets that use sensors and actuators to interact with their surroundings. These kinds of gadgets are frequently designed for novice enthusiasts and include motion detectors, thermostats, and rudimentary robots. Hardware from Arduino is open-source. The Arduino website has hardware reference designs, which are made accessible under a Creative Commons Attribution Share-Alike 2.5 license. The GNU General Public License, version 2 governs the publication of the IDE's source code. However, there has never been an official Bill of Materials for Arduino boards. An early Arduino board with an Atmel ATmega8 microcontroller chip (black, bottom right) and an RS-232 serial interface (upper left); the power connector is at the lower left, the six analog input pins are at the lower right, and the top has 14 digital I/O pins.

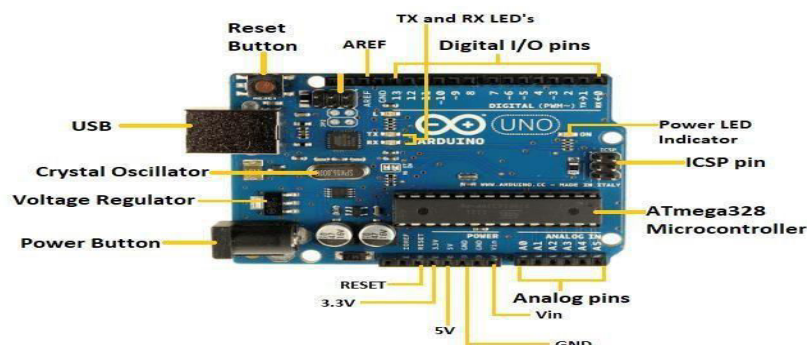


Figure 4.2: Pin Description of Arduino Uno

- **GND (3):** An acronym for "ground." The Arduino has multiple GND pins that you can utilize to ground your circuit.
- **3.3V (5) & 5V (4):** As one might expect, the 3.3V pin provides 3.3 volts of electricity, and the 5V pin provides 5 volts. The majority of the basic parts that are used with the Arduino gladly operate on 3.3 or 5 volts.
- **Analog (6):** The regions of pins on the UNO that are labeled "Analog In" (A0 through A5) are called "Analog In pins." These pins are able to read the signal from an analog sensor (such as a temperature sensor) and translate it into a readable digital value.
- **Digital (7):** The digital pins (0 to 13 on the UNO) are located across from the analog pins. These pins can be used for digital output, such as powering an LED, as well as digital input, such as signaling when a button is pushed.
- **PWM (8):** Some of the digital pins (3, 5, 6, 9, 10, and 11) may have had the tilde (~) next to them.

## SPECIFICATIONS

Microcontroller	ATmega328P
Operating Voltage	5V
Digital I/O Pins	14 (D0 - D13)
Analog Input Pins	6 (A0-A5)
Clock Speed	16 MHz
Flash Memory	32 KB
Wi-Fi	Not supported
Operating Temperature Range	-40°C to +85°C
Input Voltage	5V (via USB or VIN pin)
Output Voltage	5V
Current Consumption	~varies
USB-to-Serial Chip	CH340G
Programming Interface	USB
GPIO Pins	PWM, I2C, SPI
Onboard Antenna	No
Dimensions	68.6mm x 53.4mm
Compatible IDEs	Arduino IDE

## WORKING

The Arduino uno is a development board that utilizes the ATmega328P microcontroller module, allowing digital and analog input/output capabilities.

- **CPU and microcontroller:** The Arduino Uno makes use of the ATmega328P microprocessor, which has an 8-bit AVR CPU. On the board, this processor controls input/output, assigns and performs commands.
- **Voltage Regulation:** The Arduino Uno runs at 5V and is controlled by an integrated voltage regulator, much like the NodeMCU. This guarantees steady voltage levels for dependable coupled component performance.
- **Digital and Analog I/O:** The Arduino Uno has six analog input pins (A0-A5) and fourteen digital I/O pins (D0-D13). Project designs are made more flexible by the fact that these pins can be set up as inputs or outputs to communicate with different digital and analog devices.
- **Wi-Fi Connectivity:** The Arduino Uno lacks integrated Wi-Fi connectivity, in contrast to the NodeMCU. Nevertheless, you may use extra modules or shields, such the ESP8266 module or the ESP32, to give the Arduino Uno Wi-Fi capabilities, allowing for communication across Wi-Fi networks.
- **Programming and Communication:** The Arduino IDE is usually used to program the Arduino Uno. The board communicates with the computer using a USB-to-Serial chip (such the ATmega16U2 or CH340G) to enable uploading code, tracking output, and debugging.

- **GPIO and Communication Protocols:** The Arduino Uno's GPIO pins support a number of communication protocols, including PWM, I2C, and SPI, much like the NodeMCU. By facilitating communication with various gadgets and sensors, these protocols increase the board's functionality.
- **Operating System and Applications:** Unlike the NodeMCU, the Arduino Uno does not have an operating system. Rather, it runs code that is uploaded straight to the board. Usually written in C/C++, this code can be used for a variety of tasks such as automation systems, robotics, Internet of Things projects, and more.
- **Electricity Consumption:** Depending on how it is operating, the Arduino Uno uses different amounts of electricity. Using sleep modes and optimizing code are two examples of effective power management techniques that can help lower energy usage, particularly in battery-powered apps.

### Current Sensor Coil



Figure 4.3: GAS Sensor

An electrical device used to monitor alternating current (AC) in an electrical circuit is called a Current Transformer (CT) coil, sometimes referred to as a current sensor or current transformer. It is frequently used to precisely monitor and measure current levels without interrupting the circuit in power systems, industrial equipment, and metering applications. A magnetic core is encircled by a main and secondary winding in the CT coil. The circuit that needs to be used to measure the current is linked in series with the primary winding. The current is stepped down to a more controllable and quantifiable level by the secondary winding, which is often coiled with many more turns than the primary winding.

### Pin Description

**S (Signal) Pin:** The "S" pin could stand for "Signal." This pin might carry the output signal from the secondary winding of the current transformer coil. The signal could be voltage or current proportional to the primary current being measured. You would typically connect this pin to your measurement circuit or device. **G (Ground) Pin:** The "G" pin likely stands for "Ground." This pin would be connected to the common ground reference of your circuit. It provides a reference point for the module's internal circuitry and helps ensure accurate and stable measurements. In this interpretation, the "S" pin carries the measurement signal, and the "G" pin is used to establish a common ground reference. The module might be designed for a simpler application where only the signal and ground connections are necessary. Usage: Can be connected to an analog input pin on a microcontroller for precise measurement of gas concentration levels.

Connection: Connect this pin to an analog input pin on the microcontroller.

### Working

A current sensor is a device that can both detect current and convert it to an output voltage that can be measured. All that is necessary to determine this output voltage is the current flowing through the measured route. Following that, this output voltage signal is either retained for further analysis within a data collecting system, employed for regulating purposes, or used to display the current recorded within an ammeter. Thus, a current sensor's purpose is this.

### 16x2 Liquid Crystal Display LCD:

One popular kind of alphanumeric display module that can show two lines of text with a maximum of 16 characters per line is a 16x2 LCD (Liquid Crystal Display). These screens are frequently used to show information to people in a variety of electronics projects, gadgets, and applications. The following information relates to a standard 16x2 LCD module:

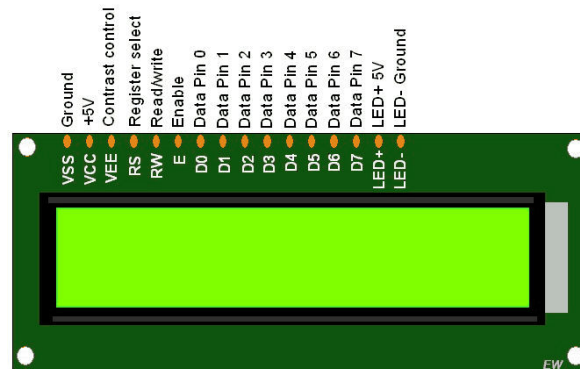


Figure 4.4: 16x2 Liquid Crystal Display LCD

### ESP8266 WiFi MODULE:

Popular and adaptable, the ESP8266 Wi-Fi module was created by Espressif Systems. Because of its affordability and features, it attracted a lot of attention and became a mainstay in the maker and Internet of Things communities.

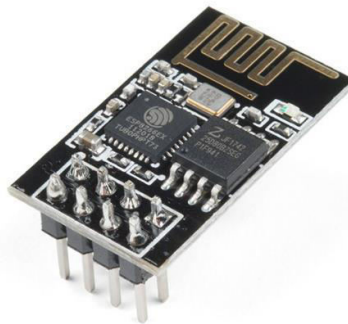


FIGURE 4.5.: ESP8266 WiFi MODULE:

#### Pin Description

**VCC (3.3V):** Power supply pin. The module requires a 3.3V power source. Applying higher voltage can damage the module.

**GND:** Ground reference pin.

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**GPIO0:** General-purpose digital I/O pin. It's also used during boot-up to determine the boot mode of the module. Depending on its state during boot, the module can enter programming mode, flashing mode, or normal operation.

**GPIO2:** General-purpose digital I/O pin. This pin can be used for general I/O operations.

**TX (Transmit):** Serial transmit pin for communicating data from the module to an external device.

**RX (Receive):** Serial receive pin for receiving data from an external device. **CH\_PD (Chip Enable):** This is the chip enable pin. It must be held high for the module to function.

**RESET:** Reset pin. Pulling this pin low momentarily resets the module.

**GPIO4:** General-purpose digital I/O pin.

**GPIO5:** General-purpose digital I/O pin.

**GPIO12:** General-purpose digital I/O pin.

**GPIO13:** General-purpose digital I/O pin.

**GPIO14:** General-purpose digital I/O pin.

**GPIO15:** General-purpose digital I/O pin. Its state during boot determines whether the module boots into UART download mode.

**GPIO16:** General-purpose digital I/O pin. This pin can also be used to wake the module from deep sleep mode.

**ADC (Analog to Digital Converter):** This pin can be used to read analog voltages. The ESP8266 has a single ADC input.

## V. SYSTEM FLOW

### Hardware assembly:

- Connect the microcontroller, WiFi module, Current coil and load according to the circuit diagram provided.
- Ensure proper power supply connections and ground connections.

### Programming the microcontroller:

- Write a program for the microcontroller (Arduino uno) to read data from the Current coil , control the Energy , and communicate with the WiFi module.
- Implement logic to determine current flow based on Current coil readings.

### IOT Connectivity

- Set up the Wi-Fi module to connect to a Wi-Fi network.
- Use an IoT platform such as Blynk or Thing Speak to send data from the microcontroller to the cloud.

## VI. RESULT AND DISCUSSION

The initiative known as "Smart Energy Meter" offers a viable way to transform domestic power management. Its emphasis on user control, safety features, and real-time insights is in line with the growing needs for sustainability and efficiency. Enhancement and resolution of any obstacles can maximize its influence and facilitate its extensive integration. Continuous power consumption information is made possible by sensors and the Blynk IoT platform, enabling users to optimize usage and make well-informed decisions. promotes energy-efficient behavior, which may result in lower energy costs and a less environmental effect.



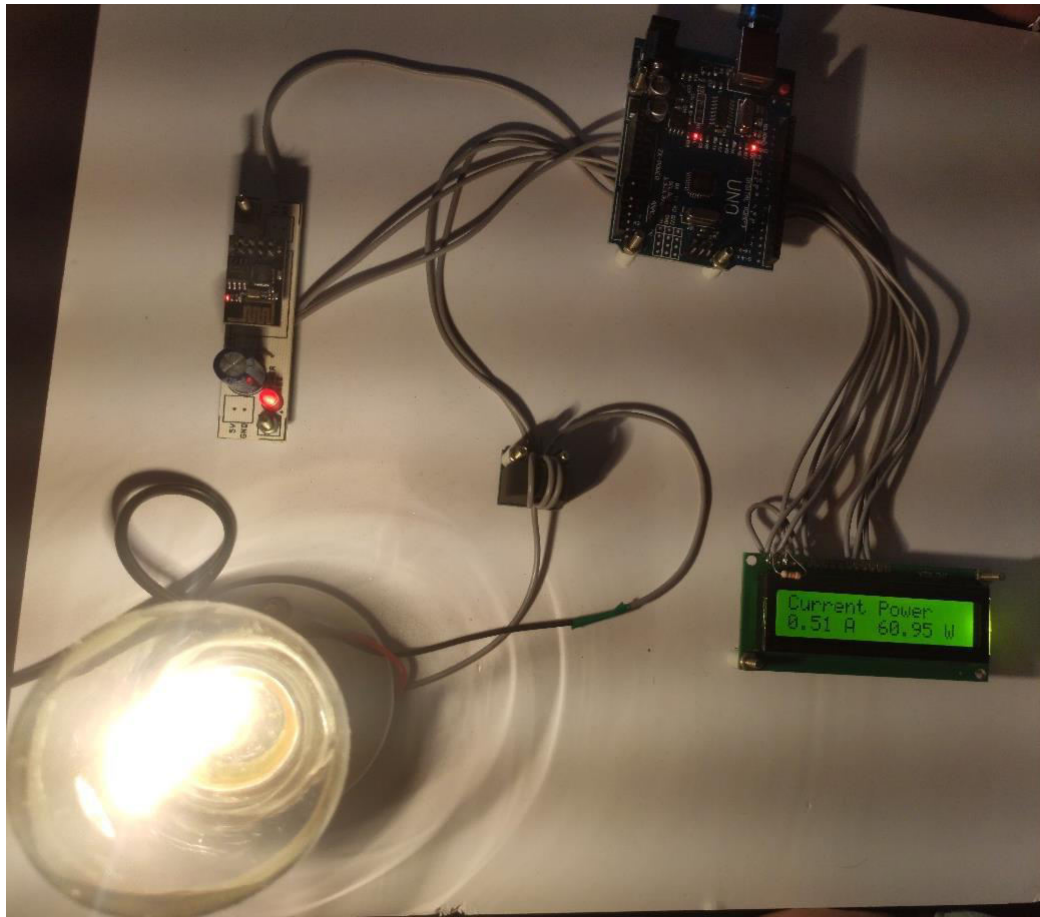


Figure 6.1 demonstrates the process of (IoT) - based Smart Energy Meter

## VII. CONCLUSION

The "Smart Energy Meter" project gives homes unprecedented control and awareness, marking a revolutionary step forward in residential power management. Through the seamless integration of cutting-edge sensing technologies, intuitive interfaces like Blynk and LCD displays, and clever features like automated load control, it sets the stage for an efficient, secure, and sustainable energy use in our homes in the future. This cutting-edge system is a shining example of embedded systems' potential to transform the way we interact with and manage basic resources in our daily lives. Essentially, the "Smart Energy Meter" project does more than just track how much electricity we use; it gives us the ability to manage the energy symphony in our homes, enabling us to make more sustainable decisions in the future.

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