SUPERVISORY CONTROLLING PLUS DATA ACQUISITION FOR REMOTE INDUSTRY

MAIN PROJECT REPORT

Submitted for the partial fulfilment of the requirements for the award of the degree of bachelor of science in electronics by the university of Kerala.

By

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K V V S COLLEGE OF SCIENCE AND TECHNOLOGY

(Affiliated to University of Kerala)

Kaithaparambu, Adoor

2018-2021

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CERTIFICATE

Certified that this is the bonafide report of the main project entitled 'SUPERVISORY CONTROLLING PLUS DATA ACQUISITION FOR REMOTE INDUSTRY'done by AMITH A G of sixth semester, in partial fulfillment of the requirements for the award of the degree of Bachelor of Science in electronics by the University of Kerala during the year 2018-2021.

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I express my great thanks to all staff of my department for their kind cooperation. My mission would be incomplete without the encouragement and help from parents and friends those who had been always with us full support, care and love. We always remember them with gratitude.

Yours sincerely

Amith A G

ABSTRACT

The project designed is a data acquisition system under supervisory control which is essential in large industrial environment. SCADA is a technology that is used to track and control all the processes in industries and saves a lot of manpower. The project uses temperature sensors interfaced to a microcontroller of NODE MCU to constantly monitor the remote plant operations. The microcontroller is connected to a system(smartphone,computer..ect) which constantly receives the data recorded by the temperature sensors through microcontroller. With the help of blynk software installed on the smartphone, the temperature values are displayed and stored in the database. There are parameters provided in the system such as set point, high or low point in the PC. Whenever the recorded temperature goes beyond or below the threshold range, the microcontroller turns off or on the cooling system or heating system through relays interfaced to it respectively. When gas is leaked alarm system turns on.

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INTRODUCTION

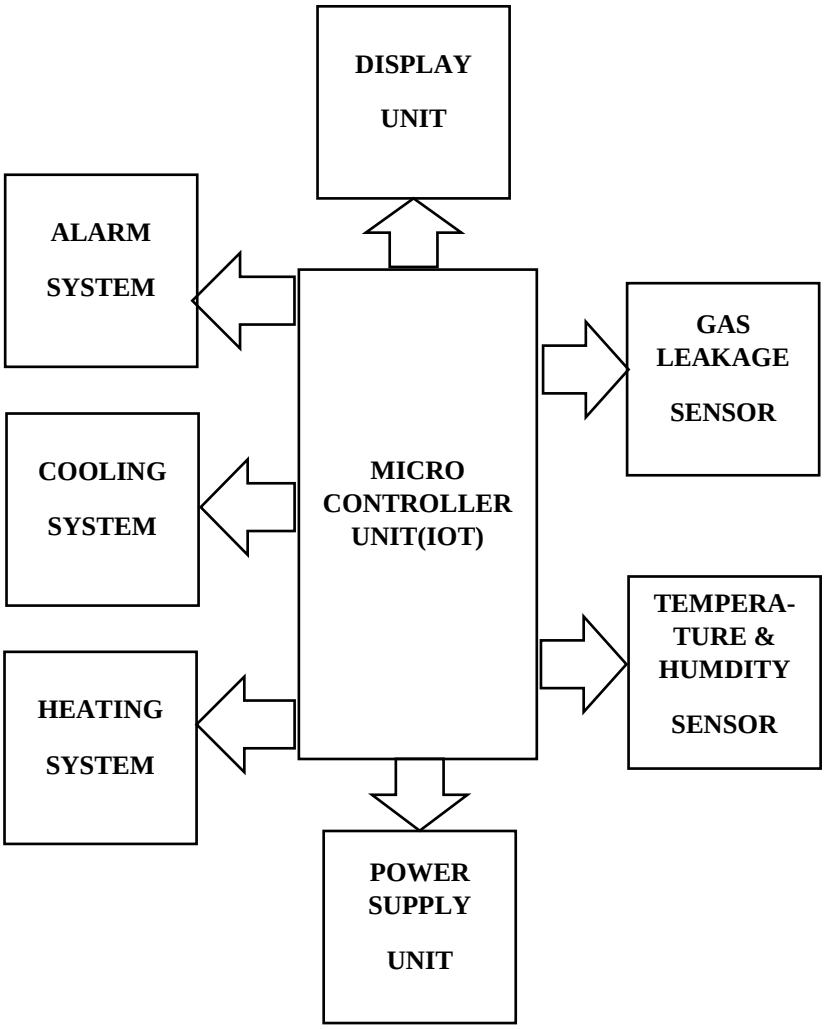
SCADA was first introduced in the 1960s at Bonneville power administration and was first published in the PICA (Power Industry Computer Applications)

SCADA system is basically used for automation in industries. Its main advantage is to reduce the human effort and increase the efficiency. For example, SCADA is basically used in industries such as food/ beverage power machine manufacturing etc. But now a day it is also used in home and apartments such as lighting, heating and ventilation, water pumping, gardening, overhead water flow control remotely.

In plant SCADA systems generally installed in control room. SCADA system having three types of working stations in control room, first working stations are operating station; in operator station the users can only do real time process parameter monitoring functions. The second type is called Engineering station in such type of work station users can able to do process parameter monitoring function and modification. Then third type of work station is known as server station. In this station users do not monitor. Any process parameters but all the SCADA system software have stored in server as backup data when in any main station .

A supervisory control and data acquisition (SCADA) system consists of one or more computers with appropriate software (Master Stations) connected by a communication system to a number of remote terminal unit placed at various locations to collect data and for remote control and to perform intelligent autonomous control of a system and report results back to the remote masters. SCADA system includes hardware and software component .Because of SCAD it is easy to control the industry from long distance.

BLOCK DIAGRAM

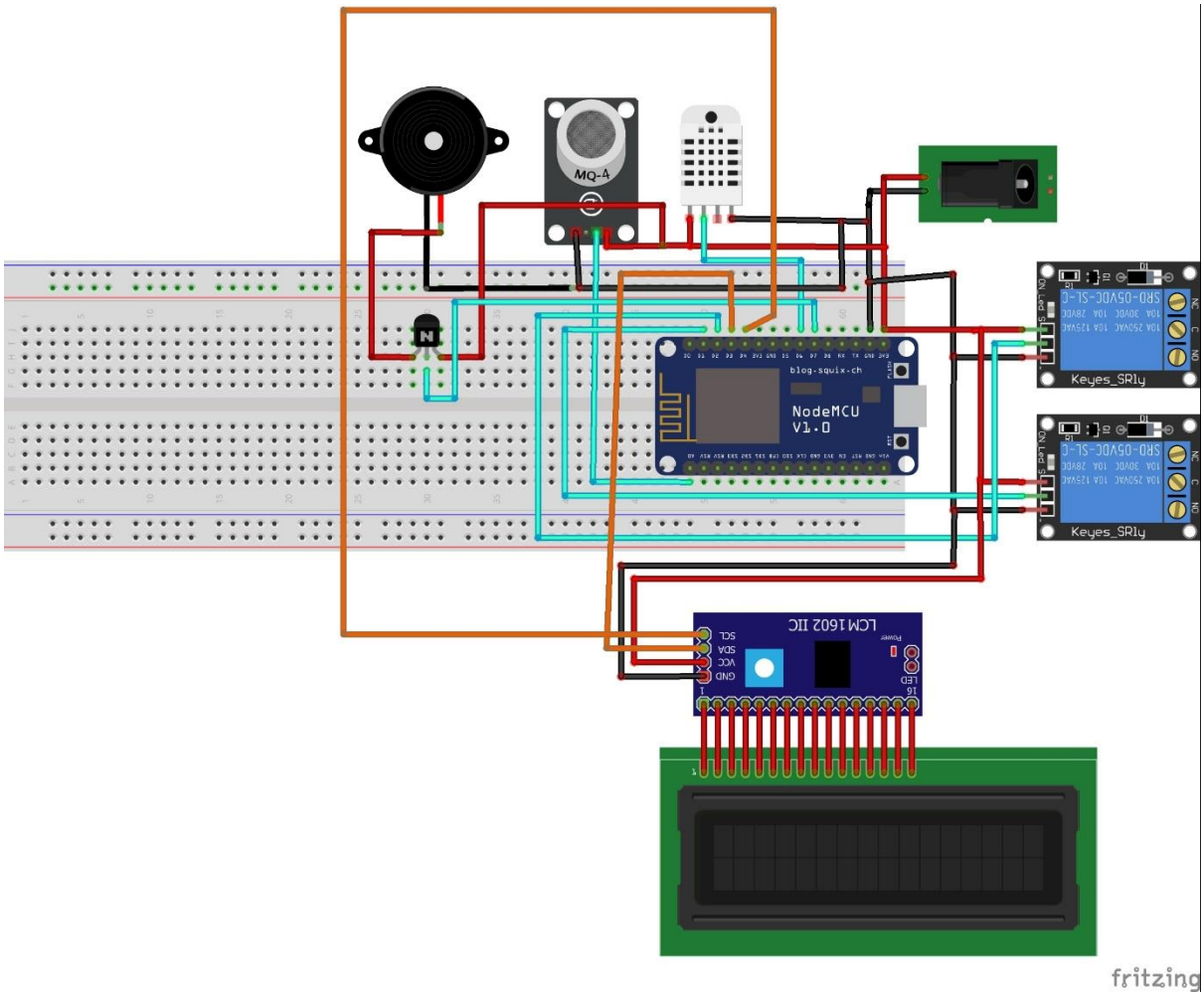


BLOCK DIAGRAM DESCRIPTION

The mini model SCADA project consist of eight block units. The block units are microcontroller unit, power supply unit, gas sensing unit, temperature and humidity sensing unit, cooling system, heating system and display unit.

- Microcontroller unit: This unit continuously monitors the critical parameters in factory (humidity, temperature, gas leakage) and controls it (or provide warning in case of gas leakage and it connects to internet. NODE MCU ESP8266 is used for this purpose. The NodeMCU ESP8266 development board comes with the ESP-12E module containing ESP8266 chip having Tensilica Xtensa 32-bit LX106 RISC microprocessor. This microprocessor supports RTOS and operates at 80MHz to 160 MHz adjustable clock frequency.
- Display unit:This unit display the critical parameter like temperature,humidity in the factory
- Power supply unit: Provide 5v input voltage to processing unit and other units. This unit consist of 9v battery and 7805 IC voltage regulator.7805 IC voltage regulator provide stable 5v to microcontroller unit and other component.
- Gas sensing unit: this unit senses gas leakage.it provide input high to node mcu if it sense the gas. We use MQ4 gas sensor
- Temperature and humidity sensing unit: this unit senses humidity and temperature parameter inside the factor.it provide relevant data to node mcu.DHT22 is used for this purpose
- Heating system: this system is used to provide sufficient heat if temperature drops down beyond the critical range which is set by the user (it can be changed). An incandescent light bulb is used to provide heat.
- Cooling system: this system provide sufficient cooling if temperature rise above the critical range. A 12v dc fan is used for this purpose.
- Warning system: this system is used to provide warning signal incase gas leaked.this system consist of buzzer and LED.

CIRCUIT DIAGRAM



CIRCUIT DIAGRAM EXPLANATION

In the circuit diagram of scda remote industry, a 3.3v output dc adaptor is used to to power the node mcu, Positive terminal fed to vcc and ground terminal of the adaptor is connect to gnd pin of the node mcu.This supply is distributed to other dc sensors and devices. The analog out pin of the gas sensor MQ4 is connected to the A0 pin of the node mcu.temperatue and humidity sensor DHT22 data pin is connected to d6 pin of the node mcu.the buzzer is connected to d2 pin of node mcu.the signal pin of relay R1 (used for the heating application) is connected to d2 pin of the node mcu and the signal pin of other relay R2 (used for cooling application) is fed to d3 pin node mcu. An incandescent light bulb is connected to the relays R1 output for heating application and 12v dc fan is connected to out relay 2 for the cooling application. Connect the data pin of LCD display to I2C module.I2C module SDA pin and SCL pin is connected to NodeMCU D3 pin and D4.

COMPONENTS REQUIRED

- NODE MCU ESP 8266
- Resistor
- Transistors
- Led
- Piezo buzzer
- Relay
- Gas sensor
- Temperature and humidity sensor
- LCD display 16x2
- I2C module
- Bulb
- 12v DC fan

NODE MCU ESP 8266

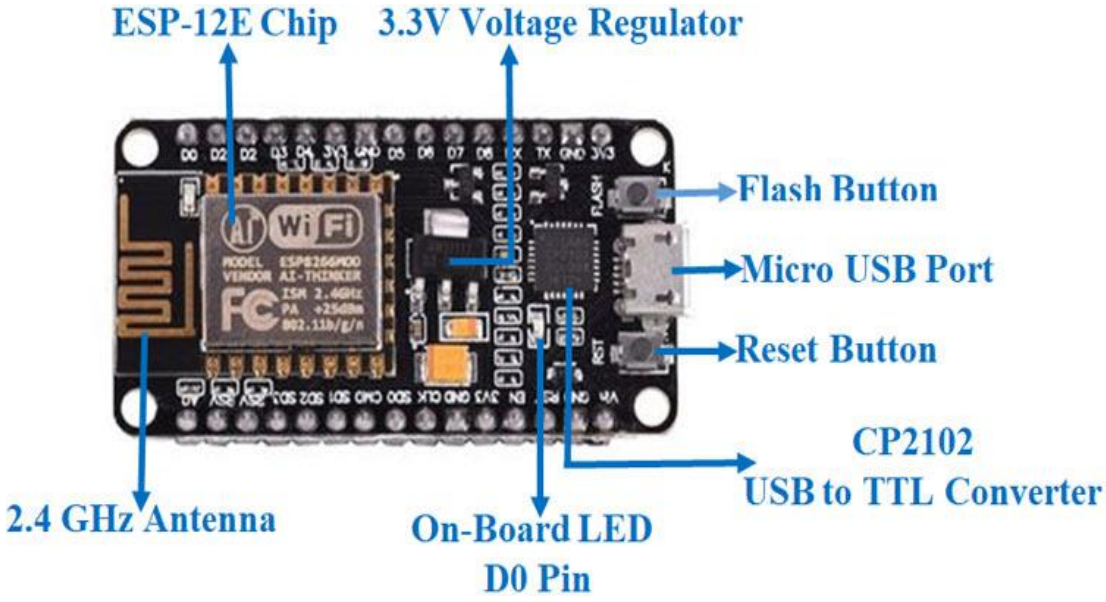
NodeMCU is an open source firmware for which open source prototyping board designs are available. The name "NodeMCU" combines "node" and "MCU" (micro-controller unit).The term "NodeMCU" strictly speaking refers to the firmware rather than the associated development kits.[citation needed]Both the firmware and prototyping board designs are open source.The firmware uses the Lua scripting language. The firmware is based on the eLua project, and built on the Espressif Non-OS SDK for ESP8266. It uses many open source projects, such as lua-cjson] and SPIFFS. Due to resource constraints, users need to select the modules relevant for their project and build a firmware tailored to their needs. Support for the 32-bit ESP32 has also been implemented.

The prototyping hardware typically used is a circuit board functioning as a dual in-line package (DIP) which integrates a USB controller with a smaller surface-mounted board containing the MCU and antenna. The choice of the DIP format allows for easy prototyping on breadboards. The design was initially based on the ESP-12 module of the ESP8266, which is a Wi-Fi SoC integrated with a Tensilica Xtensa LX106 core, widely used in IoT applications

FEATURES & SPECIFICATION

- 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

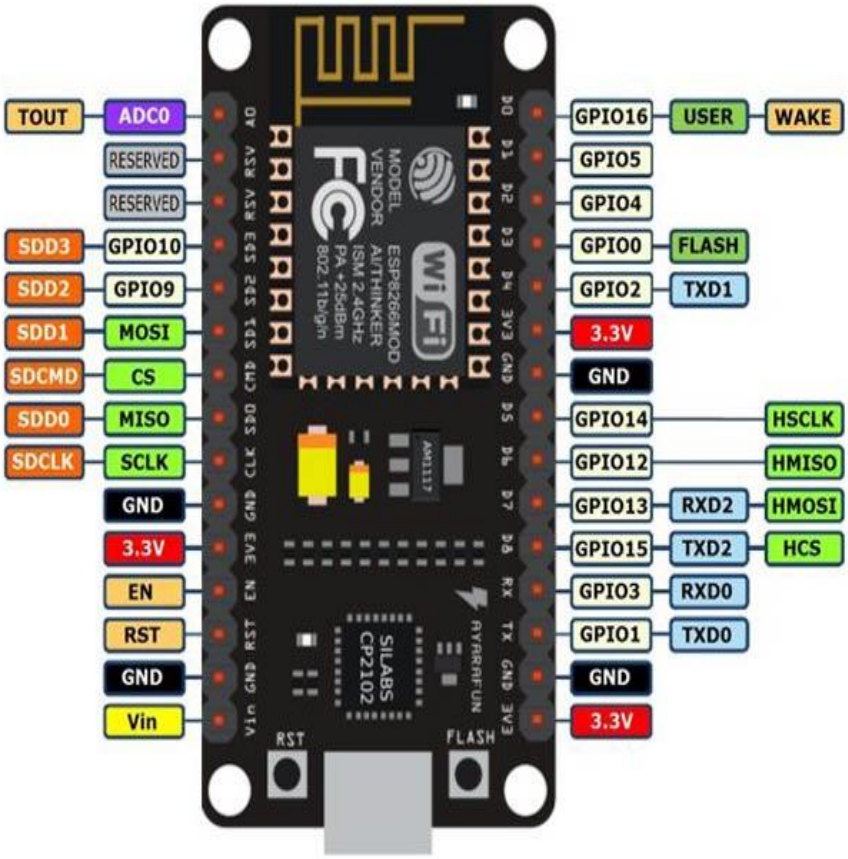


PROGRAMMING NODEMCU ESP8266 WITH ARDUINO IDE

The NodeMCU Development Board can be easily programmed with Arduino IDE since it is easy to use.Programming NodeMCU with the Arduino IDE will hardly take 5-10 minutes. All you need is the Arduino IDE, a USB cable and the NodeMCU board itself. You can check this Getting Started Tutorial for NodeMCU to prepare your Arduino IDE for NodeMCU.

APPLICATIONS OF NODEMCU

- Prototyping of IoT devices
- Low power battery operated applications
- Network projects
- Projects requiring multiple I/O interfaces with Wi-Fi and Bluetooth functionalities


TOUT
ADC0
RESERVED
RESERVED
SDD3
GPIO10
SDD2
GPIO9
SDD1
MOSI
SDCMD
CS
SDD0
MISO
SDCLK
SCLK
GND
3.3V
EN
RST
GND
Vin
GPIO16
USER
WAKE
GPIO5
GPIO4
GPIO0
FLASH
GPIO2
TXD1
3.3V
GND
GPIO14
HSCLK
GPIO12
HMISO
GPIO13
RXD2
HMOSI
GPIO15
TXD2
HCS
GPIO3
RXD0
GPIO1
TXD0
GND
3.3V
RST
FLASH
SILABS CP2102
AYARFUN
ESP8266MOD
AI-THINKER
ISM 2.4GHz
PA +25dBm
802.11b/g/n

LCD DISPLAY 16x2

The term LCD stands for liquid crystal display. It is one kind of electronic display module used in an extensive range of applications like various circuits & devices like mobile phones, calculators, computers, TV sets, etc. These displays are mainly preferred for multi-segment light-emitting diodes and seven segments. The main benefits of using this module are inexpensive; simply programmable, animations, and there are no limitations for displaying custom characters, special and even animations, etc.

FEATURES OF LCD16X2

- The operating voltage of this LCD is 4.7V-5.3V
- It includes two rows where each row can produce 16-characters.
- The utilization of current is 1mA with no backlight
- Every character can be built with a 5×8 pixel box
- The alphanumeric LCDs alphabets & numbers
- Is display can work on two modes like 4-bit & 8-bit
- These are obtainable in Blue & Green Backlight
- It displays a few custom generated characters

Registers of LCD

A 16×2 LCD has two registers like data register and command register. The RS (register select) is mainly used to change from one register to another. When the register set is '0', then it is known as command register. Similarly, when the register set is '1', then it is known as data register.

1) Command Register: The main function of the command register is to store the instructions of command which are given to the display. So that predefined tasks can be performed such as clearing the display, initializing, set the cursor place, and display control. Here commands processing can occur within the register.

2) Data Register: The main function of the data register is to store the information which is to be exhibited on the LCD screen. Here, the ASCII value of the character is the information which is to be exhibited on the screen of LCD. Whenever we send the information to LCD, it transmits to the data register, and then the process will be starting there. When register set =1, then the data register will be selected.

The main advantages of this LCD device include power consumption is less and low cost. The main disadvantages of this LCD device include it occupies a large area, slow devices and also lifespan of these devices will be reduced due to direct current. So these LCDs use AC supply with less than 500Hz frequency.

I2C CONVERTER (LMC 1602 I2C)

As we all know, though LCD and some other displays greatly enrich the man-machine interaction, they share a common weakness. When they are connected to a controller, multiple IOs will be occupied of the controller which has no so many outer ports. Also it restricts other functions of the controller. Therefore, LCD1602 with an I2C bus is developed to solve the problem.I2C bus is a type of serial bus invented by PHLIPS. It is a high performance serial bus which has bus ruling and high or low speed device synchronization function required by multiple host system. I2C bus has only two bidirectional signal lines, Serial Data Line (SDA) and Serial Clock Line (SCL). The blue potentiometer on the I2C LCD1602 is used to adjust backlight to make it easier to display on the I2C LCD1602

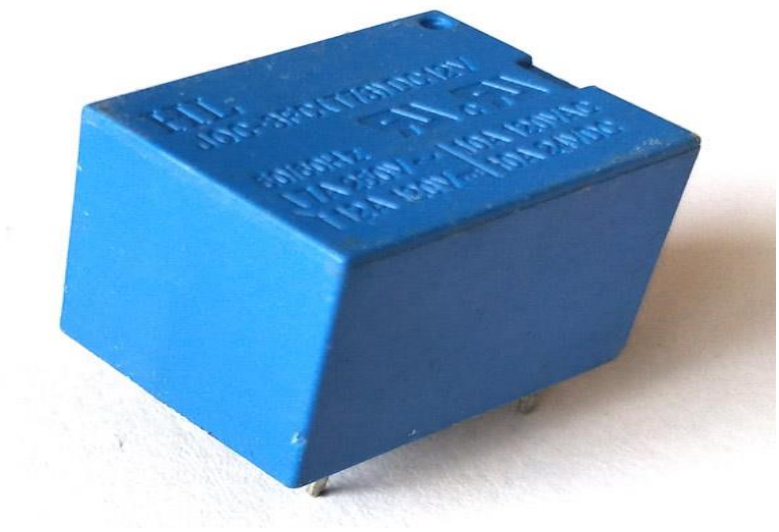
I2C interface 16x2 LCD display module, a high-quality 2 line 16 character LCD module with on-board. Contrast control adjustment, backlight and I2C communication interface. For Arduino beginners, no more cumbersome and complex LCD driver circuit connection. The real significance advantages of this I2C Serial LCD module will, simplify the circuit connection, save some I/O pins on Arduino board, simplified firmware development with widely available Arduino library.

5V RELAY

A relay is an electrically operated switch. It consists of a set of input terminals for a single or multiple control signals, and a set of operating contact terminals. The switch may have any number of contacts in multiple contact forms, such as make contacts, break contacts, or combinations thereof.

Relays are used where it is necessary to control a circuit by an independent low-power signal, or where several circuits must be controlled by one signal. Relays were first used in long-distance telegraph circuits as signal repeaters: they refresh the signal coming in from one circuit by transmitting it on another circuit. Relays were used extensively in telephone exchanges and early computers to perform logical operations. The traditional form of a relay uses an electromagnet to close or open the contacts, but other operating principles have been invented, such as in solid-state relays which use semiconductor properties for control without relying on moving parts. Relays with calibrated operating characteristics and sometimes multiple operating coils are used to protect electrical circuits from overload or faults; in modern electric power systems these functions are performed by digital instruments still called protective relays.

Latching relays require only a single pulse of control power to operate the switch persistently. Another pulse applied to a second set of control terminals, or a pulse with opposite polarity, resets the switch, while repeated pulses of the same kind have no effects. Magnetic latching relays are useful in applications when interrupted power should not affect the circuits that the relay is controlling.



Features of 5-Pin 5V Relay

- Trigger Voltage (Voltage across coil) : 5V DC
- Trigger Current (Nominal current) : 70mA
- Maximum AC load current: 10A @ 250/125V AC
- Maximum DC load current: 10A @ 30/28V DC
- Compact 5-pin configuration with plastic moulding
- Operating time: 10msec Release time: 5msec
- Maximum switching: 300 operating/minute (mechanically)

Applications of Relay

- Commonly used in switching circuits.
- For Home Automation projects to switch AC loads
- To Control (On/Off) Heavy loads at a pre-determined time/condition
- Used in safety circuits to disconnect the load from supply in event of failure
- Used in Automobiles electronics for controlling indicators glass motors etc.

PIEZOELECTRIC BUZZER (5V)

In piezoelectric buzzer, piezoelectric element may be driven by an oscillating electronic circuit or other audio signal source, driven with a piezoelectric audio amplifier. Sounds commonly used to indicate that a button has been pressed are a click, a ring or a beep. Interior of a readymade loudspeaker, showing a piezoelectric-disk-beeper (With 3 electrodes ... including 1 feedback-electrode (the central, small electrode joined with red wire in this photo), and an oscillator to self-drive the buzzer. A piezoelectric buzzer/beeper also depends on acoustic cavity resonance or Helmholtz resonance to produce an audible beep.

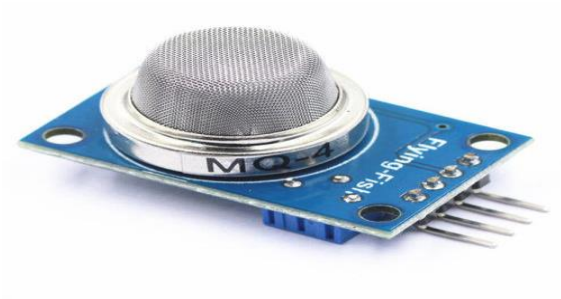
In simplest terms, a piezo buzzer is a type of electronic device that's used to produce a tone, alarm or sound. It's lightweight with a simple construction, and it's typically a low-cost product. Yet at the same time, depending on the piezo ceramic buzzer specifications, it's also reliable and can be constructed in a wide range of sizes that work across varying frequenciesto produce different sound outputs.For instance, at APC International, Ltd., we offer piezo buzzers without signal generators, self-oscillating buzzers that have signal generators and even multi-tone sound generators — often used in alarms and sirens. Regardless of the model you choose, our piezo buzzers offer high sound outputs. Plus, since they can be mounted on circuit boards, they're highly useful in a wide range of applications and assemblies.

A piezoelectric speaker (also known as a piezo bender due to its mode of operation, and sometimes colloquially called a "piezo", buzzer, and crystal loudspeaker or beep speaker) is a loudspeaker that uses the piezoelectric effect for generating sound. The initial mechanical motion is created by applying a voltage to a piezoelectric material, and this motion is typically converted into audible sound using diaphragms and resonators. Compared to other speaker designs piezoelectric speakers are relatively easy to drive; for example they can be connected directly to TTL outputs, although more complex drivers can give greater sound intensity. Typically they operate well in the range of 1-5 kHz and up to 100 kHz in ultrasound applications.

GAS SENSOR(MQ4)

Gas sensors (also known as gas detectors) are electronic devices that detect and identify different types of gasses. They are commonly used to detect toxic or explosive gasses and measure gas concentration. Gas sensors are employed in factories and manufacturing facilities to identify gas leaks, and to detect smoke and carbon monoxide in homes. Gas sensors vary widely in size (portable and fixed), range, and sensing ability. They are often part of a larger embedded system, such as hazmat and security systems, and they are normally connected to an audible alarm or interface. Because gas sensors are constantly interacting with air and other gasses, they have to be calibrated more often than many other types of sensors.

Depending on their intended environments and functions, the physical makeup and sensing process can vary notably between sensors. One of the most commonly used gas sensors for toxic identification and smoke detection is the metal oxide based gas sensor. This type of sensor employs a chemiresistor which comes in contact and reacts with target gasses. Metal oxide gas sensors increase their electrical resistance as they come into contact with gasses such as carbon monoxide, hydrogen, methane, and butane. Most home based smoke detection systems are oxide based sensors.

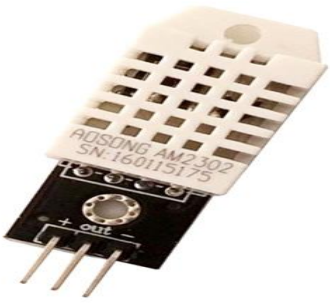


TEMPERATURE & HUMIDITY SENSOR (DHT22)

DHT22 is a highly accurate humidity and temperature sensor. This sensor measures relative humidity values. It uses the capacitive sensor element to measure Humidity. For measuring temperature it uses NTC thermistor. This sensor can be used in harsh conditions also. It is available as a sensor as well as Module. This sensor's performance can get degraded when it is exposed to UV and strong light for a long time. For error-free and disturbance-free communication, it is recommended to use high-quality shielding wire for connections.

The DHT22 sensor is the successor of the DHT11 sensor. DHT22 is available as a sensor as well as a module. The functioning of both sensor and module of DHT22 are similar. The difference lies in the internal circuitry. The module contains an in-built filtering capacitor and pull-up resistors. Whereas in sensor these have to be connected externally. DHT22 sensor and module both have 8-bit microcontroller connected to it to do the calculations. DHT22 module comes as 3-pin package whereas sensor comes as 4-pin package. The module has a high measuring range, better accuracy and a little bit costlier than the sensor.

DHT22 uses a single wire serial interface to transfer data to the microprocessor unit. The DATA pin available on the sensor is used to transfer the data and is connected to the microprocessor. When power is applied the sensor initially stays in the unstable status for one second, during this time no instructions should be sent to the sensor. For single time communication between MCU and sensor, it takes 5msec. The starts sending data only after receiving the start signal from MCU.When this sensor is used for RH range higher than the recommended it can increase the aging of the device. DHT22 sensors sensitivity can change when it is exposed to chemical vapour.



Specifications of DHT22

- It works with a DC supply voltage of 3.3V to 5.5V.
- DHT22 requires a 1.5mA of current for working.
- When in standby mode this sensor consumes 0.02mA of current.
- This sensor gives digital output values.
- Operating temperature range of this sensor is from -40°C to 80°C.
- It can detect humidity from 0-100%RH.
- This sensor can measure humidity with accuracy up to +-2% RH.
- Temperature accuracy up to <+-0.5 celsius can be measured with DHT22.
- This sensor measure humidity with a resolution of 0.1%RH and temperature with 0.1-celsius resolution.
- DHT22 has a humidity hysteresis of +-0.3%RH
- This sensor has an average sensing period of 2sec.
- This sensor is available in two sizes- small size of 14*18*5.5 mm and large size of 22*28*5 mm.
- The capacitive sensor element is used as the sensing element in DHT22.
- Wet NTC temperature measurement device is used in DHT22 for temperature calculation.
- This sensor can transmit the signal up to 2 meters.
- DHT22 has a single – wire serial interface, which makes it integration with microprocessors and microcontrollers east, simple and fast.
- This sensor also has the anti-interference ability.
- As relative humidity depends on the temperature, this sensor is temperature compensated and calibrated in accurate calibration chambers to get accurate humidity measurements.
- This calibration coefficient is saved in the form of program OTP memory. Internal sensor detection signals can call this calibration coefficient.
- DHT22 is highly accurate with excellent quality and fast response.
- DHT22 has outstanding long-term stability.
- DHT22 gives a digital output which is highly calibrated.
- This sensor is available as a 4-pin package which is fully interchangeable.

Applications of DHT22

For its reliability and stability, DHT22 utilizes the digital signal collecting technique and Humidity sensing technology. Its small size and low energy consumption make it suitable for harsh applications. Some of the applications of this sensor are listed below-

- DHT22 is applied in HVAC.
- Testing and Inspection equipment use DHT22 for measuring temperature and humidity values.
- This sensor is used in home appliances and consumer products for measuring temperature and humidity values.
- In medical units to detect the humidity values in isolation units of patients, DHT22 is used.
- For medical devices used by patients who are sensitive to high temperatures and suffering from certain lung diseases, DHT22 is used to check the air humidity levels.
- This senor is used in weather stations, refrigerators, Fax machines, food processing units, etc…
- In pharmaceutical units to maintain the temperature and humidity values in the required range this sensor is used.

PRINTED CIRCUIT BOARD (PCB)

TOOLS USED: PROTEUS

The Proteus Design Suite is a complete software solution for circuit simulation and PCB design. It comprises several modules for schematic capture, firmware IDE and PCB layout that appear as tabs inside a single, integrated application. This provides a smooth AGILE workflow for the design engineer and helps products get to market faster.

The Proteus PCB Design products include both schematic capture and PCB layout modules and are designed to be both easy to use and powerful. Features such as a world class shaped based AutoRoute, 3D Visualization, automatic net tuning, design snippets and assembly variants save you time during product design. Meanwhile, a powerful design rule system enforces whatever rules and clearances you might need for your PCB. The routing of tracks is fully design rule aware and live clearance checking makes it easy to locate and correct any violations.

The Proteus simulation products all use the schematic capture module as the electronic circuit and our customized mixed-mode SPICE engine to run the simulation. Proteus VSM then allows the microcontroller to also be simulated on the schematic while Proteus IoT Builder enables the design and test of the remote user interface for the circuit.

For embedded engineers, Proteus VSM bridges the gap in the design life cycle between schematic capture and PCB layout. It enables you to write and apply your firmware to a microcontroller component on the schematic (PIC, AVR, ARM, 8051, etc.) and then co-simulate the program within a mixed-mode SPICE circuit simulation.

For academics and the maker market, Proteus Visual Designer allows Arduino programs to be written with simple flowcharting methods and Arduino shields to be placed on the schematic with a mouse click. The entire Arduino system can then be simulated, tested and debugged in software. Proteus IoT builder then adds the ability to create a user interface for

your phone or tablet to interact with the Arduino electronics. You can even test this by controlling the running simulation from your mobile device.

The Proteus is a fully function, procedural programming language created in 1998 by Simone Zanella. Proteus incorporates many function derived from several other languages. C, BASIC, Assembly, clipper/dBase; it is especially versatile in dealing with strings, having hundreds of dedicated functions; this make it one of the richest languages for test manipulations. Proteus owes its name to a Greek god of the sea (Proteus), who look care of the Neptune's crowd and gave response; he was renowned for being able to transform himself, assuming different shapes. Transforming data from one form to another is the main usage of this language. Proteus was initially created as a multiplatform (DOS, Windows, UNIX) system utility, to manipulate text and binary file and to create CGI scripts. The language was later focused on Windows, by adding hundreds of specialized functions for: network and serial communication, data base emulation, ISAPI scripting. Most of these additional functions are only available in the Window flavor of the interpreter, even though a Linux version is still available Proteus was designed to be practical, readable, and consistent.

Its strongest points are

- Powerful string manipulation
- Comprehensibility of Proteus scripts
- Availability of advanced data structures: arrays, queues (single or double), stacks, bit maps, sets, AVL tree.

The language can be extended by adding user functions written in Proteus or DLLs created in C/C++.

- At first sight, Proteus may appear similar to basic because of its straight syntax, but similarities are limited to the surface:
- Proteus has a fully functional procedural approach
- Variables are untyped, do not need to be declared, can be local or public and can be passed by value or by reference
- All typical control structures are available (if-then-else; for-next; while-loop; repeat-until; switch-case)
- New functions can be defined and used as native function.

Data types supported by Proteus are only three; integer numbers, floating point numbers and strings. Access to advanced data structures (files, arrays, queues, stacks, AVL trees. Sets and so on) takes place by using handles, i.e. integer numbers returned by item creation functions. Type declaration is unnecessary. Variable type is determined by the function applied Proteus converts on the fly every variable when needed and holds previous data renderings. To avoid performance degradation caused by repeated conversions. There is no need to add parenthesis in expressions to determine the evaluation order, because the language is fully functional (there are no operators).

Proteus includes hundreds of functions for

- Accessing file system
- Sorting data
- Manipulation of data and strings
- Interacting with the user
- Calculating logical and mathematical expressions.

PCB DESIGNING

A printed circuit board , or PCB, is used to mechanically supported electrically connect electronic component using conductive path ways, tracks or traces etched from copper sheets laminated on to a non-conductive substrate. It also referred to us printed wiring board {PWB} or etched wiring board .A PCB populated with electronic component is a printed circuit assembly {PCA}, also non as a printed circuit board assembly {PCBA}.

MATERIALS

Conducting layers are typically made of thin copper foil .insulating layers is typically laminated with epoxy resin prepare. The board is typically coated with a solder mask. There are quite a few different dielectrics that can be chosen to provide different insulating values depending on the requirements of the circuit .some of these dielectrics are polytetrafluoroethylene [Teflon], FR-4, FR-1, CEM-1 or CEM.

LAYOUT

The first rule is to prepare each and every PCB layout as viewed from the component side. Another important rule is not to start the designing of a layout unless an absolutely clear circuit diagram is available, if necessary, with a component lists, among the components the larger one are placed first and the space between is filled with smaller one. Component requiring input/output connections come near the connectors. All components are placed in such a manner that disordering of the component is not necessary if they have to replaced.in the designing of a PCB layout it is very important to divide the circuit in to functional subunit .Each of this subunit should be realized on defined portion of the board. In the designing the inter connection which are usually done by pencil lines actually space requirements in the art work must be considered .in addition the layout can be rather roughly sketched and will still be clear enough on art work designer.

BOARD CLEANING

The cleaning of the copper surface prior to resist application in an essential step for any types of PCB process using etch or plating resist.

Where cleaning has to be done with simplest means or only for a limited quantity of PCBs, manual –cleaning process is mainly used. In the process we require just a sink with running water, pumice power, scrubbing brushes and suitable tanks.

PATTERNING (ETCHING)

The vast majority of printed circuit boards are made by bonding a layer of copper over the entire substrate , sometimes on both sides,(creating a "blank PCB ")then removing unwanted copper after applying a temporary mask (e.g. by etching), leaving only the desired copper traces. A few PCB are made by adding traces to the bare substrate (or a substrate with a very thin layer of copper) usually by a complex process of multiple electroplating step.

LAMINATION

Some PCBs have trace layers inside the PCB and are called multi –layer PCBs .these are formed by bonding together separately etched thin boards.

DRILLING

Holes through a PCB are typically drilled with tiny drill bits made of solid tungsten carbide. The drilling can be performed manually by using a hand drill.

EXPOSED CONDUCTOR PLATING AND COATING

PCBs are plated with Solder, Tin, or Gold over Nickel as a resist for etching (removal) away the (unneeded after plating) underlying copper. Matte solder is usually fused to provide a better bonding surface or stripped to bare copper. Treatments, such as benzimidazolethoil, prevent surface oxidation of bare copper. The places to which components will be mounted are typically plated, because untreated bare copper oxides quickly, and therefore is not readily solder able. Traditionally, any exposed copper was coated with solder by hot air solder leveling (HASL).This solder was a tin-lead alloy. However new solder compounds are now used to achieve Compliance.

SOLDER RESIST

Areas that should be soldered may be covered with a polymer solder resist (solder mask) Coating. The solder resist prevent solder from bridging between conductors and creating

short-circuits. Solder resist also provides some protection from the environment. Solder resist is Typically 20-30 microns thick.

PRINTED CIRCUIT ASSEMBLY

After the printed circuit board (PCB) is completed, components must be attached to Form a functional printed circuit assembly, or PCA (sometimes called a “printed circuit board assembly” PCBA).In through-mount construction, components are placed on pads or lands on the outer surfaces of the PCB. In both kinds of construction, component leads are electrically and mechanically fixed to the board with a molten metal solder.

PROTECTION AND PACKING

PCBs intended for extreme environments often have a conformal coating, which is applied by dipping or spraying after the components have been soldered. The coat prevents corrosion and leakage currents or shorting due to condensation. The earliest conformal coats were wax. Modern conformal coats are usually dips of dilute solutions of silicon rubber, polyurethane, acrylic, or epoxy. Some are engineering plastics spurted onto the PCB in a vacuum chamber.

.PCB SOLDERING

MAKING SOLDERED JOINTS

Hold the soldering iron like a pen near the base of the handle. Touch the soldering iron into the joint to be made. Feed the little solder on the joint, remove the solder, then the iron, while keeping the joint still. Input the joint closely and should have a volcano shape. Some components such as transistors can be damaged by, when soldering. It is wise to use a heart sink dipped to the lead between the joints and components body. Some components require special case when soldering.

SOLDER

It is an alloy of tin and lead, typically 60% tin and 40% lead. It meet at a temperature of 200 degree Celsius. Coating a surface with solder is called tinning, because of tin content of the solder. Lead is poisonous and one should always wash hand after using solder. Solder for electronics use contain tiny cores of flux like the wires inside the main flux. The flux is

corrosive like an acid and it cleans the metal surface as the solder melts. That is why one must itself melt the solder actually on this joints not on the iron tip without flex must joints would fails because metals quickly oxidize and the metal and the solder itself will not flow properly on to a dirty oxidized metal surface.

FLUX

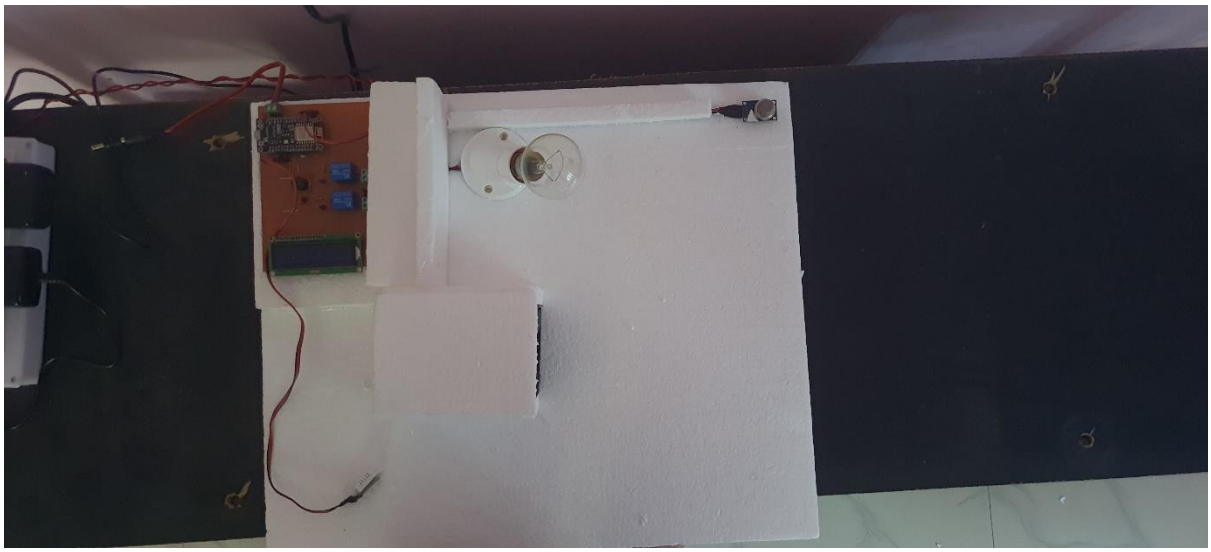
Components are basically mounted only one side of the board. The performance and reliability of solder joints give best result covered with solder and here with contributing to actual solder connections. However lead cutting after soldering is still common in particular in smaller industries where hand soldering is used. With the soldered PCB many contaminants can be found which may produce difficulties with the functioning of the circuit. Among the contaminants, we can typically find flux, chip of plastics, metals and other constructional materials, plating sails, oils greases environmental soil and other processing materials.

The following performance are expected from cleaning procedure with the appropriate cleaning medium:

1. Dissolutions or dissolving of organic liquid and solids, e.g., oils, greases, resin flux.
2. Removal of plating salts and silicone oils.
3. Displacing of particulate and other insoluble matter, e.g., chips, dust, and lint.
4. No severe attacks on board and components to be cleaned, no alteration of ink or paints rotations and last but not the least, compatibility with healthy environmental working conditions.

RESULT

By implementing SCADA systems in industries, increased reliability, reduced costs, improved worker safety, greater customer satisfaction and improved utilization. Their alarms and real-time views into operations can prevent small problems from becoming big ones, and can also speed restoration time.



ADVANTAGE

➡The data can be displayed in various formats as per user requirements.

➡It provides interface to connect thousands of sensors across wide region for various monitoring and controlling operations.

➡It is possible to obtain real data simulations with the help of operators.

➡Many types of data can be gathered from RTUs (Remote Terminal Units) connected with the master unit.

➡With the advanced protocols and application softwares, the data can be monitored from anywhere and not just from local site.

➡The redundancy of units are incorporated in the SCADA system in order to have backup in the event of faults or failures. This makes system more robust.

➡It is fast in obtaining response.

➡It is scalable and flexible in adding additional resources.

➡It is used in wide industries and departments including telecommunications, energy, transportation, oil & gas, water, military, meteorological etc.

DISADVANTAGES

➡ SCADA system is complex in terms of hardware units and dependent modules.

➡As the system is complex, it requires skilled operators, analysts and programmers to maintain SCADA system.

➡Installation costs are higher.

➡The system increases unemployment rates.

➡The system supports use of restricted softwares and hardware equipments

FUTURE SCOPE

SCADA started its journey in the Digital Revolution. And it still holds good against the automation devices. It has managed to integrate into the automation practices and become a useful tool for the smooth running of automation techniques.SCADA has huge scope in all types of industries. The entire automation field is heavily reliant on them in an industrial setup. Earlier, microprocessor control or relay logic was needed for control. Now, PLC's are sufficient. It is highly reliable and flexible. The peril of the current scenario is that at any point in time, changes might happen which will affect the whole system. SCADA offers a base on which any changes can be made without affecting the efficiency, speed and interoperability of the system. Experts have claimed that Industry 4.0 will be upon us within a short span of 15 to 20 years. It will be much different than the other three revolutions since the focus will be on communication and connectivity rather than new technologies. It will be an upgrade to the Digital Revolution, rather than a complete change. Recent technologies like the Internet of Things(IoT), Big Data Analytics, Cloud Computing, Machine Learning will be playing a major part in the process. Some of the industries have already implemented these technologies to great results. But they have integrated it as an additional feature, rather than a complete change to present system. This is precisely why the scope of industrial automation courses won't be diminishing in the near future. Industries are building upon these systems rather than changing them altogether. So, as long as people give importance to learning the basics, further advancements won't bring in a major change in the job market.

CONCLUSION

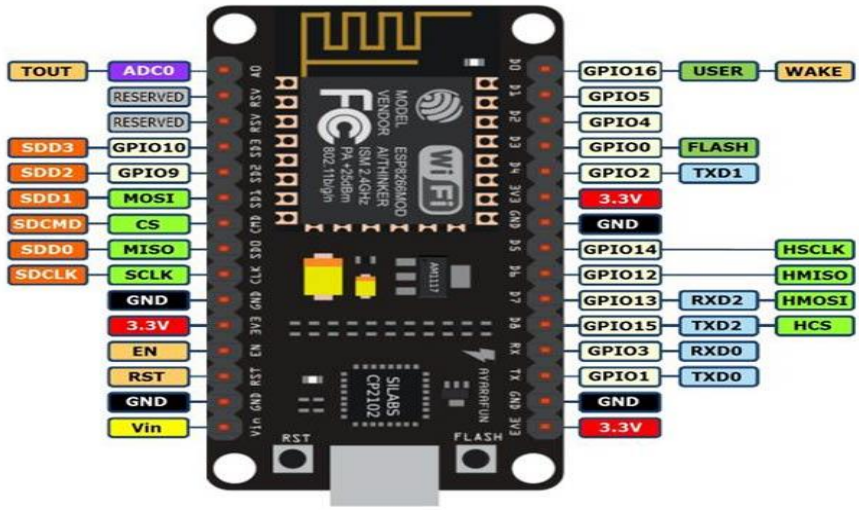
As the world converges, diverse systems are also beginning to converge. In the past, it would seem absurd to mix the telephone and a computer networks, but now it is an idea that is making high ground in the telecommunications sector. Extensibility, therefore, is also an important feature as it provides the flexibility to extend and retool the system for different transmission and interfacing media. With the availability of the Internet, mobile networks and others, there exists new means of providing greater access to SCADA systems. The SCADA is able to provide a simple interface for allowing the different networks to communicate to the SCADA. The mobile GSM network and Internet are only examples of the many networks that can be linked to the SCADA. At the end of the day, new ways of doing old things are emerging. The SCADA is only one of them. SCADA systems have been the target of various studies especially in the field of power distribution. Distributed control is the essence of any SCADA system. For it provides a cost effect way of monitoring and control multiple remote sites. The SCADA provides distributed control, extensibility and virtual coverage.

REFERENCE

- https://circuitdigest.com/electronic-circuits/automatic-rain-sensing-car-wiper
- Electronics for you(magazine)
- www.Electronicshub.com

APPENDIX A

NODE MCU ESP8266 (PIN CONFIGURATION)



Pin Category	Name	Description
Power	Micro-USB, 3.3V, GND, Vin	**Micro-USB:** NodeMCU can be powered through the USB port **3.3V:** Regulated 3.3V can be supplied to this pin to power the board **GND:** Ground pins **Vin:** External Power Supply
Control Pins	**EN, RST**	The pin and the button resets the microcontroller
Analog Pin	A0	Used to measure analog voltage in the range of 0-3.3V

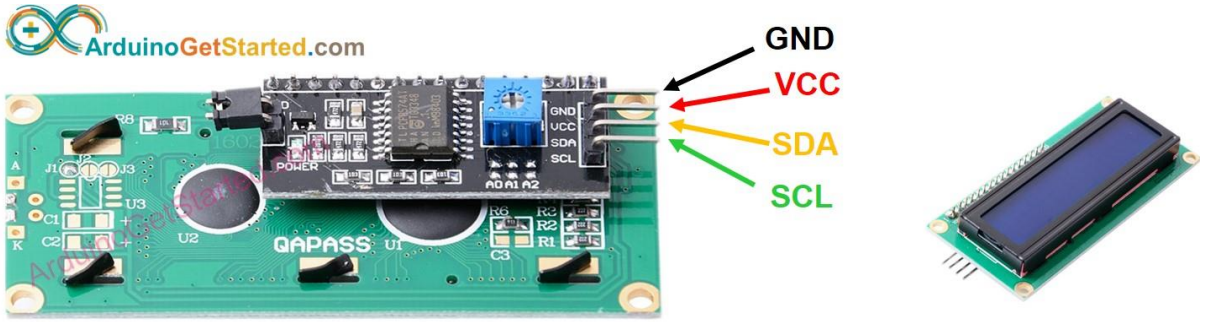
GPIO Pins	GPIO1 to GPIO16	NodeMCU has 16 general purpose input-output pins on its board
SPI Pins	SD1, CMD, SD0, CLK	NodeMCU has four pins available for SPI communication.
UART Pins	TXD0, RXD0, TXD2, RXD2	NodeMCU has two UART interfaces, UART0 (RXD0 & TXD0) and UART1 (RXD1 & TXD1). UART1 is used to upload the firmware/program.
I2C Pins		NodeMCU has I2C functionality support but due to the internal functionality of these pins, you have to find which pin is I2C.

LCD DISPLAY 16X2(PIN CONFIGURATION)

Pin No:	Pin Name:	Description
1	Vss (Ground)	Ground pin connected to system ground
2	Vdd (+5 Volt)	Powers the LCD with +5V (4.7V – 5.3V)
3	VE (Contrast V)	Decides the contrast level of display. Grounded to get maximum contrast.
4	Register Select	Connected to Microcontroller to shift between command/data register
5	Read/Write	Used to read or write data. Normally grounded to write data to LCD
6	Enable	Connected to Microcontroller Pin and toggled between 1 and 0 for data acknowledgement
7	Data Pin 0	

		Data pins 0 to 7 forms a 8-bit data line. They can be connected to Microcontroller to send 8-bit data. These LCD's can also operate on 4-bit mode in such case Data pin 4,5,6 and 7 will be left free.
8	Data Pin 1	
9	Data Pin 2	
10	Data Pin 3	
11	Data Pin 4	
12	Data Pin 5	
13	Data Pin 6	
14	Data Pin 7	
15	LED Positive	Backlight LED pin positive terminal
16	LED Negative	Backlight LED pin negative terminal

I2C MODULE (PIN CONFIGURATION)

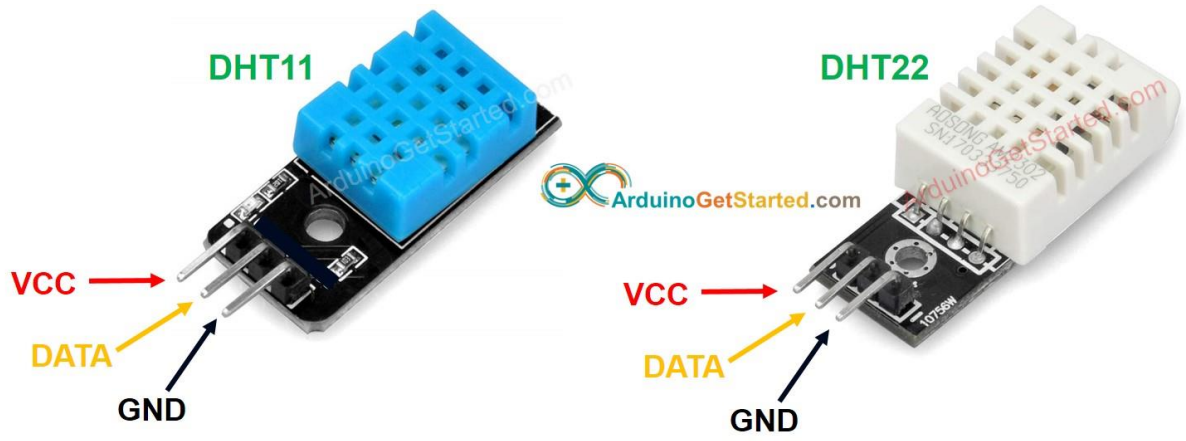


SL.NO.	PIN NAME	DISCRIPTION
1	GND	GND is a ground pin and should be connected to the ground of nodemcu.
2	VCC	Supplies power to the module and the LCD. Connect it to the 5V output of the nodemcu or a separate power supply.
3	SDA	Serial Data pin. This line is used for both transmit and receive. Connect to the SDA pin on the node mcu.
4	SCL	Serial Clock pin. This is a timing signal supplied by the Bus Master device. Connect to the SCL pin on the node mcu.

GAS SENSOR (MQ4) PIN CONFIGURATION

Pin Name	Description
VCC	This pin powers the module, typically the operating voltage is +5V
GND	Used to connect the module to system ground
Digital Out (DO)	You can also use this sensor to get digital output from this pin, by setting a threshold value using the potentiometer
Analog Out (AO)	This pin outputs 0-5V analog voltage based on the intensity of the gas

TEMPERATURE AND HUMIDITY SENSOR (DHT22)PIN CONFIGURATION

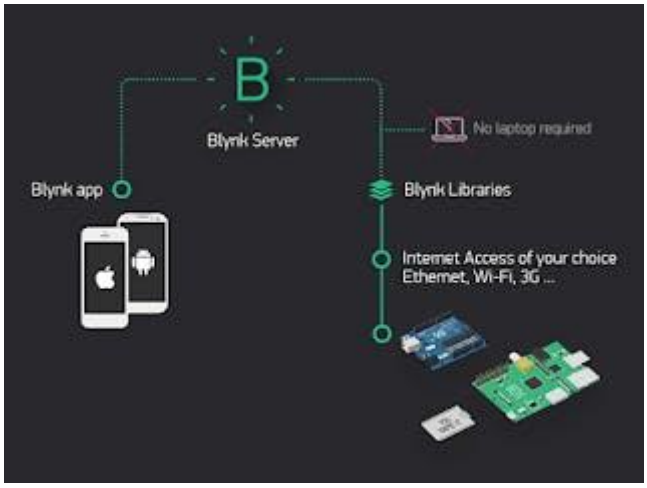


SL.NO	PIN NAME	DESCRIPTION
1	VCC	Power supply 3.5V to 5.5V
2	DATA	Outputs both Temperature and Humidity through serial Data
3	GND	Connected to the ground of the circuit

APPENDIX B

PROGRAM LOGIC

- Scan for wifi(ID :OnePlus 6 and password renjiths) then connect and establish link with blynk server
- Set the ideal range of temperature
- Perform complex calculation via library to get the value of temperature and humidity.
- Monitor the parameters continuously(temperature,humidity and gas) from the sensors output
- Display the temperature and humidity in lcd and sent the data to blynk server.
- If gas sensor output is high then turn on buzzer and display gas leaked in the lcd and sent alert to system connected with blynk server



PROGRAM (ARDUINO IDE)

```
#define BLYNK_PRINT Serial
#include <ESP8266WiFi.h>
#include <LiquidCrystal_I2C.h>
#include <BlynkSimpleEsp8266.h>
#include "DHT.h"
#define DHTPIN D5
#define DHTTYPE DHT22
#define GAS_SEN A0
#define FAN D1
#define LIGHT D2
#define Buzzer D7
int gas = 0;
LiquidCrystal_I2C lcd(0x27, 16, 2);

char auth[] = "AMku9sLLkOIXPGKhhzMUMzD0yYREyckm";
char ssid[] = "OnePlus 6";
char pass[] = "renjiths";

float TEMP_SET_MAX = 35;
float TEMP_SET_MIN = 33;

float h, t;
int x, GAS_SENSE_VALUE = 0;

DHT dht(DHTPIN, DHTTYPE);
BlynkTimer timer;

void myTimerEvent()
{
  Blynk.virtualWrite(V0,t);
  Blynk.virtualWrite(V1,h);
  Blynk.virtualWrite(V2,GAS_SENSE_VALUE);
```

```
  if (gas == 1) {
    Blynk.notify("GAS Leakage Happened !");
   }
}

void setup()
{
  Serial.begin(9600);
  pinMode(GAS_SEN, INPUT);
  pinMode(Buzzer, OUTPUT);
  pinMode(FAN, OUTPUT);
  pinMode(LIGHT, OUTPUT);
  digitalWrite(LIGHT, LOW);
  digitalWrite(FAN, LOW);
  lcd.begin(D4, D3);
  lcd.backlight();
  lcd.setCursor(0, 0);
  lcd.print("Connecting Blynk");
  Blynk.begin(auth, ssid, pass);
  timer.setInterval(5000L, myTimerEvent);
  lcd.setCursor(0, 1);
  lcd.print("   connected   ");
  delay(3000);
  dht.begin();
  lcd.clear();
  lcd.setCursor(0, 0);
  lcd.print("Services Started");
  digitalWrite(Buzzer, HIGH);
  delay(50);
  digitalWrite(Buzzer, LOW);
  delay(50);
  digitalWrite(Buzzer, HIGH);
  delay(50);
  digitalWrite(Buzzer, LOW);
```

```
  delay(50);
  digitalWrite(Buzzer, HIGH);
  delay(50);
  digitalWrite(Buzzer, LOW);
  delay(50);
  delay(2000);
  lcd.clear();
}

void loop()
{
  Blynk.run();
  timer.run(); // Initiates BlynkTimer
  h = dht.readHumidity();
  t = dht.readTemperature();
  if (isnan(h) || isnan(t)) {
    lcd.clear();
    lcd.setCursor(0, 0);
    lcd.print("DHT Sensor Error");
    lcd.setCursor(3, 1);
    lcd.print("Restarting");
    delay(2000);
    ESP.restart();
  }
  GAS_LEAK();
  if (gas == 0) {
    TEMP_MAINTAIN();
    delay(4000);
    lcd.clear();
    lcd.setCursor(0, 0);
    lcd.print("Temp:");
    lcd.setCursor(6, 0);
    lcd.print(t);
    lcd.setCursor(12, 0);
```

```
    lcd.print((char)223);
    lcd.setCursor(13, 0);
    lcd.print("C");
    lcd.setCursor(0, 1);
    lcd.print("Hum :");
    lcd.setCursor(6, 1);
    lcd.print(h);
    lcd.setCursor(12, 1);
    lcd.print("%");
    delay(4000);
  }
}
void TEMP_MAINTAIN() {
  if (t > TEMP_SET_MIN && t < TEMP_SET_MAX) {
    lcd.clear();
    lcd.setCursor(2, 0);
    lcd.print("Temperature");
    lcd.setCursor(5, 1);
    lcd.print("Normal");
    digitalWrite(FAN, LOW);
    digitalWrite(LIGHT, LOW);
  }
  if (t > TEMP_SET_MAX) {
    lcd.clear();
    lcd.setCursor(0, 0);
    lcd.print("Temperature High");
    lcd.setCursor(1, 1);
    lcd.print("Fan Turned ON");
    digitalWrite(FAN, HIGH);
    digitalWrite(LIGHT, LOW);
  }
  if (t < TEMP_SET_MIN) {
    lcd.clear();
    lcd.setCursor(0, 0);
```

```
    lcd.print("Temperature Low");
    lcd.setCursor(0, 1);
    lcd.print("Heater Turned ON");
    digitalWrite(LIGHT, HIGH);
    digitalWrite(FAN, LOW);
  }
}
void GAS_LEAK() {
  GAS_SENSE_VALUE = analogRead(GAS_SEN);
  if (GAS_SENSE_VALUE < 5) {
    lcd.clear();
    lcd.setCursor(2, 0);
    lcd.print("MQ5 Sensor");
    lcd.setCursor(2, 1);
    lcd.print("Read Error");
  }
  if (GAS_SENSE_VALUE > 500) {
    gas = 1;
    digitalWrite(Buzzer, HIGH);
    digitalWrite(FAN, HIGH);
    digitalWrite(LIGHT, LOW);
    lcd.clear();
    lcd.setCursor(3, 0);
    lcd.print("GAS Leakage");
    lcd.setCursor(4, 1);
    lcd.print("happened");
    delay(100);
    digitalWrite(Buzzer, LOW);
    delay(100);
  }
  if (GAS_SENSE_VALUE < 500 && gas == 1) {
    gas = 0;
    digitalWrite(FAN, LOW);
  }}
```