

# Arduino Based Advanced Energy Efficient Industrial Automation System

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## Abstract

This paper presents the design, construction, control and evaluation of automatic electrical load controlling system. This is an intelligent step in smart automatic industrial load controlling system than those which are already taken. Intelligent technology is the kind of smart technology that delivers new insights and revolutionize how we live.

The system makes a use of intelligent technology to sense the motion as well as the ambient temperature of surrounding using special sensors automatically controls the electrical utilities at home by keeping the number of running loads under a fixed limit and thus helps to save energy.

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## Introduction

An automatic electrical load controlling system's design, construction, control, and evaluation are discussed in this work. This is a more thoughtful action than those taken in the intelligent automatic load controlling system. Technology that revolutionizes our way of life and provides fresh insights is intelligent technology. The system employs intelligent technology to sense ambient temperature and illumination using special sensors, and it automatically manages the electrical utilities at industrial facilities by limiting the number of running loads. This aids in energy conservation. This study presents an autonomous system that is intended to cost-effectively meet the demands of today's modern technologies.

In recent times, there are more number of people prone to disabilities due to various factors. To alleviate the life of differently abled people, we propose a project which uses hand gestures to operate devices in the surrounding.

## Literature Review Existing system

Unattended high-power devices are a problem since they use more electricity. We are choosing the proposed technology to address this issue because there is a lot of power loss and high costs. Digitisation and automation are becoming increasingly prevalent in our daily lives, both inside and outside the house. They are all attempts to simplify, use easily, monitor and be aware of any devices in a house that are connected to the system. These automated systems can be an alternative to other home manual settings. Smart homes are

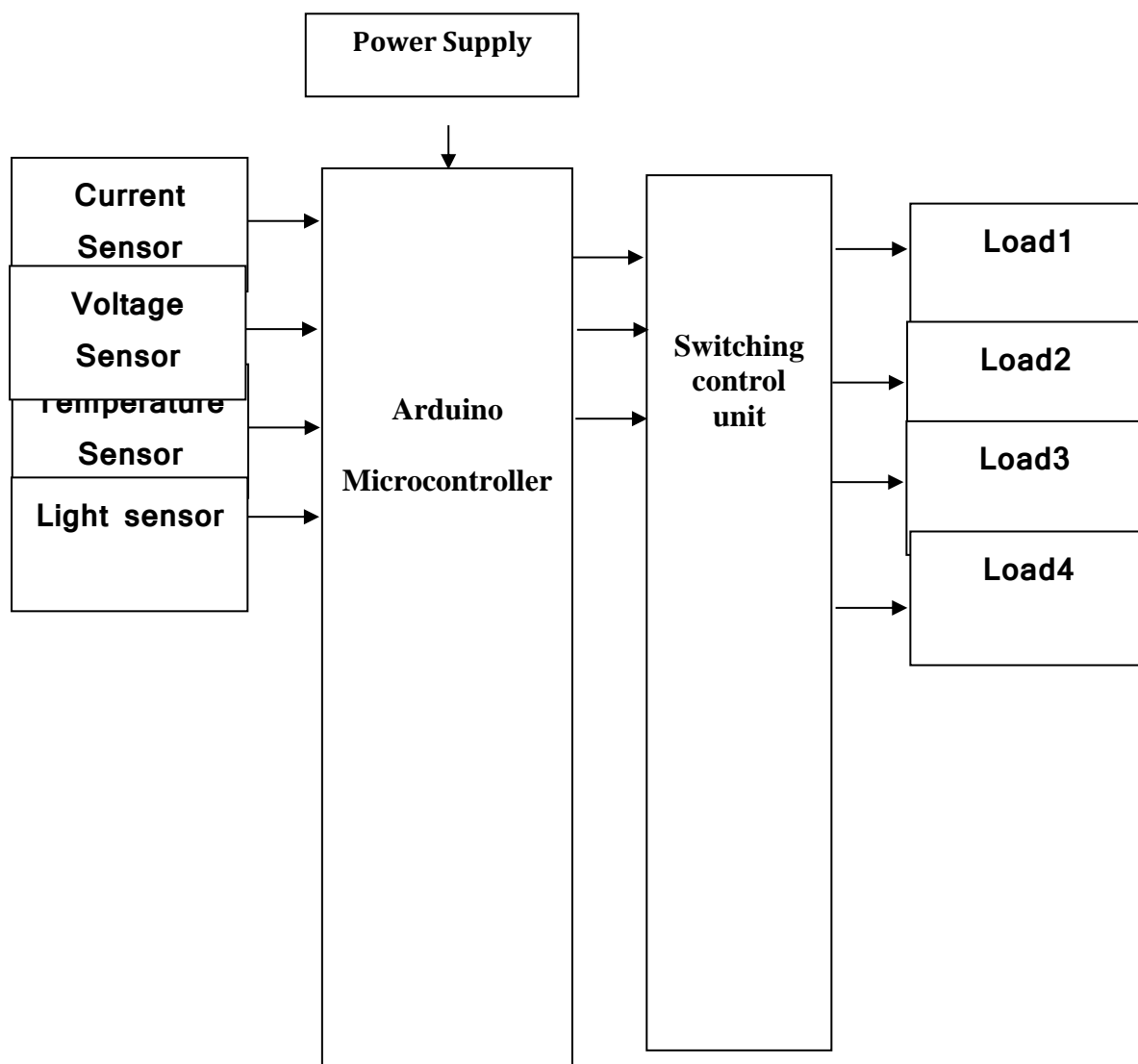
rarely found in my country, Iraq. People's unfamiliarity with them, the lack of use, the costs and a failure to see the importance of such systems are all possible explanations for this. Nowadays, it is generally advancing very rapidly, the internet and smart phones in particular. Using such technology and devices is inevitable and difficult to avoid. Such smart systems are able to indicate and control light, temperature, dew point, gas flow, fire ignition, opening

### **Proposed system**

For developing energy efficient automatic utility control system, the device consists of voltage sensor current sensor with temperature monitoring unit for measuring ambient temperature and the illumination measuring unit to provide information about light. Both the data of ambient condition are continuously sent to the micro controller.

The micro controller is pre-programmed to check the number of running loads all the time. If number of running loads crosses a certain limit (the limit is preset by the embedded program in micro controller. In this case, the maximum limit is set at three loads) then one of the loads will be disconnected automatically. The purpose of switching on or off of each load is controlled by the switching control unit. The decision of which load will be disconnected is taken by the micro controller evaluating the ambient data sent by the sensors. Let, three loads (a light, a fan and a television) are running at a time. When a fourth load is switched on or added, the number of running loads may cross the set limit and if the combined loads crosses a set limit, one of the loads will be disconnected automatically to save energy depending upon priority of the load. If there is enough daylight, the light will be off sensing that the light will not be necessary during day time. Similarly, if the ambient temperature is not hot, the fan will be forced to turn off. So, the system considers about users' comfort and works accordingly.

## Block Diagram

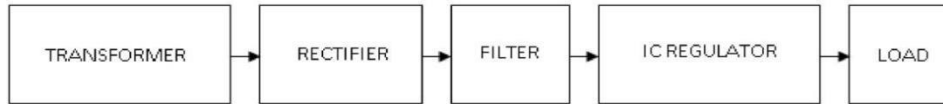


**Figure 1. Block Diagram of Arduino based advanced energy efficient industrial automation system.**

### Hardware Components

#### Power Supply

The power supply section is the section which provides +5V for the components to work. IC LM7805 is used for providing a constant power of +5V. The ac voltage, typically 220V, is connected to a transformer, which steps down the ac voltage down to the level of the desired dc output. A diode rectifier then provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a dc voltage. This resulting dc voltage usually has some ripple or ac voltage variation. A regulator circuit removes the ripples and also retains the same dc value even if the input dc voltage varies, or the load connected to the output dc voltage changes. This voltage regulation is usually obtained using one of the popular voltage regulator IC units.



**Figure 2. Block diagram of power supply**

### **Transformer**

Transformers convert AC electricity from one voltage to another with little loss of power. Transformers work only with AC and this is one of the reasons why mains electricity is AC.

Step-up transformers increase voltage, step-down transformers reduce voltage. Most power supplies use a step-down transformer to reduce the dangerously high mains voltage (230V in India) to a safer low voltage.

The input coil is called the primary and the output coil is called the secondary. There is no electrical connection between the two coils; instead they are linked by an alternating magnetic field created in the soft-iron core of the transformer. Transformers waste very little power so the power out is (almost) equal to the power in. Note that as voltage is stepped down current is stepped up.

### **Rectifier**

There are several ways of connecting diodes to make a rectifier to convert AC to DC. The bridge rectifier is the most important and it produces full-wave varying DC. A full-wave rectifier can also be made from just two diodes if a centre-tap transformer is used, but this method is rarely used now that diodes are cheaper. A single diode can be used as a rectifier but it only uses the positive (+) parts of the AC wave to produce half-wave varying DC.

Rectifier circuit is the most used circuit because almost every electronic appliance operates on DC (Direct Current) but the availability of the DC Sources are limited such as electrical outlets in our homes provide AC (Alternating current). The rectifier is the perfect candidate for this job in industries & Home to convert AC into DC. Even our cell phone chargers use rectifiers to convert the AC from our home outlets to DC. Different types of Rectifiers are used for specific applications.

### **Bridge Rectifier**

When four diodes are connected as shown in figure, the circuit is called as bridge rectifier. The input to the circuit is applied to the diagonally opposite corners of the network, and the output is taken from the remaining two corners. Let us assume that the transformer is working properly and there is a positive potential at point A and a negative potential at point B. the positive potential at point A will forward bias D3 and reverse bias D4.

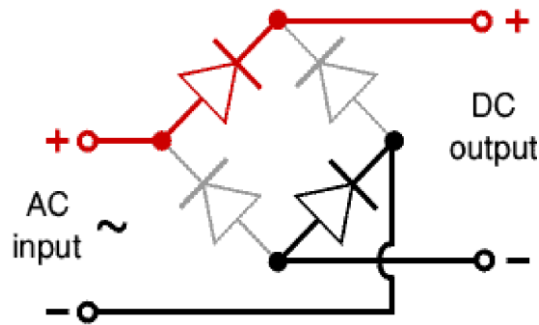


Fig 3: rectifier

### Voltage Regulators

Voltage regulators comprise a class of widely used ICs. Regulator IC units contain the circuitry for reference source, comparator amplifier, control device, and overload protection all in a single IC. IC units provide regulation of either a fixed positive voltage, a fixed negative voltage, or an adjustable set voltage. The regulators can be selected for operation with load currents from hundreds of milli amperes to tens of amperes, corresponding to power ratings from milli watts to tens of watts.

A fixed three-terminal voltage regulator has an unregulated dc input voltage,  $V_i$ , applied to one input terminal, a regulated dc output voltage,  $V_o$ , from a second terminal, with the third terminal connected to ground.

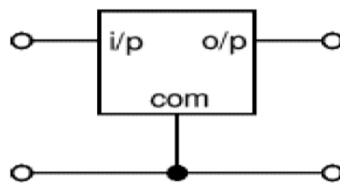


Fig 4: voltage regulators

### LCD (liquid crystal display)

The most commonly used Character based LCDs are based on Hitachi's HD44780 controller or other which are compatible with HD44580. The most commonly used LCDs found in the market today are 1 Line, 2 Line or 4 Line LCDs which have only 1 controller and support at most of 80 characters, whereas LCDs supporting more than 80 characters make use of 2 HD44780 controllers. Most LCDs with 1 controller has 14 Pins and LCDs with 2 controller has 16 Pins (two pins are extra in both for back-light LED connections).

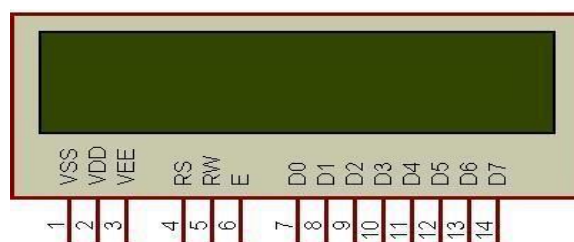


Figure 4.LCD type HD44780 pin diagram

## PCB BOARD

PCB (Printed Circuit Board) is an essential component in modern electronic devices. It provides a foundation for mounting and connecting electronic components together to form a functioning electronic circuit. A PCB is a thin board made of a non-conductive material, usually fiberglass, with conductive tracks or pathways etched onto its surface. The etched tracks are used to connect various components, such as resistors, capacitors, transistors, and ICs (Integrated Circuits) together to create a functional electronic circuit.



## ARDUINO UNO:

USB-to-serial driver chip. Instead, it features the Atmega8U2 programmed as a USB-to-serial converter. The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI

"Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform; for a comparison with previous versions, see the index of Arduino boards.

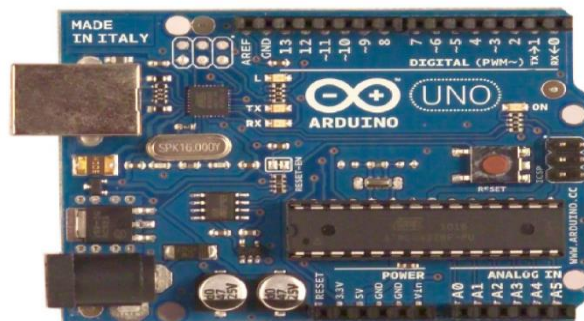


Fig 4: Arduino uno

### Temperature Sensor :

The LM35 is an integrated circuit sensor that can be used to measure temperature with an electrical output proportional to the temperature (in °C)

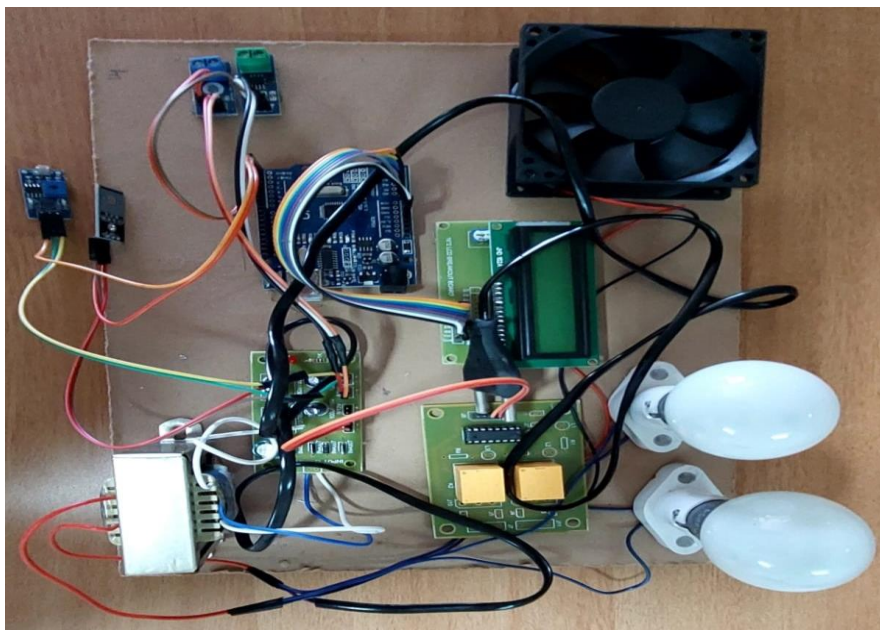
Have you ever left your smartphone in your car on a hot day? If so, your screen might have displayed an image of a thermometer and a warning that your phone has overheated. That is because there is a tiny embedded temperature sensor that measures the interior temperature of your phone. Once the inside of the phone reaches a certain temperature (iPhones shut down at approximately 113 degrees Fahrenheit, for example), the temperature sensor sends an electronic signal to an embedded computer. This, in turn, restricts users from accessing any applications or features until the phone has cooled back down, as running programs would only further damage the phone's interior components.

### Voltage sensor :

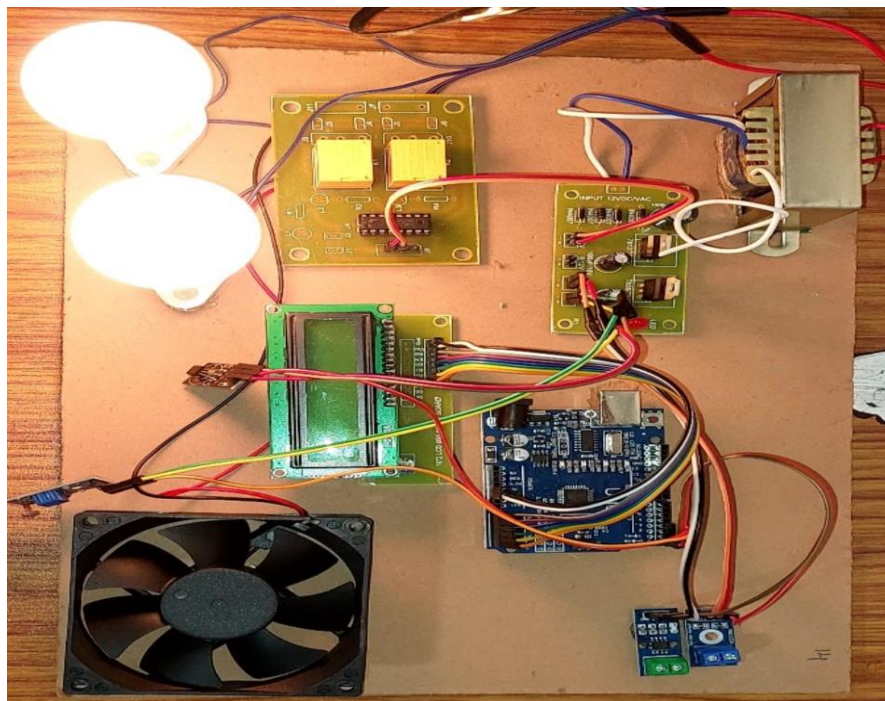
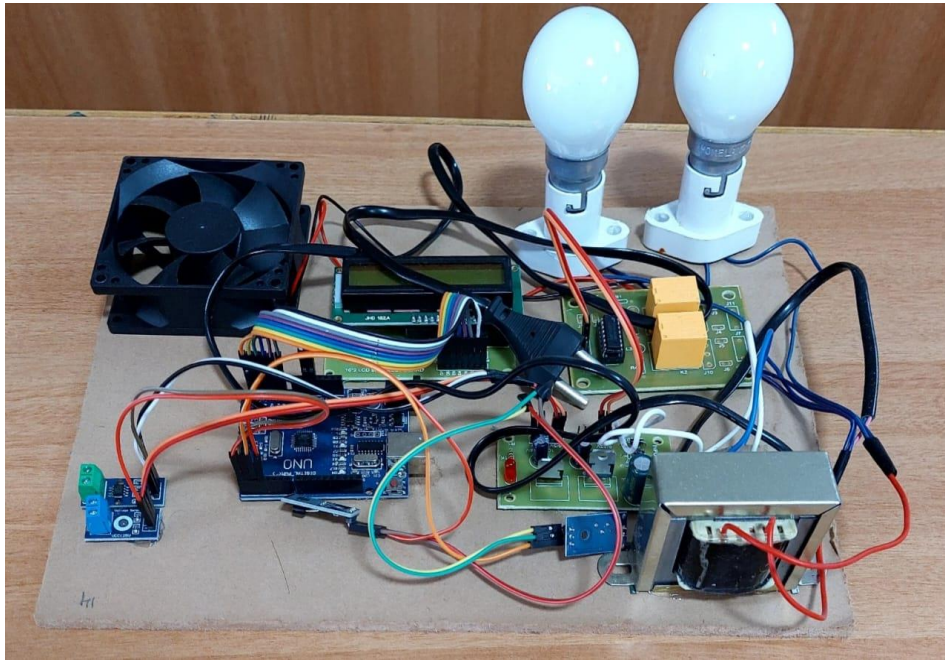
Voltage sensors are electronic devices that are used to measure the voltage level of an electrical circuit. They are commonly used in a variety of applications, including power systems, motor control systems, and battery monitoring systems. There are several different types of voltage sensors, each with its own set of advantages and disadvantages.

This sensor is used to monitor, calculate and determine the voltage supply. This sensor can determine the AC or DC voltage level. The input of this sensor can be the voltage whereas the output is the switches, analog voltage signal, a current signal, an audible signal, etc. Some sensors provide sine waveforms or pulse waveforms like output & others can generate outputs like AM (Amplitude Modulation), PWM (Pulse Width Modulation) or FM (Frequency Modulation). The measurement of these sensors can depend on the voltage divider.

### Result







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## Conclusion

The project “**Arduino based advanced energy efficient industrial automation system**” has been successfully designed and tested. It has been developed by integrating features of all the hardware components used. Presence of every module has been reasoned out and placed carefully thus contributing to the best working of the unit. Secondly using highly advanced IC’s and with the help of growing technology the project has been successfully implemented.

## Future Scope

1. Scope in industries.
2. Scope in efficient usage of electricity.
3. It can be used in homes, old age homes.
4. It can be used in houses where usage of electricity is unattended.
5. It can be used in air flow control.
6. It can be used in temperature control system.