INDUSTRIAL AUTOMATED FAULT MONITORING AND PROTECTION SYSTEM



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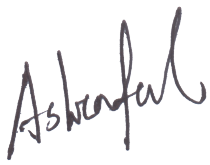
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Declaration

It is declared hereby that this project paper or any part of it has not been submitted to anywhere else for the award of any degree.



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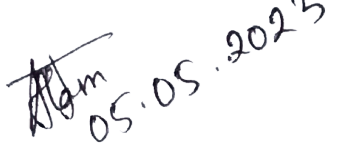
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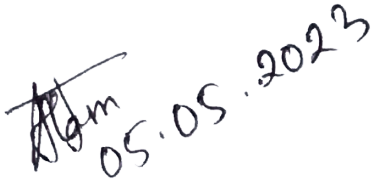


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Certification

I certify that I have read this project and that, in my opinion, it is fully adequate, in scope & quality as a dissertation for the degree of BSc in Engineering.

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Above all, we wish to convey our heartfelt thanks and love towards our parents to whom we owe everything. We are forever indebted to our parents for their understanding, endless support and encouragement when it was most required.

Abstract

The project aims is to design an Industrial Automated Fault Monitoring and Protection System and write program in to the arduino microprocessor. Industrial Automated Fault Monitoring and Protection System contains arduino microcontroller with fire sensor, lpg gas sensor, smoke sensor, temperature sensor and current sensor.

An appropriate program in the arduino microprocessor to interact with the android controller has to be created. The program has been successfully complied through arduino IDE to the arduino microprocessor & loaded in to it after proper checking of logic to decrease any loss/damage of hardware.

After doing all of this we have test this project thoroughly and find the maximum number of error & wrong logic in the microprocessor program. After doing this, only we can say that we have been able to create as per our goal described.

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CHAPTER 1
INTRODUCTION

1.1 Introduction

Safety of lives and property is a major concern globally. Arising from the ever increasing rate of intrusions and fire outbreaks in the society, home and industrial safety have become of paramount essence. With advancements in technology, safety monitoring systems in both home and industry can be effectively deployed to extensively minimize safety hazards. Fire accident is a common incident in factories, houses, markets in every country. Due to poor fire extinguishing arrangement, lack of adequate fire alarm and emergency exit, it increases death and wreck. When it comes to security issues, we cannot take it for granted. Security is the level of protection against danger and loss. Nowadays, in a world that full of technology, people needs the help of technology to provide early warning alert to ensure they have enough time to avoid danger. In designing this project, the dangerous sources that have been highlighted are about gas leakage and fire. This is because both of these can become a huge disaster if the security procedure is not taken early. To minimize fire accident our project will act as a sentinel which is control from a central console room. For detection we used a high sensitive smoke detector by which microcontroller will get high pulse at input pin which is preprogrammed for our desired output signal.

This project is about producing an alert warning system based on Global System for Mobile(GSM) network. It will be used to detect the presence of natural gases as well as LPG. Whenever gas leakage occurs, the sensors used in the circuit will detect it and the GSM modem will send out an SMS alert to the user and also to the nearest fire station. With the system that provides a real-time notification, it increases the response time of the owner. This will provide the immediate aid to the situation occur. This system can be installed in kitchens, Liquefied Petroleum Gas (LPG) storage rooms, near the Natural Gas Vehicle (NGV) tank in mobile cars or any places thinks required.

1.2 Objective

The project was carried out to satisfy main objectives:

- To save unwanted accident due to careless movement for fire
- To save from short circuit

- Detect Gas Leakage (like LPG) using MQ6 Sensor and Arduino.
- Detect Flame using Flame sensor and Arduino.
- Measure Temperature
- Setup an SMS based Alert Mechanism using GSM Module
- Sound Alarm on gas leak and flame.
- Display status in an LCD using a 16×2 LCD module.
- To reduce fire damages.

1.3 Project Organization

This project report is divided into 4 chapters:

Chapter 1: Covers introduction, motivation and objective.

Chapter 2: Covers literature review & theory, description of circuit elements such as power supply, microcontroller, current sensor, smoke sensor, temperature sensor, and gsm module.

Chapter 3: This chapter involves the design, implementation and describes the working principle of the project.

Chapter 4: This chapter contains results and discussion of the project.

Chapter 5: Finally we have concluded this work by writing chapter four that includes discussion, conclusion and future scopes.

CHAPTER 2

THEORY

2.1 Background Study

Automation is a demand in this era of information and communication technology where a smart control system is used to reduce or replace human operators in the industry, offices or homes to produce some goods or services. The consumer is facing problems like receiving due bills for bills that have already been paid as well as poor reliability of electricity supply and quality even if bills are paid regularly. The remedy for all these problems is to keep track of the consumers load on timely basis, which will held to assure accurate billing. Load control and monitoring system is the subset of automation system that allows us to control household appliances like light, door, fan, air-conditioner etc in an intelligent way. It also includes those of domestic activities such as home entertainment systems, houseplant and yard watering, pet feeding and the use of domestic robots. Load control and monitoring system also can provide home security and emergency systems to be activated while necessary. It helps handicapped and old aged people who will enable them to control home appliances and alert them in critical situations. It not only refers to reduce human efforts but also energy efficiency and time saving. There are different types of load control and monitoring systems in the market. They are generally proprietary and closed, expensive and not very customizable by the end user. To overcome this limitation, there are scopes of research in this area.

In this project work, a IOT based home automation and energy monitoring device has been chosen to implement. It can operate by any mobile when needed by using blynk application. A program code was being downloaded into the microcontroller. When the blynk gets any press from user it gives data signal to the microcontroller, the microcontroller then gives an output signal to the relay Module to turn ON or OFF the output. This is a very simple project work which is very cost-effective and can be used in so many places where automatic power consumption control is the main concern.

Liquefied Petroleum Gas (LPG) was first discovered in 1910 by the scientist Dr. Walter Snelling which is a combination of commercial grade gases like propane and the other butane which are having saturated and also the unsaturated hydrocarbons. Due to the usefulness of

LPG, it is widely employed for many purposes as industrial and domestic fuel, auto gas, heating, lighting etc. The wide demand in market for the LPG is also growing day by day. But when LPG is leaked it may lead to serious fire accidents. Also the number of casualties' due to such incidents are also on the rise in the recent years. Therefore, there is purpose for a system to find and also prevent the leakage of LPG. But before the invention of electronic gas detectors for households in 1980s, it was detected by a chemical dipped paper which will change its color in the presence of those gases. But after many inventions have been discovered to find, monitor and alert the spillage of the dangerous gases. Also in recent days, booking a LPG gas cylinder is done by simply sending a text message. LPG companies have recently launched some customer friendly approaches like IVRS method for the people. Therefore, a reliable system to detect and also display the leakage of any of the gases is very important for household purposes. In this paper, a microprocessor based system with a gas sensor MQ6 is proposed to detect the leakage of the dangerous gases. The system is implemented with a LCD display to indicate the leakage. Gas sensor used in this system has a very good sensitivity and also has good response time at a low price. If any leakage is sensed, a SMS will be sent automatically to the corresponding persons or family member using GSM.

Several works has been done on gas leakage detector.

J Tsado et al. developed a system of gas leakage detection system that used 555 timer to interface the MQ 6 gas sensor with the microcontroller and then by means of relays activates the GSM module to alert the user. N. Harshada and B. Pawar developed a system that directly interface the MQ 6 gas sensor with the microcontroller. In addition to the GSM module sending an SMS to the user when it detects gas leakage, there is a buzzer to sound an alarm, the exhaust fan would be switched on and the sprinkler activated, to reduce the concentration of gas in the air. V. Ramya and B. Palaniappan also implemented a similar design but without the sprinkler. Apart from detecting the gas concentration in the air, K. Abid, et al. included a means of booking a refill of the cylinder with their design so that the user would be automatically notified when the gas in the cylinder goes below a set threshold. Others such as B. Didpaye and S. Nanda, T. Soundarya and J. Anchitaalagammai, S. Ashish, et al., and K. B. Vinoth, et al., implemented a system that detects the gas leakage and control the leakage by shutting off the source of the gas supply using either a solenoid valve or a stepper motor.

In this paper we developed a system that can monitor the LPG concentration in the air and simultaneously alert the user through an SMS so that appropriate actions can be taken to avert the

danger. A unique feature of this design is that it can also be powered by batteries so that whether there is supply from mains or not the system will be fully functional

2.2 Atmega328 Microcontroller

The high-performance Microchip 8-bit AVR RISC-based microcontroller combines 32KB ISP flash memory with read-while-write capabilities, 1KB EEPROM, 2KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and five software selectable power saving modes. The device operates between 1.8-5.5 volts. By executing powerful instructions in a single clock cycle, the device achieves throughputs approaching 1 MIPS per MHz, balancing power consumption and processing speed [6].

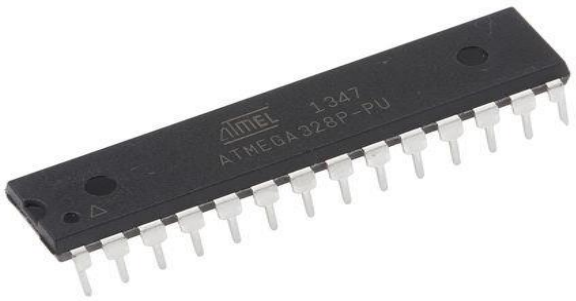


Figure 2.1: Atmega328P Microcontroller.

Features

- High Performance, Low Power Atmel AVR 8-Bit Microcontroller Family
- Advanced RISC Architecture
    - 131 Powerful Instructions – Most Single Clock Cycle Execution
        - -32 x 8 General Purpose Working Registers
        - -Fully Static Operation
        - -Up to 20 MIPS Throughput at 20MHz
        - -On-chip 2-cycle Multiplier
- High Endurance Non-volatile Memory Segments
        - -4/8/16/32KBytes of In-System Self-Programmable Flash program memory

        - -256/512/512/1KBytes EEPROM
        - -512/1K/1K/2KBytes Internal SRAM
        - -Write/Erase Cycles: 10,000 Flash/100,000 EEPROM
        - -Data retention: 20 years at 85ºC/100 years at 25ºC
        - -Optional Boot Code Section with Independent Lock Bits
    - In-System Programming by on-chip Boot Program
        - -True Read-While-Write Operation
        - -Programming Lock for Software Security

- Peripheral Features
    - -Two 8-bit Timer/Counters with Separate Prescaler and Compare Mode
    - -One 16-bit Timer/Counter with Separate Prescaler, Compare Mode, and
    - Capture Mode
    - -Real Time Counter with Separate Oscillator
    - -Six PWM Channels
    - -8-channel 10-bit ADC in TQFP and QFN/MLF package
    - -Temperature Measurement
    - -6-channel 10-bit ADC in PDIP Package
    - -Programmable Serial USART
    - -Interrupt and Wake-up on Pin Change
- Special Microcontroller Features
    - -Power-on Reset and Programmable Brown-out Detection
    - -Internal Calibrated Oscillator
    - -External and Internal Interrupt Sources
    - -Six Sleep Modes: Idle, ADC Noise Reduction, Power-save, Power-down, Standby, and Extended Standby
- I/O and Packages
    - -23 Programmable I/O Lines
    - -28-pin PDIP, 32-lead TQFP, 28-pad QFN/MLF and 32-pad QFN/MLF
- Operating Voltage:
    - 1.8V to 5.5V
- Temperature Range:
    - --40°C to 85°C
- Speed Grade:

- -0 - 4MHz@1.8 - 5.5V, 0 - 10MHz@2.7 - 5.5.V, 0 - 20MHz @ 4.5 - 5.5V

➢ Power Consumption at 1MHz, 1.8V, 25°C

- -Active Mode: 0.2mA

➢ -Power-down Mode: 0.1µA [6].

Block Diagram of Atmega328P

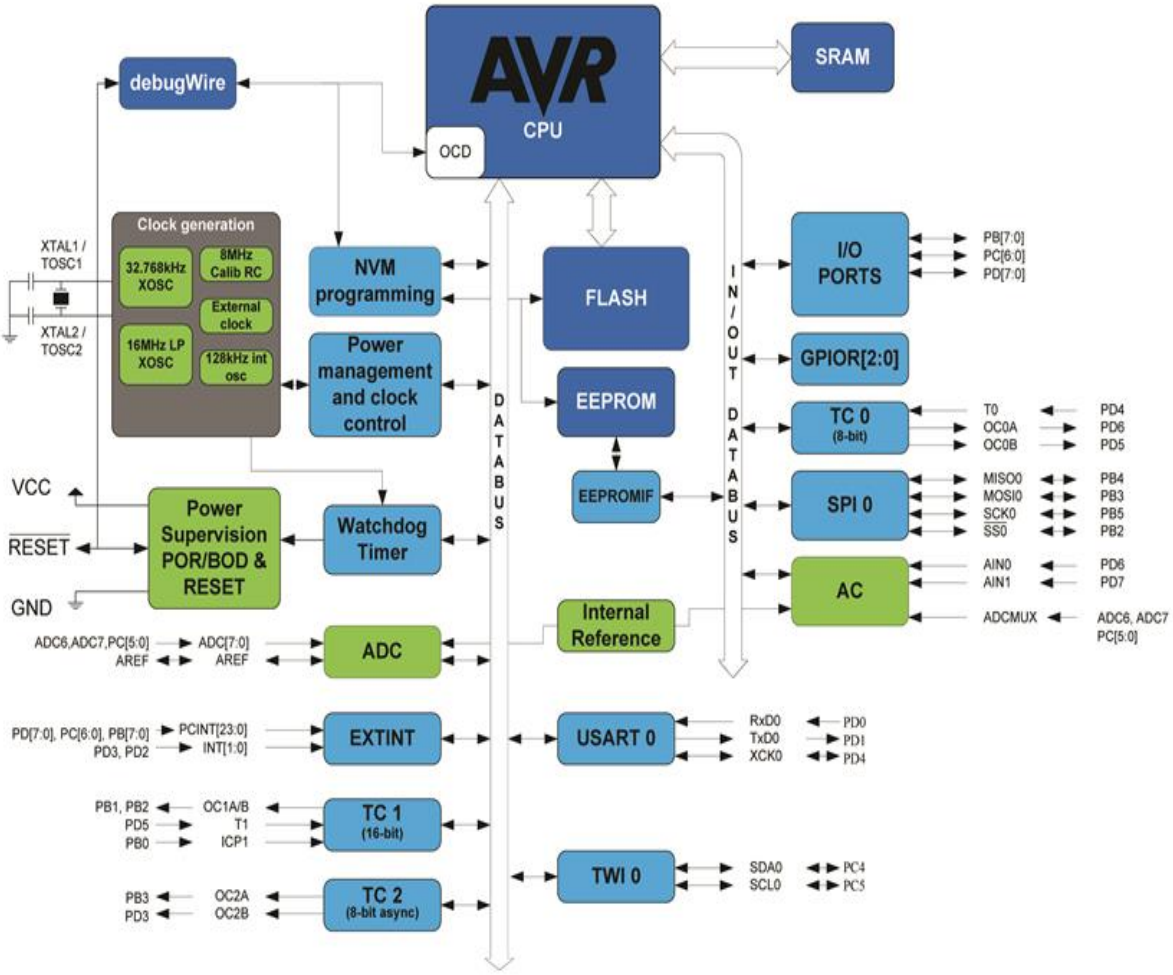


Figure 2.2: Clock Source Selection.

Pin Configurations of Atmega328

Atmega328P has 23 I/O pins, 2 power pins, 2 ground pins, reset pin and 2 clock pins shown in Figure 4.

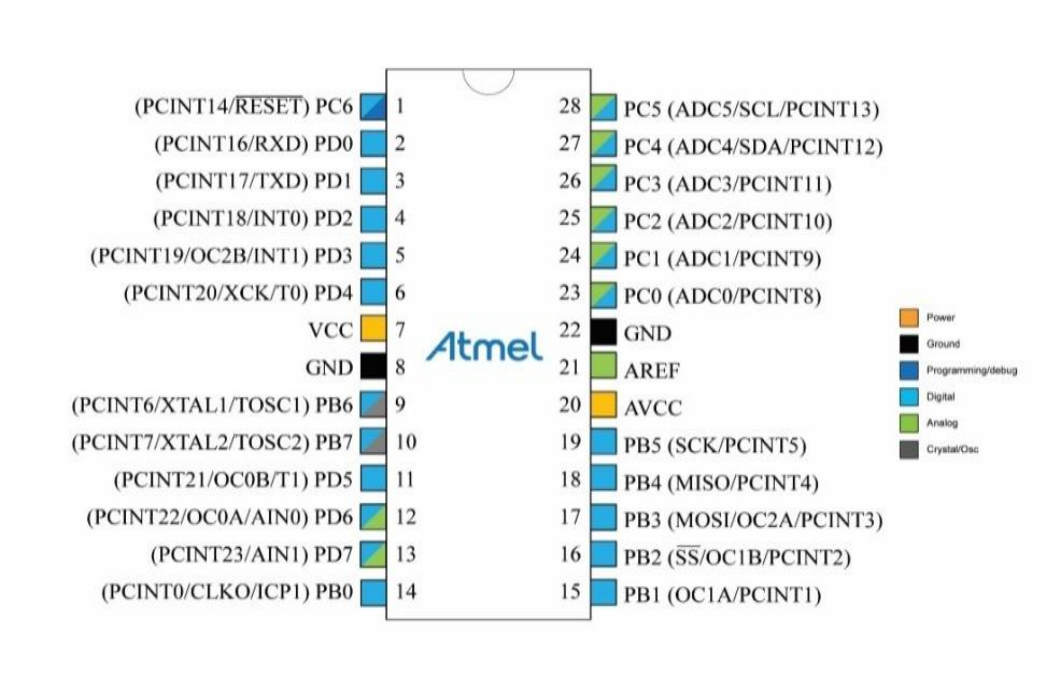


Figure 2.3: Block Diagram of Atmega328.

Pin Descriptions

i. VCC

Digital supply voltage

ii. GND

Ground

iii. Port B (PB0-PB7)

Port B is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port B output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port B pins that are externally pulled low will source current if the pull-up resistors are activated. The Port B pins are tri-stated when a reset condition becomes active, even if the clock is not running. Depending on the clock selection fuse settings, PB6 can be used as input to the inverting Oscillator amplifier and input to the internal clock operating circuit. If the Internal Calibrated RC Oscillator is used as chip clock source, PB[7:6] is used as TOSC[2:1] input for the Asynchronous Timer/Counter2 if the AS2 bit in ASSR is set [7].

iv. Port C (PC0-PC5)

Port C is a 7-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The PC[5:0] output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port C pins that are externally pulled low will source current if the pull-up resistors are activated. The Port C pins are tri-stated when a reset condition becomes active, even if the clock is not running [7].

v. PC6/RESET

If the RSTDISBL Fuse is programmed, PC6 is used as an I/O pin. Note that the electrical characteristics of PC6 differ from those of the other pins of Port C. If the RSTDISBL Fuse is unprogrammed, PC6 is used as a Reset input. A low level on this pin for longer than the minimum pulse length will generate a Reset, even if the clock is not running. Shorter pulses are not guaranteed to generate a Reset. The various special features of Port C are elaborated in the Alternate Functions of Port C section [7].

vi. Port D (PD0-PD7)

Port D is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port D output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port D pins that are externally pulled low will source current if the pull-up resistors are activated. The Port D pins are tri-stated when a reset condition becomes active, even if the clock is not running [7].

vii. AV_{CC}

AV_{CC} is the supply voltage pin for the A/D Converter, PC[3:0], and PE[3:2]. It should be externally connected to V_{CC}, even if the ADC is not used. If the ADC is used, it should be connected to V_{CC} through a low-pass filter. Note that PC[6:4] use digital supply voltage, V_{CC} [7].

viii. AREF

AREF is the analog reference pin for the A/D Converter [7].

Memory Organizations

This section describes the different memory types in the device. The AVR architecture has two main memory spaces, the Data Memory and the Program Memory space. In addition, the device features an EEPROM Memory for data storage. All memory spaces are linear and regular [8].

1. In-System Reprogrammable Flash Program Memory

The ATmega328/P contains 32Kbytes On-chip In-System Reprogrammable Flash memory for program storage. Since all AVR instructions are 16 or 32 bits wide, the Flash is organized as 16K x 16. The Flash memory has at least 10,000 write/erase cycles. The ATmega328P Program Counter (PC) is 14 bits wide, thus addressing the 16K program memory locations [8].

2. SRAM Data Memory

The 32 general purpose working registers, 64 I/O Registers, 160 Extended I/O Registers, and the 2Kbytes of internal data SRAM in the device are all accessible through all addressing modes [8].

3. EEPROM Data Memory

The ATmega328/P contains 1K bytes of data EEPROM memory. It is organized as a separate data space, in which single bytes can be read and written. The EEPROM has at least100,000write/erase cycles. The access between the EEPROM and the CPU is described in the following, specifying the EEPROM Address Registers, the EEPROM Data Register, and the EEPROM Control Register [8].

Clock Options

The following figure illustrates the principal clock systems in the device and their distribution. All the clocks need not be active at a given time. In order to reduce power consumption, the clocks to modules not being used can be halted by using different sleep modes. The clock systems are described in the following sections. The system clock frequency refers to the frequency generated from the System Clock Prescaler. All clock outputs from the AVR Clock Control Unit runs in the same frequency [8].

Clock Sources

The device has the following clock source options, selectable by Flash Fuse bits as shown below. The clock from the selected source is input to the AVR clock generator, and routed to the appropriate modules.

Device Clocking Option	CKSEL[3:0]
Low Power Crystal Oscillator	1111 - 1000
Full Swing Crystal Oscillator	0111 - 0110
Low Frequency Crystal Oscillator	0101 - 0100
Internal 128kHz RC Oscillator	0011
Calibrated Internal RC Oscillator	0010
External Clock	0000
Reserved	0001

Figure 2.4: Clock Source Selection.

We used crystal oscillator for clock source. A 16MHz Crystal is connected to XTAL1 & XTAL2 pin.

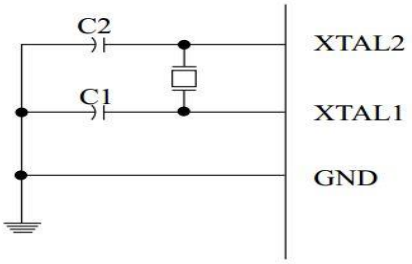


Figure 2.5: Crystal Oscillator Connection.

Power Management and Sleep Modes

Sleep modes enable the application to shut down unused modules in the MCU, thereby saving power. The device provides various sleep modes allowing the user to tailor the power consumption to the application requirements. When enabled, the Brown-out Detector (BOD) actively monitors the power supply voltage during the sleep periods. To further save power, it is possible to disable the BOD in some sleep modes [8].

There are 6 types of Sleep Modes:

1. Idle Mode
2. ADC Noise Reduction Mode

3. Power Down Mode
4. Power Save Mode
5. Standby Mode
6. Extended Standby Mode [8]

Analog to Digital Converter

The device features a 10-bit successive approximation ADC. The ADC is connected to an 8-channelAnalog Multiplexer which allows eight single-ended voltage inputs constructed from the pins of Port A. The single-ended voltage inputs refer to 0V (GND).The ADC contains a Sample and Hold circuit which ensures that the input voltage to the ADC is held at a constant level during conversion. A block diagram of the ADC is shown below. The ADC has a separate analog supply voltage pin, AV_{CC}. AV_{CC} must not differ more than ±0.3V from V_{CC}. The Power Reduction ADC bit in the Power Reduction Register (PRR & PRADC) must be written to '0' in order to be enable the ADC. The ADC converts an analog input voltage to a 10-bit digital value through successive approximation. The minimum value represents GND and the maximum value represents the voltage on the AREF pin minus 1LSB. Optionally, AV_{CC} or an internal 1.1V reference voltage may be connected to the AREF pin by writing to the REFSn bits in the ADMUX Register. The internal voltage reference must be decoupled by an external capacitor at the AREF pin to improve noise immunity [9].

Features of ADC:

- 10-bit Resolution
- 0.5 LSB Integral Non-Linearity
- ±2 LSB Absolute Accuracy
- 13µs - 260µs Conversion Time
- Up to 76.9kSPS (Up to 15kSPS at Maximum Resolution)
- Six Multiplexed Single Ended Input Channels
- Temperature Sensor Input Channel
- Optional Left Adjustment for ADC Result Readout
- 0 - V_{CC} ADC Input Voltage Range
- Selectable 1.1V ADC Reference Voltage
- Free Running or Single Conversion Mode
- Interrupt on ADC Conversion Complete

- Sleep Mode Noise Canceler [9].

General I/O Ports

All AVR ports have true Read-Modify-Write functionality when used as general digital I/O ports. This means that the direction of one port pin can be changed without unintentionally changing the direction of any other pin with the SBI and CBI instructions. The same applies when changing drive value (if configured as output) or enabling/disabling of pull-up resistors (if configured as input). Each output buffer has symmetrical drive characteristics with both high sink and source capability. The pin driver is strong enough to drive LED displays directly. All port pins have individually selectable pull-up resistors with a supply-voltage invariant resistance. All I/O pins have protection diodes to both V_{CC} and Ground as indicated in the following figure on next page [9].

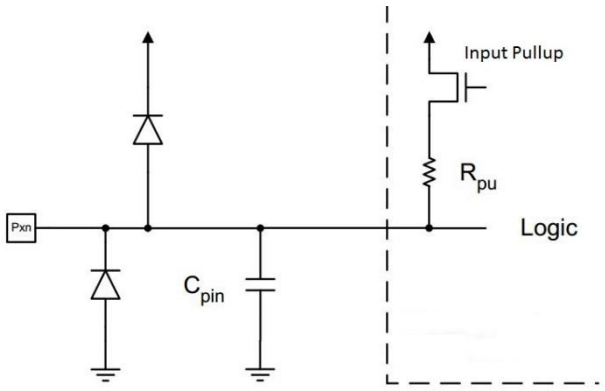


Figure 2.6: I/O Pin Configuration.

If some pins are unused, it is recommended to ensure that these pins have a defined level. The simplest method to ensure a defined level of an unused pin, is to enable the internal pull-up. Connecting unused pins directly to VCC or GND is not recommended, since this may cause excessive currents if the pin is accidentally configured as an output [9].

USART Interface

The Universal Synchronous and Asynchronous serial Receiver and Transmitter (USART) is a highly-flexible serial communication device.

The main features are:

- Full Duplex Operation (Independent Serial Receive and Transmit Registers)
- Asynchronous or Synchronous Operation

• Master or Slave Clocked Synchronous Operation
• High Resolution Baud Rate Generator
• Supports Serial Frames with 5, 6, 7, 8, or 9 Data bits and 1 or 2 Stop Bits
• Odd or Even Parity Generation and Parity Check Supported by Hardware
• Data Over Run Detection
• Framing Error Detection
• Noise Filtering Includes False Start Bit Detection and Digital Low Pass Filter
• Three Separate Interrupts on TX Complete, TX Data Register Empty and RX
• Multi-processor Communication Mode
• Double Speed Asynchronous Communication Mode [9].

The USART has to be initialized before any communication can take place. The initialization process normally consists of setting the baud rate, setting frame format and enabling the Transmitter or the Receiver depending on the usage. For interrupt driven USART operation, the Global Interrupt Flag should be cleared (and interrupts globally disabled) when doing the Initialization. Before doing a re-initialization with changed baud rate or frame format, be sure that there are no ongoing transmissions during the period the registers are changed. The TXC Flag can be used to check that the Transmitter has completed all transfers, and the RXC Flag can be used to check that there are no unread data in the receive buffer. Note that the TXC Flag must be cleared before each transmission (before UDR is written) if it is used for this purpose [9].

2.3 NodeMCU

The ESP8266 is a low-cost Wi-Fi microchip with full TCP/IP stack and microcontroller capability produced by manufacturer Espressif Systems. This small module allows microcontrollers to connect to a Wi-Fi network and make simple TCP/IP connections using Hayes-style commands. However, at first there was almost no English-language documentation on the chip and the commands it accepted. The ESP8285 is an ESP8266 with 1 MiB of built-in flash, allowing for single-chip devices capable of connecting to Wi-Fi.

Advantages of IOT Microcontrollers:

The main advantages of microcontrollers are given.

a) Microcontrollers act as a microcomputer without any digital parts.

b) As the higher integration inside microcontroller reduces cost and size of the system.
c) Usage of a microcontroller is simple, easy to troubleshoot and system maintaining.
d) Most of the pins are programmable by the user for performing different functions.
e) Easily interface additional RAM, ROM, I/O ports.
f) Low time required for performing operations.

Microcontrollers Applications:

Some basic applications of a microcontroller are given below.

1. Used in biomedical instruments.
2. Widely used in communication systems.
3. Used as a peripheral controller in PC.
4. Used in robotics.
5. Used in automobile fields.

NodeMCU Arduino Compatible ESP8266:

This NodeMCU development board is based on the ESP8266, which is a Wi-Fi communication IC built by Espressif. At its core is a microcontroller that runs at a blazing 80 MHz and includes a built-in TCP/IP stack and transceiver, which allows for Wi-Fi communication. This low-cost option can, not only, add Wi-Fi capability to your next project, it can run it. This board is a standalone microcontroller development board that can be easily programmed using the Arduino IDE. Some of the peripherals provided by that ESP8266 include 9 GPIOs, 1 analog input, UART, SPI, and TWI/I2C, and Wi-Fi. It operates at a 3.3V logic level and it can be powered from the USB voltage or AC adapter input. The NodeMCU D1 uses the ESP 8266 microcontroller that is 2 x faster than an Uno, has 160Kbs of Ram compared to the 2K of an Uno and a 100x the amount of Flash memory! And each I/O pin is interruptible!

Technical Specs:

- Supply Voltage (Vin): 5 – 15V
- Logic Voltage: 3.3V
- Wi-Fi, UART, I2C, SPI
- Digital I/Os: 9
- Analog Inputs: 1

Resources

- Installing ESP8266 Support in Arduino IDE
- ESP8266 Arduino Core Reference
- ESP8266 Arduino Libraries
- Over-the-Air Update/Programming
- ESP8266 Datasheet

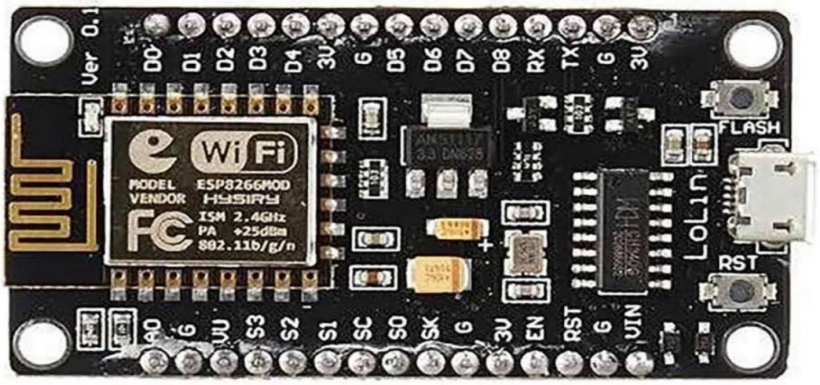


Figure 2.7: NodeMCU microcontroller

NodeMCU Wi-Fi ESP8266 Board

- An Arduino Nano Compatible Wi-Fi board based on ESP8266EX.
- NodeMCU® Wi-Fi ESP8266 Development Board is programmable via Arduino IDE.
- 11 digital input/output pins, all pins have interrupt/pwm/I2C/one-wire supported (except D0)
- 1 analog input (3.3V max input)
- A Micro USB connection
- A power jack, 9-24V power input.
- Compatible with Arduino
- Compatible with nodemcu

Programming:

The NodeMCU has a micro USB for auto programming, alsowe can program it using OTA.

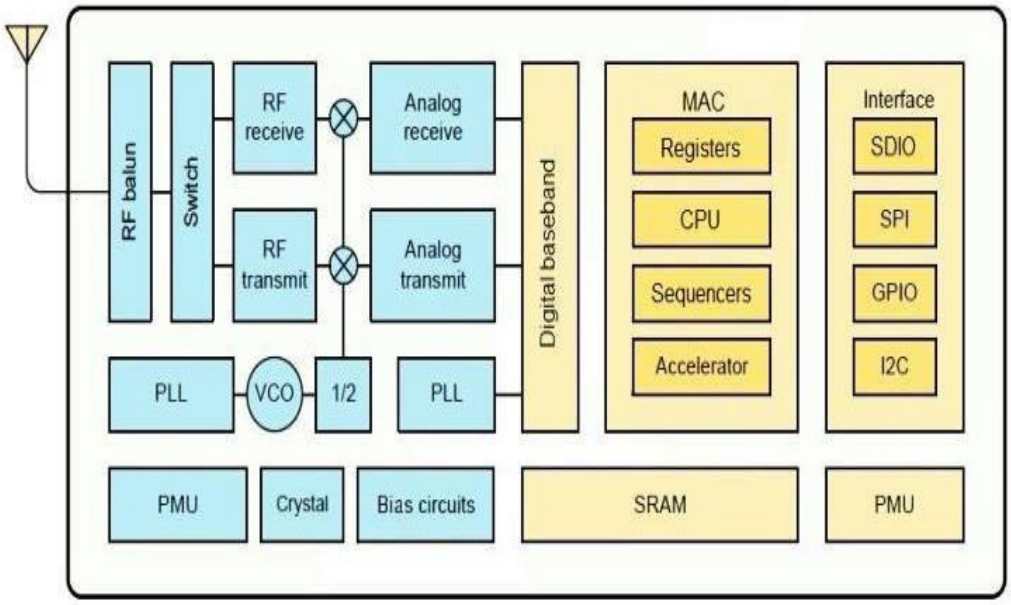


Figure 2.8: NodeMCU microcontroller pin out diagram

2.4 Blynk application

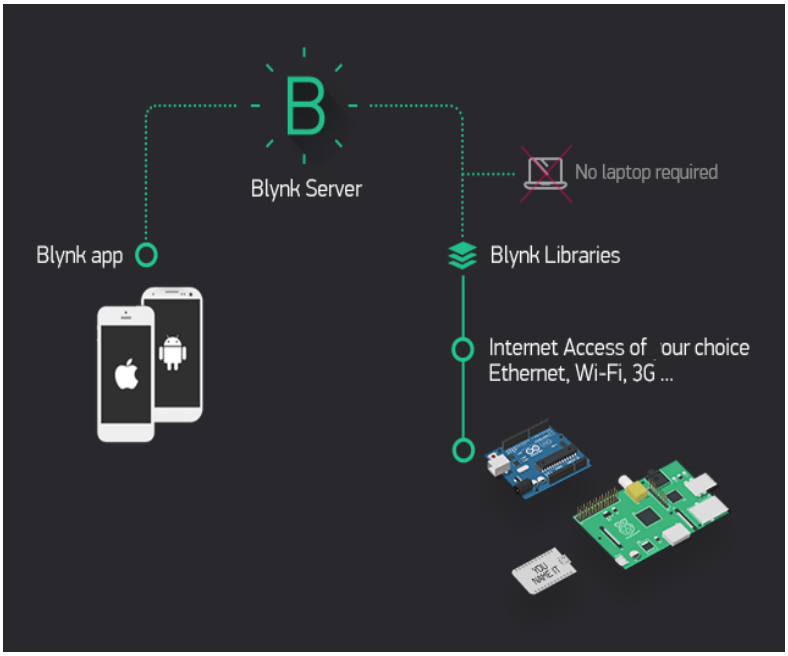


Figure 2.9: Blynk application communication feature

There are many apps to control the Wi-Fi communication with our smart phones. In our project we have used Blynk app for controlling our project using our smart phone. Blynk app for iOS and Android is the easiest way to build our own mobile app that work with the

hardware of our choice. Blynk Library is an extension that runs on top of the hardware application. It handles all the connection routines and data exchange between our hardware, Blynk Cloud, and our project.

Major features

“Blynk app” It can control hardware remotely, it can display sensor data, it can store data, visualize it and do many other cool things. There are three major components in the platform: Blynk App - allows to you create amazing interfaces for our projects using various widgets.



Figure 2.10: Blynk application widget box

2.5 Current Sensor

In this project there used a current sensor for detect consumed power. Depending on consumed power we find the costing of used equipment. Here we used ACS712 Current sensor for sensing current.

The ACS712 current sensor provides economical and precise solutions for AC or DC current sensing in home, industrial, commercial, and communications systems. The device package allows for easy implementation by the customer. Typical applications include motor control, load detection and management, switched-mode power supplies, and over current fault protection.

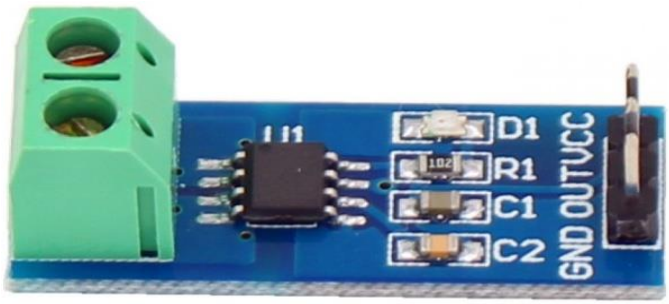


Figure 2.11: ACS712 Current Sensor

The device consists of a precise, low-offset, linear Hall sensor circuit with a copper conduction path located near the surface of the die. Applied current flowing through this copper conduction path generates a magnetic field which is sensed by the integrated Hall IC and converted into a proportional voltage. Device accuracy is optimized through the close proximity of the magnetic signal to the Hall transducer.

The ACS712 current sensor is based on the principle of Hall-effect, which was discovered by Dr. Edwin Hall in 1879. According to this principle, when a current carrying conductor is placed into a magnetic field, a voltage is generated across its edges perpendicular to the directions of both the current and the magnetic field. It is illustrated in the figure shown below. A thin sheet of semiconductor material (called Hall element) is carrying a current (I) and is placed into a magnetic field (B) which is perpendicular to the direction of current flow. Due to the presence of Lorentz force, the distribution of current is no more uniform across the Hall element and therefore a potential difference is created across its edges perpendicular to the directions of both the current and the field. This voltage is known Hall voltage and its

typical value is in the order of few microvolt's. The Hall voltage is directly proportional to the magnitudes of I and B. So if one of them (I and B) is known, then the observed Hall voltage can be used to estimate the other.

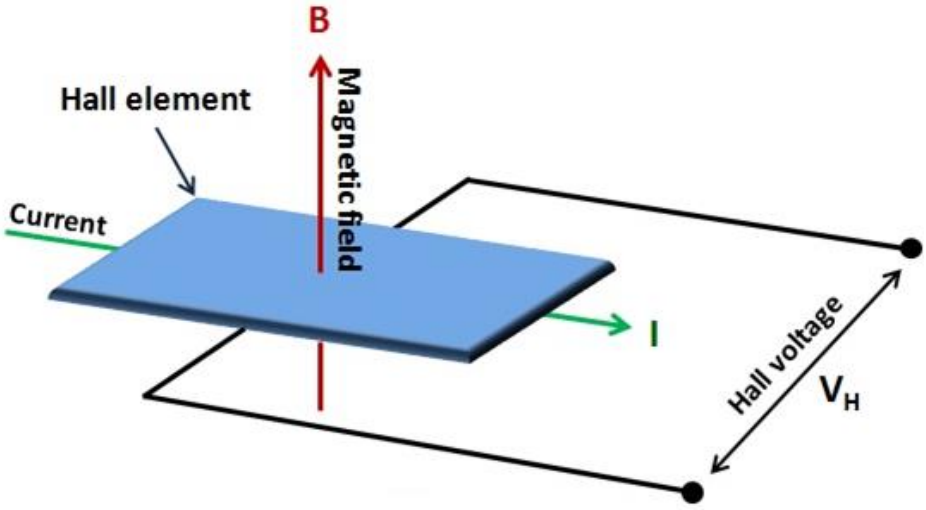


Figure 2.12: Hall Effect

Principle of Hall-effect

The ACS712 device is provided in a small, surface mount SOIC8 package. It consists of a precise, low-offset, linear Hall sensor circuit with a copper conduction path located near the surface of the die. When current is applied through the copper conductor, a magnetic field is generated which is sensed by the built-in Hall element. The strength of the magnetic field is proportional to the magnitude of the current through the conduction path, providing a linear relationship between the output Hall voltage and input conduction current. The on-chip signal conditioner and filter circuit stabilizes and enhances the induced Hall voltage to an appropriate level so that it could be measured through an ADC channel of a microcontroller. The pin diagram of ACS712 device and its typical application circuit is shown below. Pins 1, 2 and 3, 4 forms the copper conduction path which is used for current sensing. The internal resistance of this path is around 1.2 mOhm thus providing low power loss. As the terminals of this conduction path are electrically isolated from the sensor leads , the ACS712 device eliminates the risk of damaging the current monitoring circuit due to the high voltage on the conduction side. The electrical isolation between the conduction current and the sensor circuit also minimizes the safety concerns while dealing with high voltage systems.

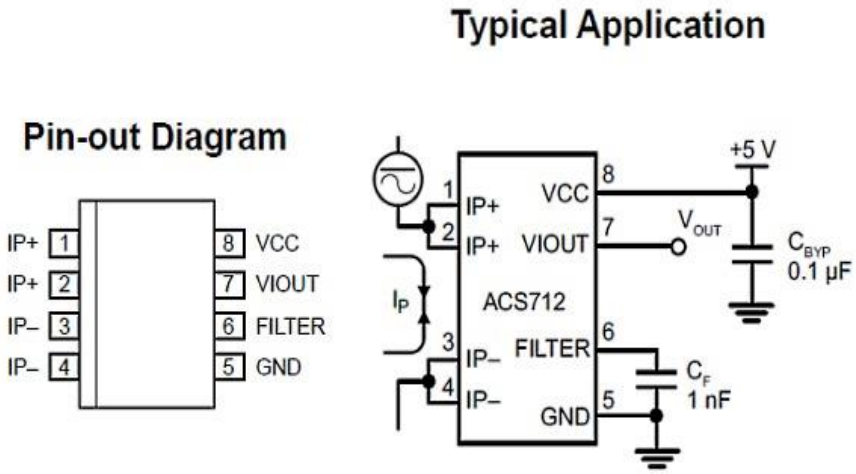


Figure 2.13: Pin diagram of ACS712

In low-frequency applications, it is often desirable to add a simple RC filter circuit at the output of the device to improve the signal-to-noise ratio. The ACS712 contains an internal resistor (RF) connected between the output of the on-chip signal amplifier and the input of the output buffer stage (shown below). The other end of the resistor is externally accessible through pin 6 (Filter).

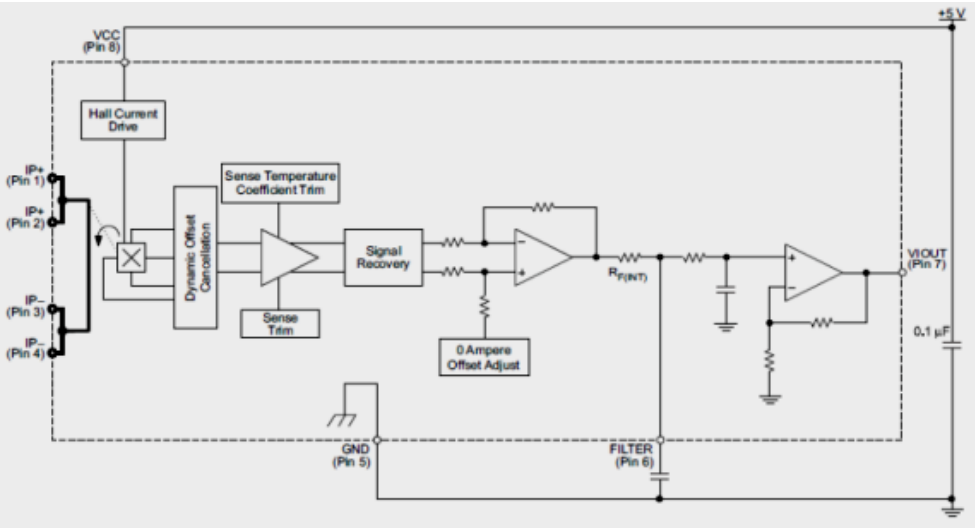


Figure 2.14: Functional block diagram of ACS712

With this architecture, users can implement a simple RC filter through the addition of an external capacitor (CF) between the Filter pin and ground. It should be noted that the use of external capacitor increases the rise time of the sensor output, and therefore, sets the bandwidth of the input signal. The maximum bandwidth of the input signal is 80 KHz at zero

external filter capacitor. The bandwidth decreases with increasing CF. The datasheet of ACS712 recommends to use 1 nF for CF to reduce noise under nominal conditions.

Sensitivity and output of ACS712

The output of the device has positive slope when an increasing current flows through the copper conduction path (from pins 1 and 2, to pins 3 and 4). The ACS712 device comes in three variants, providing current range of±5A (ACS712-05B), ±20A (ACS712-20B), and ±30A (ACS712-30A). The ACS712-05B can measure current up to ±5A and provides output sensitivity of 185mV/A (at +5V power supply), which means for every 1A increase in the current through the conduction terminals in positive direction, the output voltage also rises by 185 mV.

The sensitivities of 20A and 30A versions are 100 mV/A and 66 mV/A, respectively. At zero current, the output voltage is half of the supply voltage (Vcc/2). It should be noted that the ACS712 provides ratio metric output, which means the zero current output and the device sensitivity are both proportional to the supply voltage, VCC. This feature is particularly useful when using the ACS712 with an analog-to-digital converter. The precision of any A/D conversion depends upon the stability of the reference voltage used in the ADC operation. In most

Microcontroller circuits, the reference voltage for A/D conversion is the supply voltage itself. So, if the supply voltage is not stable, the ADC measurements may not be precise and accurate. However, if the reference voltage of ADC is same as the supply voltage of ACS712, then the ratio metric output of ACS712 will compensate for any error in the A/D conversion due to the fluctuation in the reference voltage.

Let me explain this with an example. Suppose, an ADC chip uses Vcc = 5.0V as a reference for A/D conversion and the same supply voltage powers an ACS712 sensor chip. The analog output of the ACS712 will be digitized through the ADC chip. When there is zero current through the current sensor, the output is Vcc/2 = 2.5V. If the ADC chip is 10-bit (0-1023), it will convert the analog output from the ACS712 sensor into digital value of 512 count.
Now, if the supply voltage drifts and becomes Vcc = 4.5V, then, due to the ratio metric nature, the new output of the ACS712 sensor will be 4.5/2 = 2.25V, which will still be

digitized to 512 by the ADC as its reference voltage is also lowered to 4.5V. Similarly, the sensitivity value will also be lowered by a factor of 4.5/5 = 0.9, which means if the ACS712-

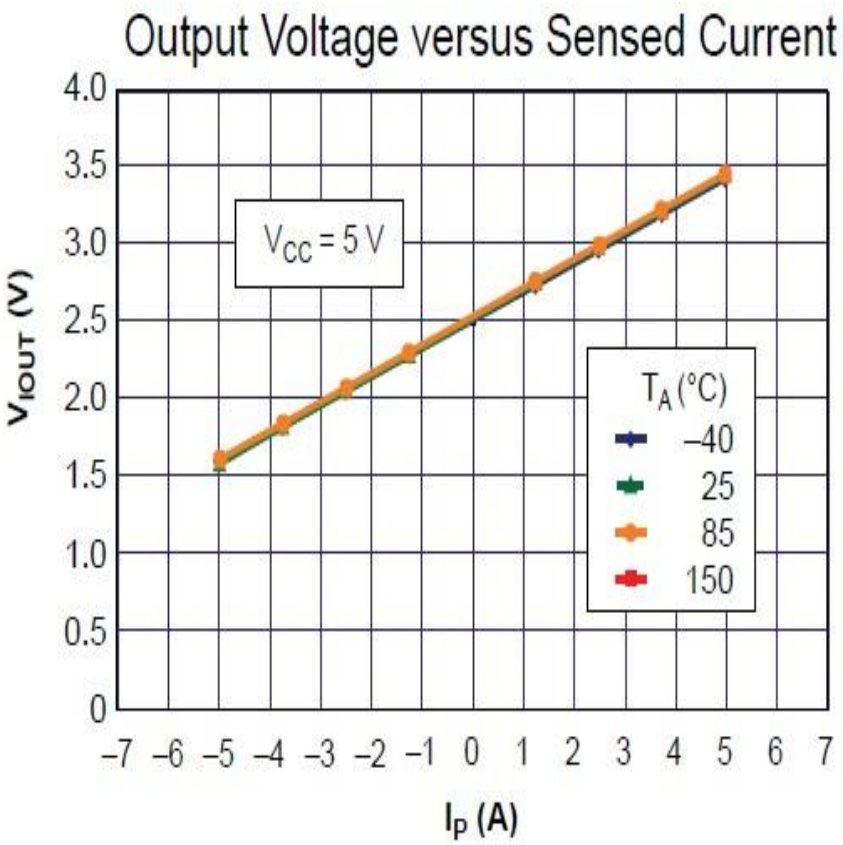


Figure 2.15: Output voltage vs. sensed current

05B is powered with a 4.5V supply, the sensitivity is reduced to 166.5 mV/A, instead of 185mV, A. This concludes that any fluctuation in the reference voltage will not be a source of error in the analog-to-digital conversion of the ACS712 output signals.

2.6 Temperature sensor

A temperature sensor is an electronic device that measures the temperature of its environment and converts the input data into electronic data to record, monitor, or signal temperature changes. There are many different types of temperature sensors. Some temperature sensors require direct contact with the physical object that is being monitored (contact temperature sensors), while others indirectly measure the temperature of an object (non-contact temperature sensors).



Figure 3.16: Temperature Sensor

The DS18B20 temperature sensor is a one-wire digital temperature sensor. This means that it just requires one data line (and GND) to communicate with the Arduino. It is one of the most popular temperature sensors on the market and provides fairly high accuracy (±0.5 °C) over a large temperature range (-55 °C to + 125 °C). Because the operating voltage of the sensor is 3.0 to 5.5 V.

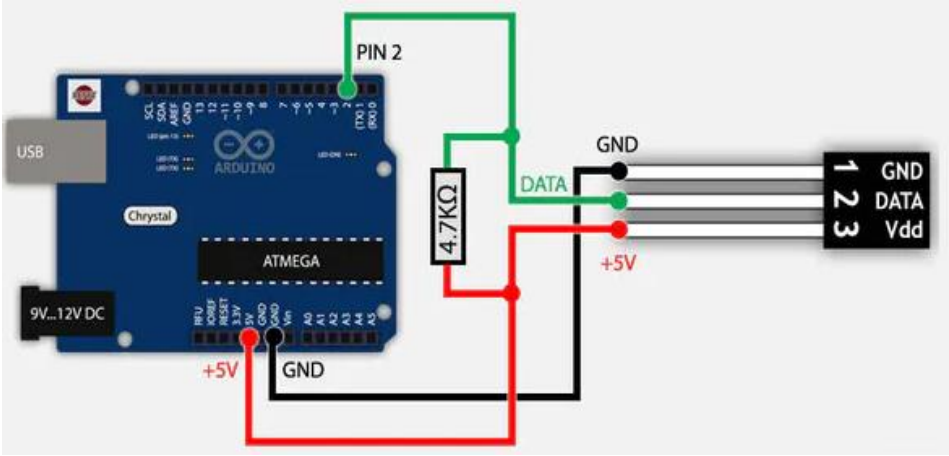


Figure 2.17: Arduino and temperature sensor connection

2.7 Smoke Sensor

Sensitive material of MQ-5 Smoke sensor is SnO2, which with lower conductivity in clean air. When the target combustible gas exist, The sensors conductivity is more higher along with the gas concentration rising. Please use simple electro circuit, convert change of conductivity to correspond output signal of gas concentration.

MQ-5 Smoke sensor has high sensitivity to Methane, Propane and Butane, and could be used to detect both Methane and Propane. The sensor could be used to detect different combustible gas especially Methane, it is with low cost and suitable for different application.

Features

- Indication of the signal output.
- Dual signal output (analog output, and TTL level output)
- TTL output signal is low. (When low output signal light, and can be connected directly to the microcontroller)
- 0 ~ 5V analog output voltage, the higher the concentration, the higher the voltage.
- Smoke , Liquefied petroleum gas, natural gas, city gas, better sensitivity.
- Has a long life and reliable stability
- Fast response and recovery characteristics
- Operating voltage: DC 5 V



Figure 2.18: Smoke Sensor Module

Application

- Domestic Smoke detector
- Industrial Smoke detector
- Portable Smoke detector

2.8 Gas Sensor

Gas sensor MQ-6 is highly sensitive to LPG, isobutene and propane. This sensor is used in gas leakage detecting equipment in domestic and industrial applications. It is suitable for LPG detection and important thing is, it avoids the noise signal of alcohol, cooking fumes and

smoke. In clean air it has lower conductivity. If combustible gas is detected, the sensor conductivity increases with increase in gas concentration. Higher sensitivity to LPG, low cost and long life are the main features to select this gas sensor. Voltage variation obtained is from 0.5 volts in clean air to 0.9 volts when leakage detected. Hence 0.7 volts is considered as threshold level indication of gas leakage. If output voltage of 0.7 volts is detected, gas leakage system will be operated.



Figure 2.19: LPG Gas Detector

Arduino and LPG sensor Connection

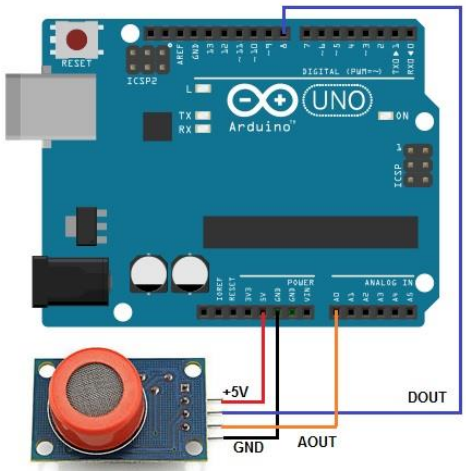


Figure 2.20: Arduino and LPG sensor Connection

2.9 Flame Sensor

A flame detector is a sensor designed to detect and respond to the presence of a flame or fire, allowing flame detection. Responses to a detected flame depend on the installation, but can include sounding an alarm, deactivating a fuel line (such as a propane or a natural gas line), and activating a fire suppression system. When used in applications such as industrial furnaces, their role is to provide confirmation that the furnace is working properly; in these

cases they take no direct action beyond notifying the operator or control system. A flame detector can often respond faster and more accurately than a smoke or heat detector due to the mechanisms it uses to detect the flame.



Figure 2.21: Flame Sensor

The flame sensor module has the following features:

- The operating voltage is from 3.3 – 5V.
- It gives us both analogue and digital output.
- It has a led indicator, which indicates whether the flame is detected or not.
- The threshold value can be changed by rotating the top of a potentiometer.
- Flame detection distance, the lighter flame test can be triggered within 0.8m, if the intensity of the flame is high, the detection distance will be increased.
- The detection angle of the flame sensor module is about 60 degrees.

2.10 GSM Module

A number of signal detecting devices are available in the market. These devices include:

- Ethernet Module
- Wifi Module
- Bluetooth Module
- SIM / GSM Module

All of the devices have their own advantages and disadvantages but we will be targeting that particular device which best suits our requirement. There are certain features that should be considered when choosing the GSM module for use. The features are

- Long Distance Coverage

- Function description
  - Supply voltage: 3.5V - 4.2V
  - Power consumption: sleep mode < 2.0mA, idle mode < 7.0mA
  - GSM transmission (avg): 350 mA
  - GSM transmission (peek): 2000mA
  - Module size: 25 x 23cm
  - SIM card socket: micro SIM
  - Antenna connector: IPX
  - Status signaling: LED
  - Working temperature range: -40 do + 85 ° C
  - Has high-performance
  - Low Cost

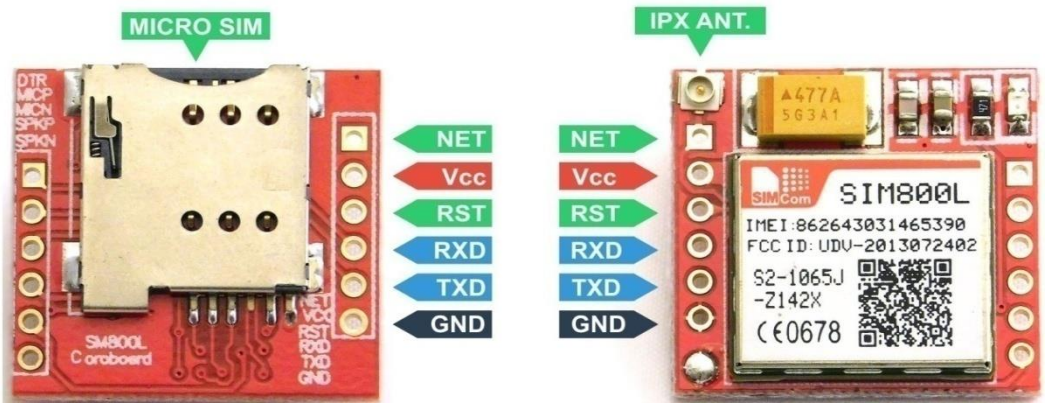


Figure 2.22: SIM800L GSM Module

This GSM module can easily achieve data. Its operating frequency is among the 900/1800/1900 MHz frequency band. In SIM800L signal transmit time of different devices stands at a 0.5 seconds interval so that the work load of SIM chip can be reduced substantially and more sleeping time can be saved for GSM module. This module is set with serial interface, which is easy to use and simplifies the overall design.

GSM (Global System for Mobile communication) is a digital mobile telephony system that is widely used in Europe and other parts of the world. GSM uses a variation of time division multiple access (TDMA) and is the most widely used of the three digital wireless telephony technologies (TDMA, GSM, and CDMA). GSM digitizes and compresses data, then sends it

down a channel with two other streams of user data, each in its own time slot. It operates at either the 900 MHz or 1800 MHz frequency band.

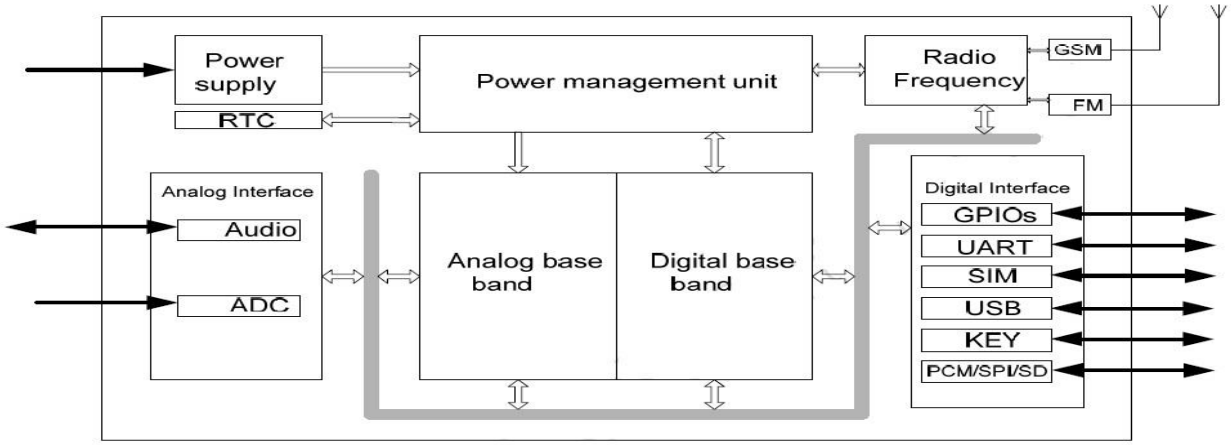


Figure 2.23**:** Schematic Diagram of SIM800L GSM Module

GSM/GPRS module is used to establish communication between a computer and a GSM-GPRS system. Global System for Mobile communication (GSM) is an architecture used for mobile communication in most of the countries. Global Packet Radio Service (GPRS) is an extension of GSM that enables higher data transmission rate. GSM/GPRS module consists of a GSM/GPRS modem assembled together with power supply circuit and communication interfaces (like RS-232, USB, etc) for computer. GSM/GPRS MODEM is a class of wireless MODEM devices that are designed for communication of a computer with the GSM and GPRS network. It requires a SIM (Subscriber Identity Module) card just like mobile phones to activate communication with the network. Also they have IMEI (International Mobile Equipment Identity) number similar to mobile phones for their identification. A GSM/GPRS MODEM can perform the following operations:

1. Receive, send or delete SMS messages in a SIM.
2. Read, add, search phonebook entries of the SIM.
3. Make, Receive, or reject a voice call.

The MODEM needs AT commands, for interacting with processor or controller, which are communicated through serial communication. These commands are sent by the

controller/processor. The MODEM sends back a result after it receives a command. Different AT commands supported by the MODEM can be sent by the processor/controller/computer to interact with the GSM and GPRS cellular network.

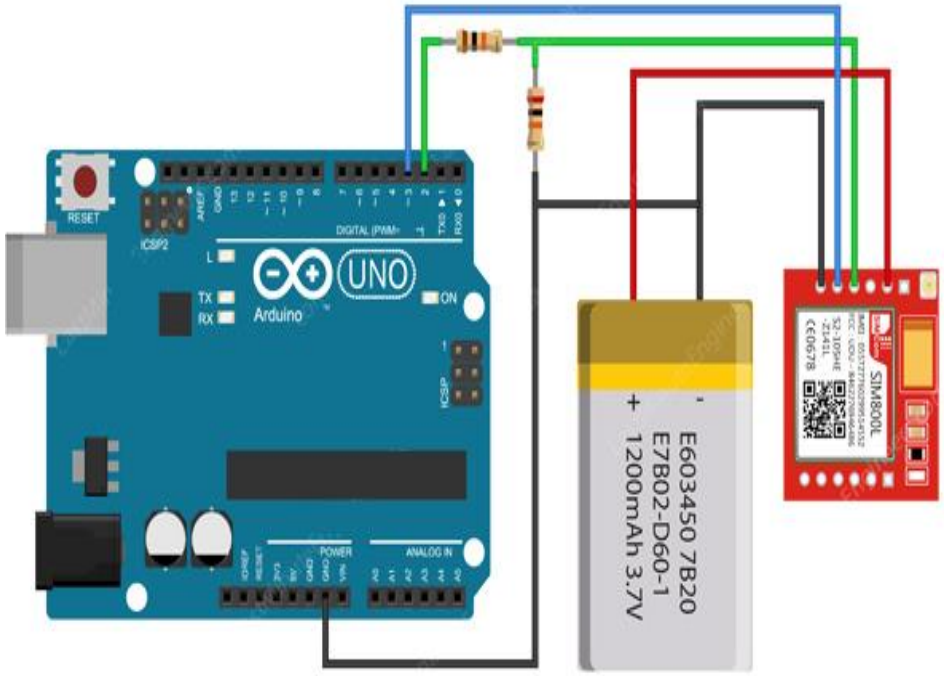


Figure 2.24: Circuit Diagram for Arduino and GSM module Connection.

2.11 LCD Display

LCD stands for liquid crystal display. Character and graphical LCD's are most common among hobbyist and DIY electronic circuit/project makers. Since their interface serial/parallel pins are defined so it's easy to interface them with many microcontrollers. Many products we see in our daily life have LCD's with them. They are used to show status of the product or provide interface for inputting or selecting some process. Washing machine, microwave, air conditioners and mat cleaners are few examples of products that have character or graphical LCD's installed in them [13].

The LCD data port is connected to the port of the I^2C module and through this port the microcontroller is able to send information or instruction codes to the LCD and equally read the contents of the LCD's internal registers. LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 20x4 LCD display is very basic module and is very commonly used in various devices and circuits [13].



Figure 2.25: 20 x 4 LCD.

These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix [13].

This LCD has two registers, namely, Command and Data. The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD. Click to learn more about internal structure of a LCD. To drive the display, it will need 5 digital output pins. Another pin can be used to control (via on/off or PWM) the backlight - the backlight LEDs are wired to a transistor. The display driver is a PCD8544 chip, and it runs at 3.3V so it will need a 3.3V supply of at least 10mA current. Logic levels of I/O pins must be less than 3.6V to prevent damage. So, a level shifter is needed to connect it to 5V logic such as a microcontroller [13].

Character LCD's come in many sizes 8x1, 8x2, 10x2, 16x1, 16x2, 16x4, 20x2, 20x4, 24x2, 30x2, 32x2, 40x2 etc. Many multinational companies like Philips, Hitachi, and Panasonic make their own custom type of character LCD's to be used in their products. All character LCD's performs the same functions (display characters numbers special characters, ASCII characters etc.). Their programming is also same and they all have same 14 pins (0-13) or 16 pins (0 to 15) [13].

On a character LCD a character is generated in a matrix of 5x8 or 5x7. Where 5 represents number of coulombs and 7/8 represent number of rows. Maximum size of the matrix is 5x8. You cannot display character greater then 5x8 dimension matrix. Normally we display a character in 5x7 matrix and left the 8th row for the cursor. If we use the 8th row of the matrix for the character display, then there will be no room for cursor. To display character greater than this dimension you have to switch to graphical LCD's [14].

2.12 Relay switch

The Arduino operates at 5V it can't control these higher voltage devices directly, here we use a single and dual Channel 5V Relay Module to switch the 12V DC. This is a 5V 2-channel relay interface board, and each channel needs a 15-20mA driver current. It can be used to control various appliances and equipment with large current. It is equipped with high-current relays that work under AC250V 10A or DC30V 10A. It has a standard interface that can be controlled directly by microcontroller.

Principle

From the picture below, you can see that when the signal port is at low level, the signal light will light up and the optocoupler 817c (it transforms electrical signals by light and can isolate input and output electrical signals) will conduct, and then the transistor will conduct, the relay coil will be electrified, and the normally open contact of the relay will be closed. When the signal port is at high level, the normally closed contact of the relay will be closed. So, you can connect and disconnect the load by controlling the level of the control signal port.The SRD-05VDC-SL-C relay has three high voltage terminals (NC, C, and NO) which connect to the device you want to control. The other side has three low voltage pins (Ground,
Vcc, and Signal) which connect to the Arduino.
NC: Normally closed 120-240V terminal
NO: Normally open 120-240V terminal
C: Common terminal
Ground: Connects to the ground pin on the Arduino
5V Vcc: Connects the Arduino 5V pin
Signal: Carries the trigger signal from the Arduino that activates the relay

Inside the relay is a 120-240V switch that's connected to an electromagnet. When the relay receives a HIGH signal at the signal pin, the electromagnet becomes charged and moves the contacts of the switch open or closed.



Figure 2.26: 5V Relay Module

Pin Description and Features

INPUT	OUTPUT
VCC: Positive supply voltage GND: Ground IN1--IN4: Relay control port	Connect a load, DC 30V/10A , AC 250V/10A

Features:

Size: 75mm (Length) * 55mm (Width) * 19.3mm (Height)

Weight: 61g

PCB Color: Blue

There are four fixed screw holes at each corner of the board, easy for install and fix. The diameter of the hole is 3.1mm

High quality Songle relay is used with single pole double throw, a common terminal, a normally open terminal, and a normally closed terminal

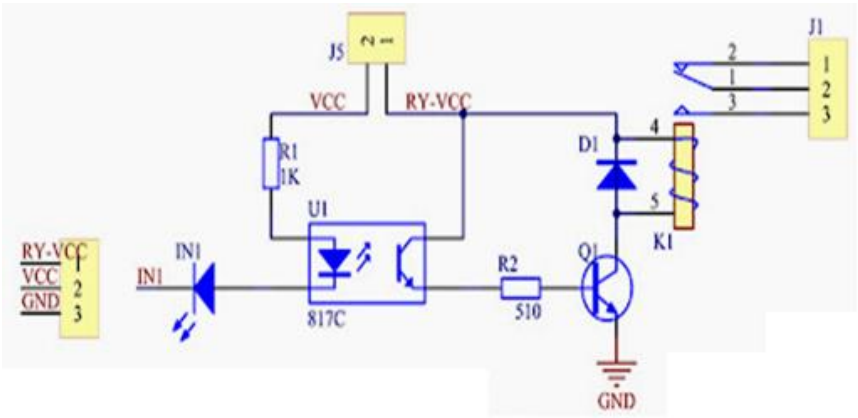


Figure 2.27: 5V Relay Module circuit diagram

2.13 Transformer

A transformer is a passive electrical device that transfers electrical energy between two or more circuits.

.



Figure 2.28: 220v to 12V step down transformer.

A varying current in one coil of the transformer produces a varying magnetic flux, which, in turn, induces a varying electromotive force across a second coil wound around the same core. Electrical energy can be transferred between the two coils, without a metallic connection between the two circuits. Faraday's law of induction discovered in 1831 described the induced voltage effect in any coil due to changing magnetic flux encircled by the coil.

Transformers are used for increasing or decreasing the alternating voltages in electric power applications, and for coupling the stages of signal processing circuitsBasically, transformer are two types.

1. Step up transformer

2. Step down transformer

We have used step down transformer as required for our project. Which is 220v to 12v 3000ma step down transformer.

2.14 Full wave rectifier

A Full wave rectifier is a circuit arrangement which makes use of both half cycles of input alternating current (AC) and converts them to direct current (DC). ... This arrangement is known as a Bridge Rectifier. It uses the entire AC wave (Both positive and negative sections). Each diode uses 0.7v when conducting and there are always two diodes conducting.

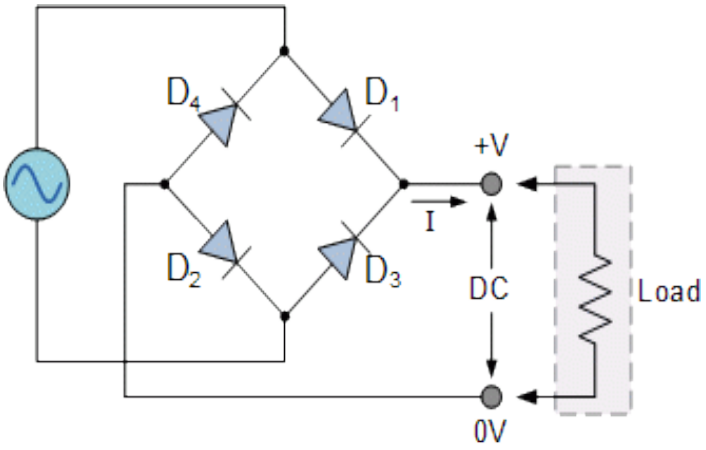


Figure 2.29: Full wave rectifier is a circuit diagram

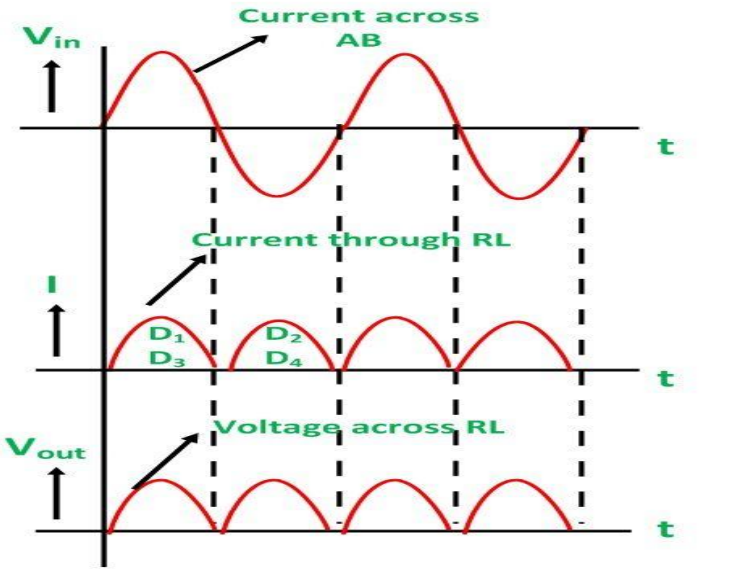


Figure 2.30: Full wave rectifier wave from

2.15 Buck Converter

A buck converter (step-down converter) is a DC-to-DC power converter, which steps down voltage from its input to its output. The basic operation of the buck converter has the current in an inductor controlled by two switches. In the idealized converter, all the components are considered to be perfect. Specifically, the switch and the diode have zero voltage drop when on and zero current flow when off, and the inductor has zero series resistance. Further, it is assumed that the input and output voltages do not change over the course of a cycle



Figure 2.31: DC-DC Buck Converter

CHAPTER 3

DESIGN AND IMPLEMENTATION

3.1 Block Diagram

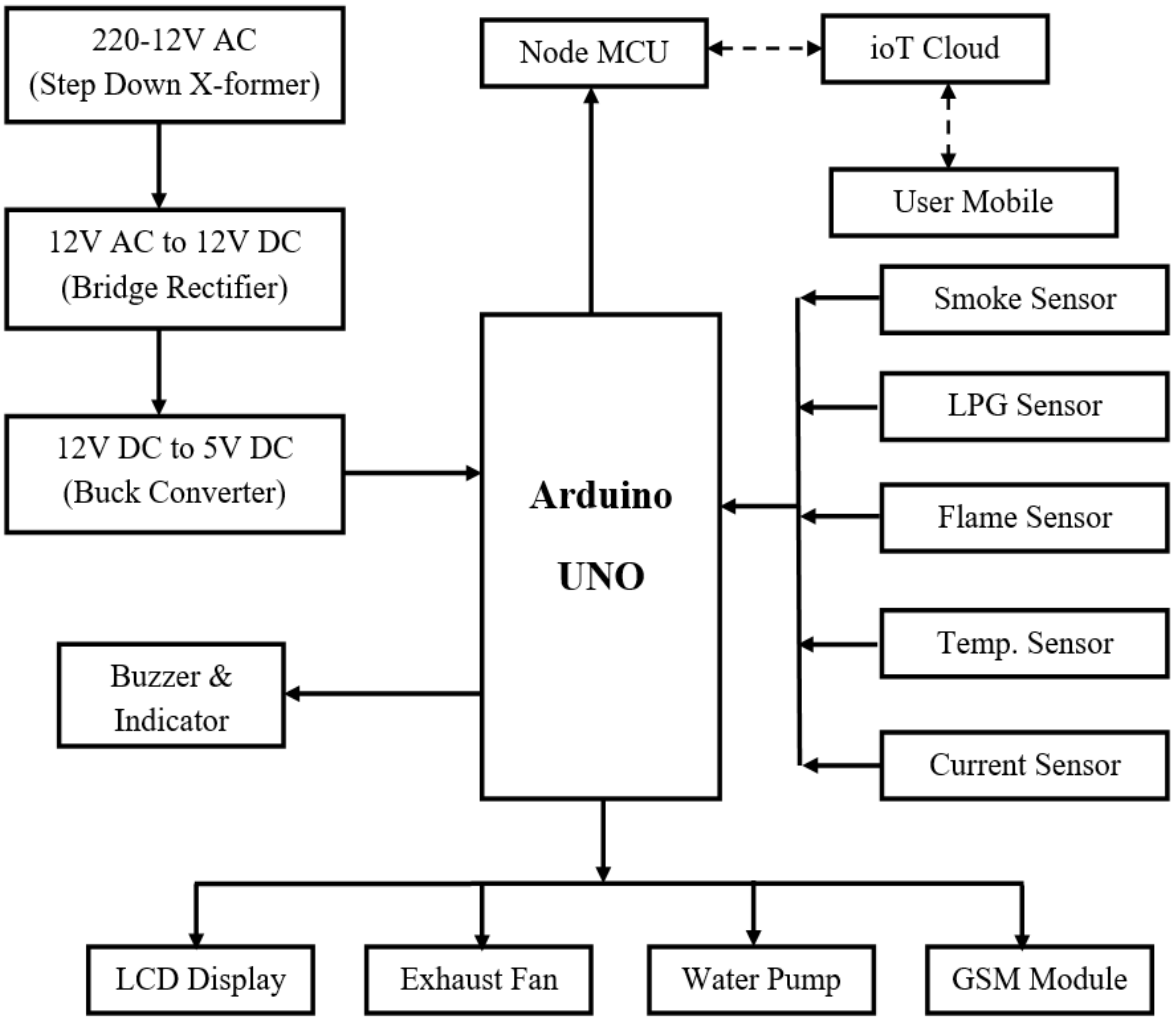


Figure 3.1: Block Diagram of the system.

3.2 Circuit Diagram

The circuit diagram of the project is designed by Proteus ISIS 8.12.

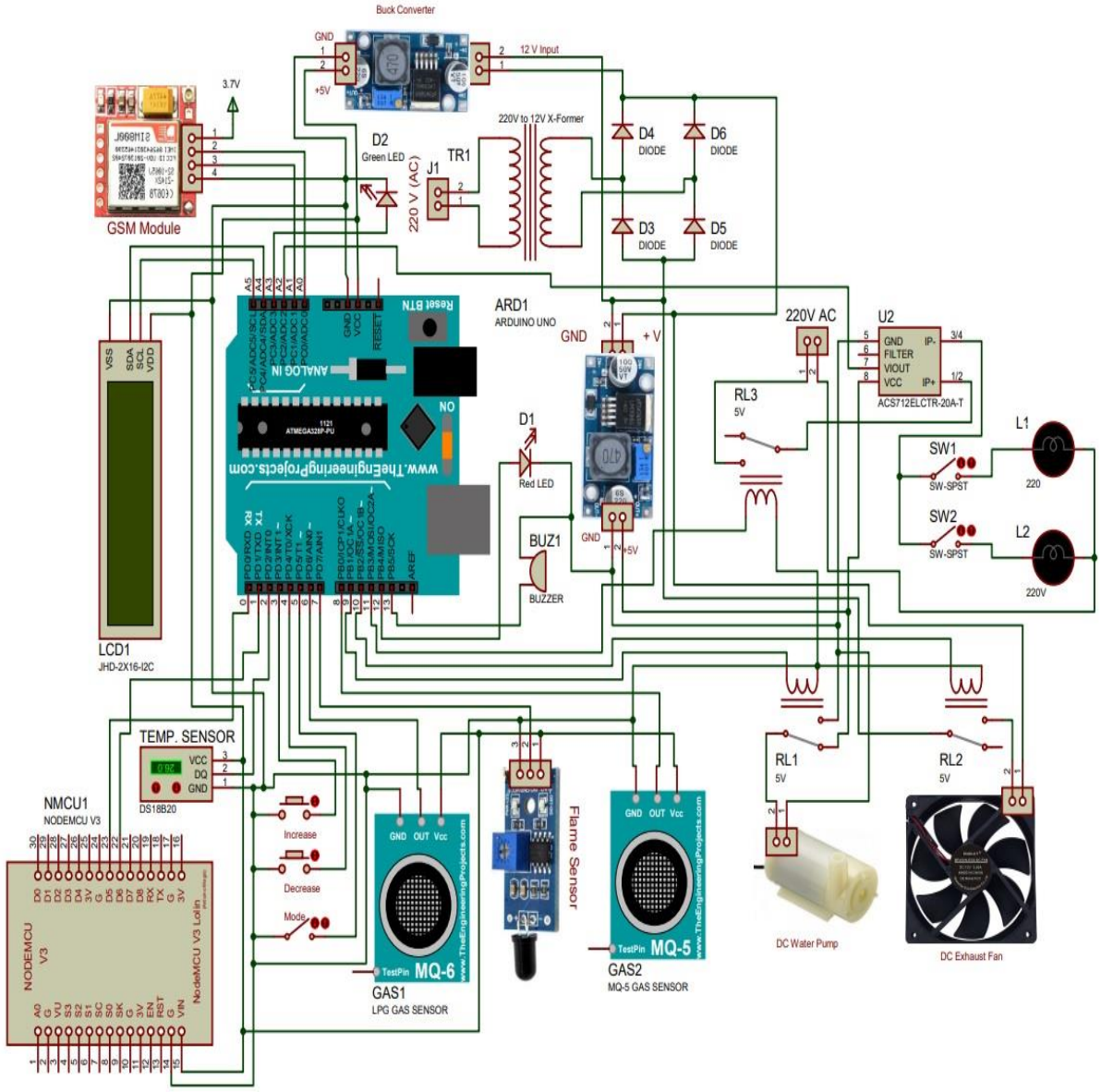


Figure 3.2: Complete Circuit Diagram of the Project.

3.3 Circuit Description

The circuit consists of Flame sensor, Temperature sensor, LPG gas sensor, Current sensor and smoke sensor, GSM Module, NodeMCU, Exhaust fan, water pump, red Led, Green Led and Buzzer. LPG sensor is connected to D6 or arduino, Flame sensor is at D7, Smoke sensor is connected to D8, A DS18B20 digital temperature sensor is connected to D2, Current sensor is connected with pin A2. A GSM Module called SIM-800L is connected to A0-A1 pin of microcontroller. A LCD display is connected to i2c port of microcontroller is mark as A4-A5, There are Red Led, Green, Led and Buzzer is connected to pin No.12,13,A3 respectivvely. There are three button for configure set temperature and current is connected to D3,D4,D5.

Another Wifi connectable microcontroller is connected to UART port of Arduino is called D0-D1 for transfer sensor data to user mobile via internet. User can view System temperature, consumed Current, Flame status, gas status, smoke status and setting parameter on smartphone using internet connectivity. A 5v power Source is connected to power pin of microcontroller by using stepdown transformer, Bridge rectifier and buck converter.

3.4 Project Design

The circuit board is built on Vero Board. The complete circuit is shown below.

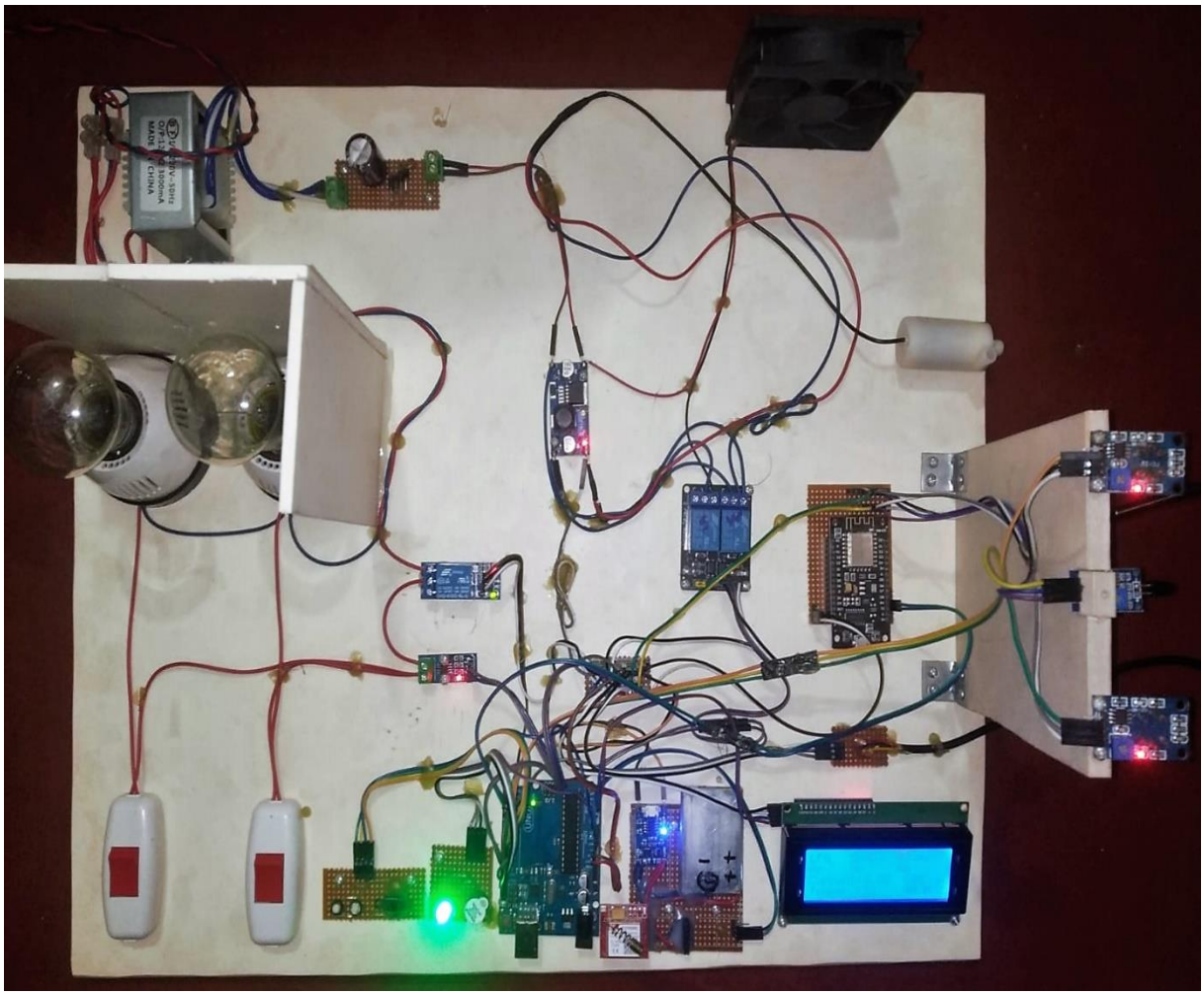


Figure 3.3: Complete Project.

3.5 Working Principle

- LPG gas sensor, Flame sensor, Temperature sensor and current sensors are connected with microcontroller.

- When Gas detected by gas sensor it sent signal to microcontroller and microcontroller operate exhaust fan, alarm and sent sms
- Similarly for Flame microcontroller operate Pump, Exhaust fan start when abnormal temperature detected, Load disconnect for prevent short circuit protection.
- All safety status displayed by a LCD display and inform to authority via SMS and user can check status using internet.

3.6 Programming Microcontroller

The microcontroller executes the program loaded in its Flash memory. This is the so called executable code comprised of seemingly meaningless sequence of zeros and ones. It is organized in 12, 14 or 16 bit wide words, depending on the microcontroller's architecture. Every word is considered by the CPU as a command being executed during the operation of the microcontroller [18].

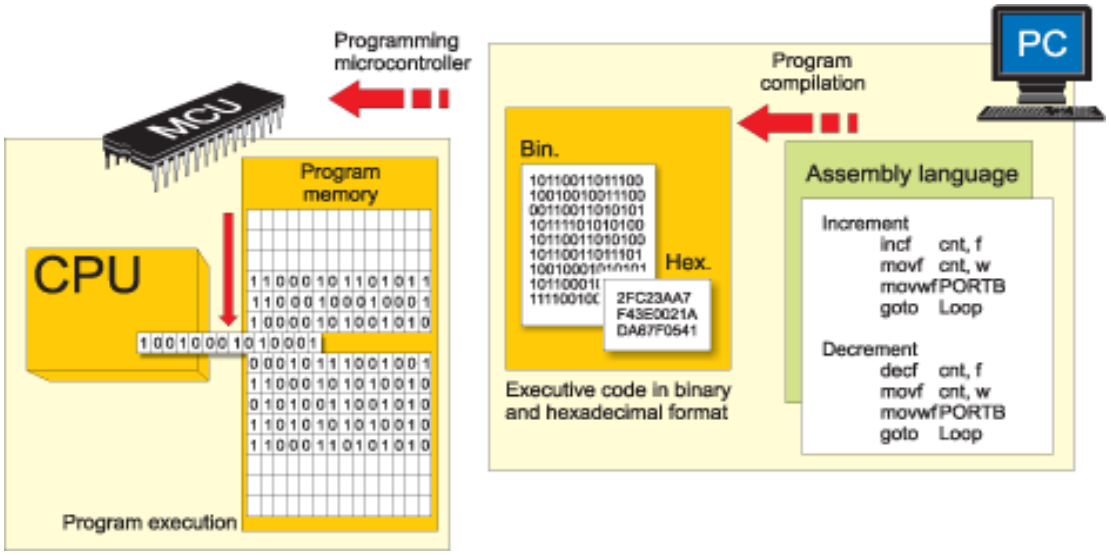


Figure 3.4: Compiling Program.

3.7 Arduino IDE

Arduino software

The smart microcontroller unit named as Arduino Uno can be programmed with the Arduino software. There is no any requirement for installing other software rather than Arduino. Firstly, Select "Arduino Uno from the Tools , Board menu (according to the microcontroller

on your board).The IC used named as ATmega328 on the Arduino Uno comes pre burned with a boot loader that allows you to upload new code to it without the use of an external hardware programmer. Programming software of this line follower is known as ARDUINO-1.6.8. This is open source programming platform**.** The open-source ARDUINO environment makes it easy to write code and upload it to the input/output board. Here we use ARDUINO-1.6.8 platform.

To configure software, we have to use ARDUINO -1.6.8 named arduino.exe

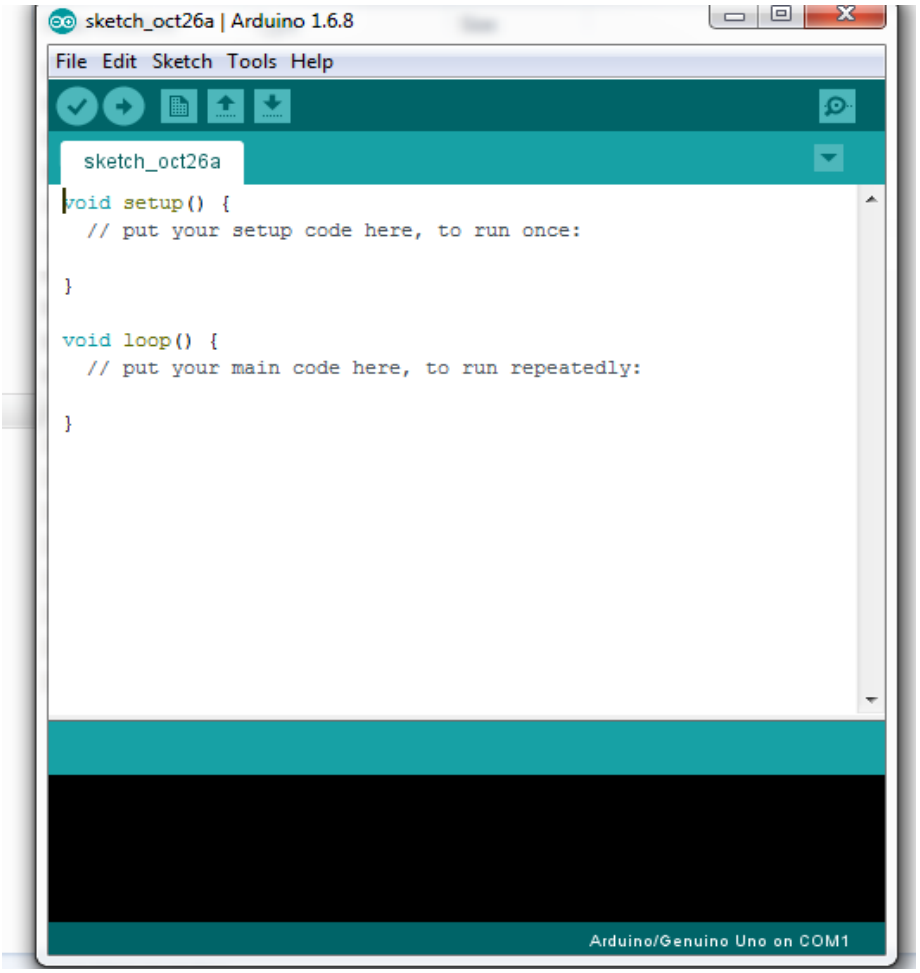


Figure 3.5: Programming platform for ARDUINO

To configure this programmer with computer we need a USB cable then check serial port and select the programmer from Aruino-1.6.8 platform such as,

Serial communication

It is used for the communication between Arduino and a computer or other

devices. Every Arduino board has at least one serial port. This ports communicates thanks to the digital pins 0 (RX) and 1 (TX), and with the computer thanks to the USB connection.

Serial.begin(speed)

It establishes the speed of data in bits per second (bauds) for the transmission of data in serial communication.

Serial.read()

It reads the data from the serial port.

Serial.print(val,[format])

It prints the data to the serial port as ASCII text

Serial.println(val,[format])

It prints the data to the serial port as ASCII text but it jumps to a new line.

Serial.available()

It gives back the number of available bytes to be read by the serial port. It refersto data that has already been received and is available in the buffer of the port.

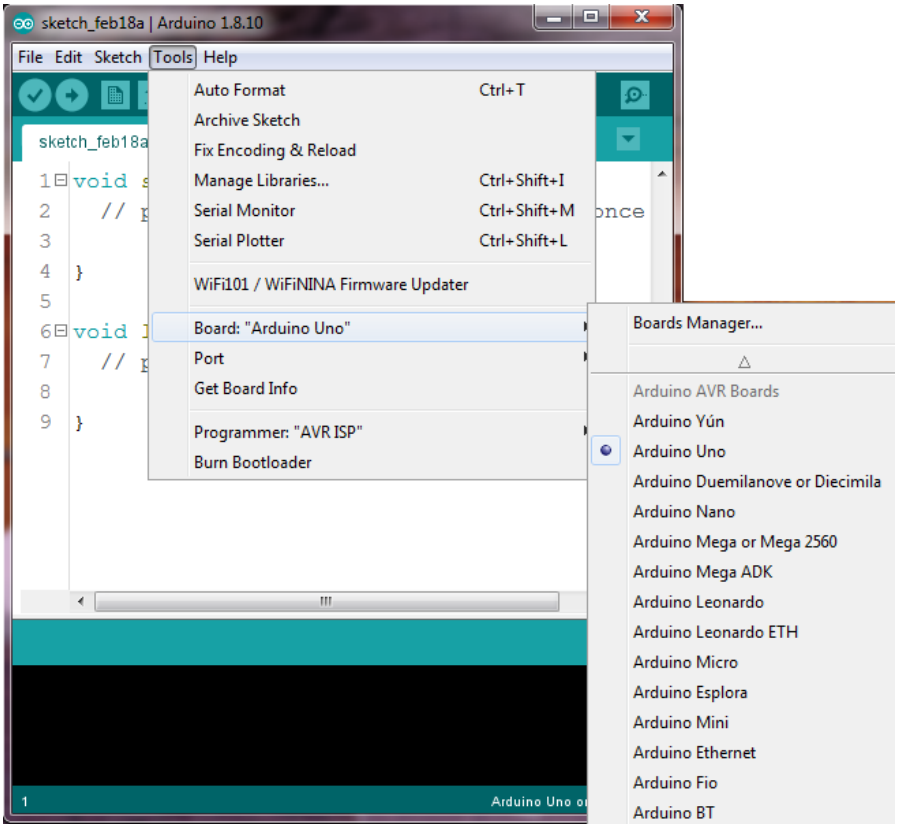


Figure 3.6: IDE configuration for ARDUINO UNO Programmer

3.8 Software Configuration

Programming software of this line follower is known as ARDUINO-IDE .This is open source programming platform. The open-source ARDUINO environment makes it easy to write code and upload it to the input/output board.

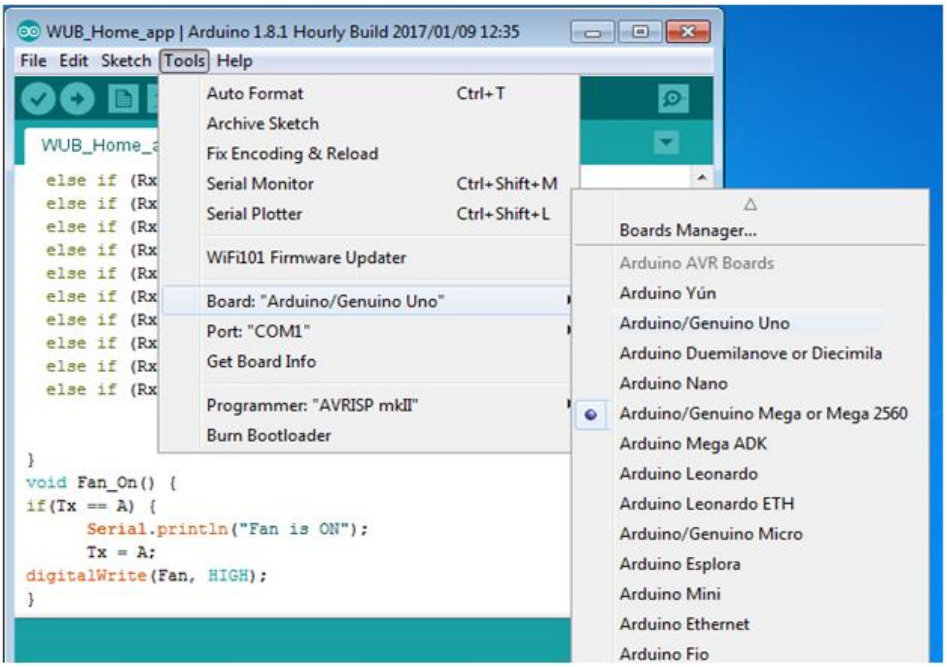


Figure 3.7: IDE Board Selection Menu

Here we use ARDUINO-1.8.1 platform. To configure software we have to use ARDUINO IDE named arduino.exe To configure this programmer with computer we need a USB cable then check serial port and select the programmer from IDE platform such as, After complete configuration IDE is ready for programming. At finally upload main program to new ATMEGA2560 using IDE



Figure 3.8: Uploading the program

When microcontroller will programmed properly a confirmation message will be show, which looks like,



Figure 3.9: Message for upload complete

Now our Arduino is ready to use.

3.9 Prototyping Board

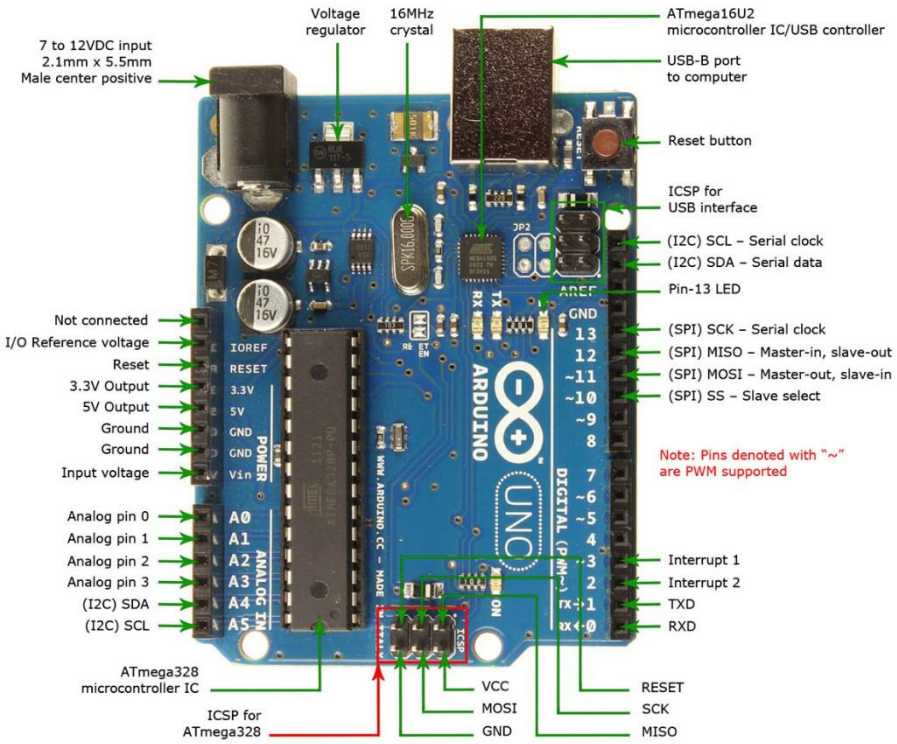


Figure 3.10: Arduino Uno Board.

For testing and debugging firmware code Arduino Development Board is used. An Arduino board historically consists of an Atmel 8-bit, 16-bit or 32-bit AVR microcontroller with complementary components that facilitate programming and incorporation into other circuits. An important aspect of the Arduino is its standard connectors, which let users connect the CPU board to a variety of interchangeable add-on modules termed shields. Some shields communicate with the Arduino board directly over various pins, but many shields are

individually addressable via an I²C serial bus—so many shields can be stacked and used in parallel. So it was a suitable choice for prototyping the project [18].

An Arduino's microcontroller is also pre-programmed with a boot loader that simplifies uploading of programs to the on-chip flash memory, compared with other devices that typically need an external programmer. This makes using an Arduino more straightforward by allowing the use of an ordinary computer as the programmer. Currently, optiboot bootloader is the default bootloader installed on Arduino UNO [18].

A handful of other processors have also been used by Arduino compatible devices. Most boards include a 5 V linear regulator and a 16 MHz crystal.

3.10 Microcontroller Programmer/Program Burner

A microcontroller programmer or microcontroller burner is a hardware device accompanied with software which is used to transfer the machine language code to the microcontroller/EEPROM from the PC.

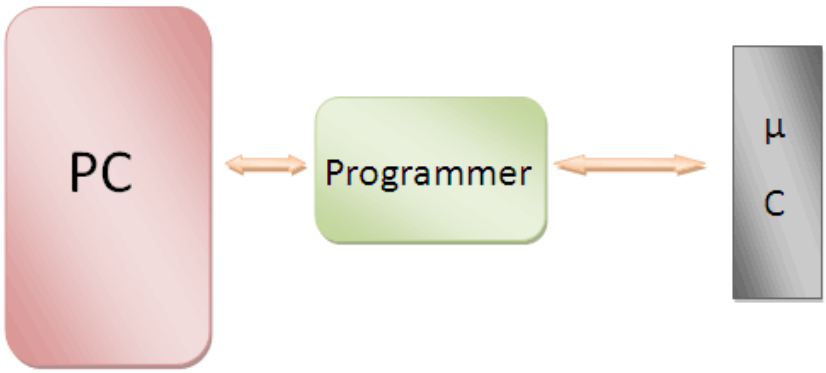


Figure 3.11: Download Program to MCU.

The compiler converts the code written in languages like assembly, C, java etc. to machine language code (which is understandable by the machines/ microcontrollers) and stores it in a hex file. A microcontroller programmer acts as an interface between the PC and the target controller. The API/software of the programmer reads data from the hex file stored on the PC and feeds it into the controller's memory. The target controller on which the program needs to be burned is placed on the programmer using a ZIP socket. The software transfers the data from the PC to the hardware using serial, parallel or USB port [19].

Depending on the way it interacts with PC, there are two types of microcontroller programmers:

1. Parallel Programmer uses the parallel port of the PC. They are low cost programmer but not widely used. Serial Programmers uses the serial port to interact with PC via RS232 protocols. They are more popular among hobbyist working on PC. However both the serial and parallel programmers will become obsolete in near future. The major reason being unavailability of parallel and serial ports in the PCs & Laptops in the coming years [20].

2. USB Programmer uses the USB interface to transfer the data from PC. The main advantage of the USB burner is that they are powered from the PC itself and there is no need of any additional supply. The USB programmers have already become popular and will soon replace the serial and parallel programmer [20].

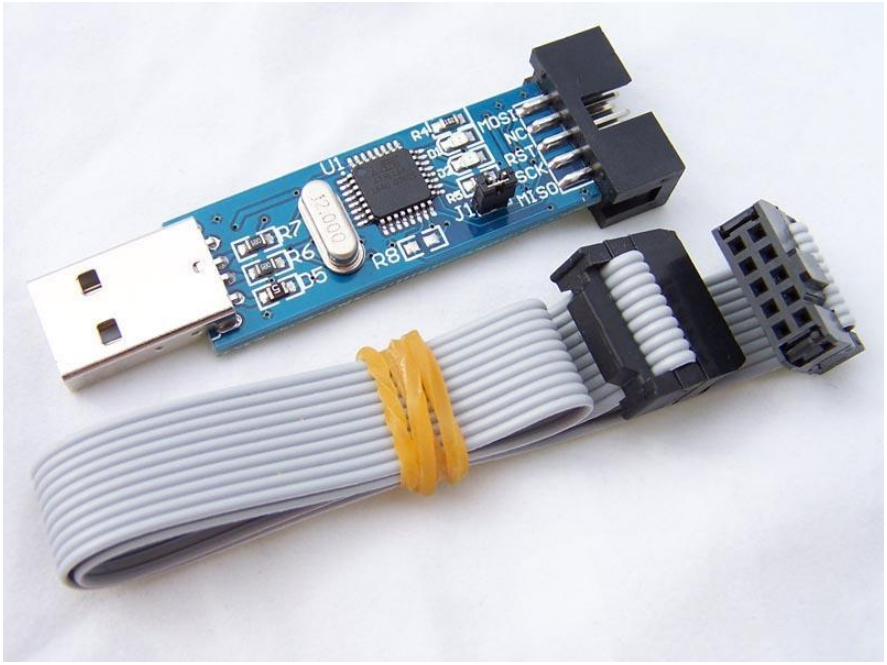


Figure 3.12: USBasp AVR Programmer.

The conventional method to burn a controller is to take it out the circuit, place it on burner and then dump the hex file into the controller using the API. In order to remove this problem of removing the controller from the circuit every time it needs to be programmed, the controllers have now been upgraded with In System Programmer (ISP) feature. This allows burning/programming a controller without removing the controller from the circuit it is used

in. The latest controllers are coming with the feature like bootloader memory which allows self-burning capabilities, i.e. such microcontroller controller does not need any additional programmer hardware. They need only an API to transfer the program to the target controller. This API can also be incorporated in the compiler and hence the compiler can directly burn the target controllers [20].

CHAPTER 4

RESULT AND DISCUSSION

4.1 Introduction

In this chapter, we see the final result. There are many steps to complete this project and there also has so many error. We try our best to overcome error and make a industrial safety System.

4.2 Result

- The system detect LPG leakage and activate exhaust pump to reduce LPG.
- It detect flame and operate pump to control the flame.
- Temperature control by activating exhaust fan.
- Smoke control by activating exhaust fan.
- To protect the industries appliance it disconnect main line during short circuit.
- The system sent a alert sms to authority when it detect any fault.



Figure 4.1: System Status in LCD.

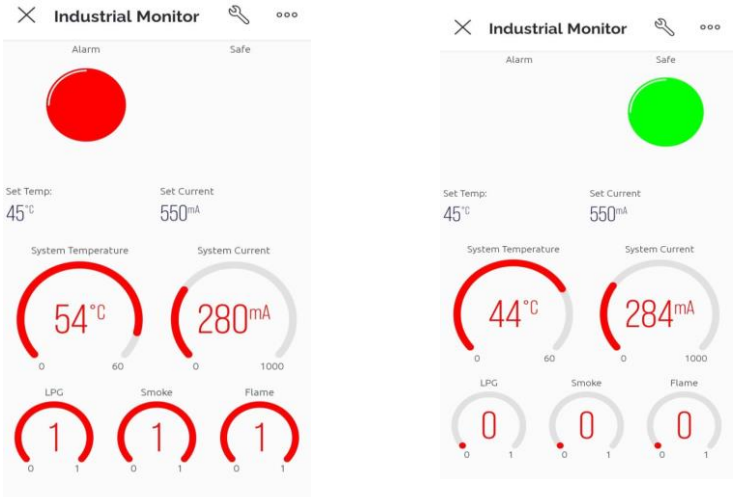


Figure 4.2: System Status in Mobile.

4.3 Advantages

- The sensor has excellent sensitivity combined with a quick fast response time.
- The system is highly reliable and secure.
- In the long run the maintenance cost is very less when compared to the present system.
- It is possible to get instantaneous result and with the high accuracy.
- Inform owner via message to ensure more safety.

4.4 Application

- This Project can be use in industry to ensure safety from Fire, LPG and short circuit.
- This project can be used in home and hotel utility (kitchen) area for safety purpose.
- Useful in domestic LPG safety.
- Very useful in LPG/CNG fitted car to avoid measure accident.
- Prevent measure accident in gas agencies (gas station) where multi cylinder stored.

4.5 Limitation

- It cannot provide safety during load shading
- It can detect flame within 3 feet
- This system monitor only one unit/room
- It cannot be use to protect high current consuming equipment due to current sensor (max 20A)

4.6 Discussion

Fire incident is totally unexpected but we could protect or minimize its happening frequency and devastating effect by using an automatic control system. Gas leakages resulting into fatal inferno has become a serious problem in household and other areas where household gas is handled and used. Gas leakage leads to various accidents resulting in financial loss as well as human injuries and loss. This system can be use in the industrial areas (Sub station, Boiler room, dying room, power control room), shopping malls, hospitals, housing areas, ships, universities, garments factories etc. The work aims at designing a system that detects

Temperature and gas leakage and alerts this describer through alarm and cell phone message besides turning off the gas supply valve as a primary safety measure.

This project is very useful to prevent accident due to gas leakage, short circuit, over temperature and fire. If we implement this in broad way, it is very successful. We can get message remotely at a fraction of time. This detection system is not costly, so that everyone can use it. An appropriate program in the arduino microprocessor to interact with the GSM module has been created successfully. The program has been successfully complied through arduino IDE to the arduino microprocessor & loaded in to it after proper checking of logic to decrease any loss/damage of hardware.

CHAPTER 05

CONCLUSION AND FUTURE WORK

5.1 Conclusion

Safety is a main concern worldwide. Since the technology is getting advanced, various safety systems are developed and implemented to protect our homes or industry from unwanted accident. In this project, multilevel safety system which has been designed and developed consists of smoke sensor, temperature sensor, current sensor, LPG sensor, GSM module, LCD display and an alarm circuit. Alarm system is to alert the authority and also sends alert messages to the concern person.

5.2 Future Scope

- The system can be enhanced by adding more exhaust fan and door control element.
- Control valve of gas can shut off during gas leakage.
- IOT can be implemented by which all leakage information transmits to website via internet.

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APPENDIX

```
//// Library/////
#include "ACS712.h"
#include <Wire.h>
#include <SoftwareSerial.h>
#include <LiquidCrystal_I2C.h>
#include <EEPROM.h>
#include <DS18B20.h>

LiquidCrystal_I2C lcd(0x27,20,4);   ////LCD Display
DS18B20 ds(2); //Temp sensor

int address = 0; //Current data store
int address1 = 1; //Temp Data store
byte scount=EEPROM.read(address);;
byte scountt=EEPROM.read(address1);;

ACS712 sensor(ACS712_05B, A2); // Current sensor

#define tem 5   //mode Switch
#define Ainc 3  //increase
#define Adec 4  //decrease
#define temp 2  //Temp Sensor
#define Sensor1 6  //Gas Sensor
#define Sensor2 7  //Flame Sensor
#define Sensor3 8  //smoke Sensor
#define pump 9 //Water Relay
#define Exhaust 10  //Fan Relay
#define load 11  //Load Relay
#define redLed 12
#define Buzzer 13  //buzzer
#define greenLed A3
```

```
String number1 ="01620585388";


void setup()
{
lcd.init();
lcd.backlight();
pinMode(redLed, OUTPUT);
pinMode(Buzzer, OUTPUT);
pinMode(pump, OUTPUT);
pinMode(Exhaust, OUTPUT);
pinMode(load, OUTPUT);
pinMode(Ainc, INPUT_PULLUP);
pinMode(Adec, INPUT_PULLUP);
pinMode(mod, INPUT_PULLUP);
pinMode(greenLed, OUTPUT);

digitalWrite(redLed, LOW);  // led is off
digitalWrite(Buzzer, LOW);
digitalWrite(greenLed, HIGH); // Green Led ON
digitalWrite(pump, HIGH);  // pump is off
digitalWrite(Exhaust, HIGH); // Fan is off
digitalWrite(load, HIGH);  //// Load is off
}


void loop()
{
//temp data read
int teme=ds.getTempC();
     lcd.setCursor(0,3);
```

```
    lcd.print("Temper.:");
    lcd.print(teme);
    sdata1 = (teme);  //iot


 if (ds.getTempC()>scountt && t_flag==0)
 {
   Serial.println("HIGH Temp.....");
t_flag=1;
mySerial.println("AT+CMGF=1");
delay(50);
mySerial.println("AT+CMGS=\"" + number1 + "\"\r"); //Mobile phone number to send
message
delay(50);
mySerial.print("Caution: High Temperature");
delay(10);
mySerial.print((char)26);// ASCII code of CTRL+Z
delay(100);
 }

//////////////////////////////////   Current ////////////////////////////////////////////////
 float U = 230;
 float I = sensor.getCurrentAC();
 int mA=I*1000;
 float P = U * I;

if (mA>scount*50)
{
 Serial.println("HIGH CURRENT.....SMS.....");
 c_flag=1;
 digitalWrite(load, HIGH);
  lcd.setCursor(13,2);
  lcd.print("*");
```

```
   mySerial.println("AT+CMGF=1");
 delay(50);
 mySerial.println("AT+CMGS=\"" + number1 + "\"\r"); //Mobile phone number to send
message
 delay(50);
 mySerial.print("Caution: High Current, Please Take Action");
 delay(10);
 mySerial.print((char)26);// ASCII code of CTRL+Z
 delay(100);
}

int gas_Sensor   = digitalRead(Sensor1);
int flame_Sensor = digitalRead(Sensor2);
int smoke_Sensor = digitalRead(Sensor3);


////////////////////////////        ALARM       ///////////////////////////////////
if (gas_Sensor==LOW || flame_Sensor==LOW || smoke_Sensor==LOW ||
ds.getTempC()>scountt || I>scount*50 )
{
digitalWrite(redLed, HIGH);
digitalWrite(Buzzer, HIGH);
digitalWrite(greenLed, LOW);
sdata8 = 1;
sdata9 = 2;
a_flag=1;
}

if (gas_Sensor==HIGH && flame_Sensor==HIGH && smoke_Sensor==HIGH  &&
ds.getTempC()<scountt && I<scount*50 && c_flag==0)
{
digitalWrite(redLed, LOW);
digitalWrite(Buzzer, LOW);
```

```
digitalWrite(greenLed, HIGH);
sdata8 = 0;
sdata9 = 3;
}

////// Fan On Condition//////

if (gas_Sensor==LOW || smoke_Sensor==LOW || ds.getTempC()>scountt)
{digitalWrite(Exhaust, LOW);}
if (gas_Sensor==HIGH && smoke_Sensor==HIGH && ds.getTempC()<scountt)
{digitalWrite(Exhaust, HIGH);}



////////////////////////////// LPG Gas  //////////////////////////////

if (gas_Sensor==LOW) {
 lcd.setCursor(0,0);
lcd.print("LPG");
lcd.setCursor(0,1);
lcd.print("Yes");
sdata3 = 1;
g_flag=0;
delay(100);
mySerial.println("AT+CMGF=1");
 delay(50);
 mySerial.println("AT+CMGS=\"" + number1 + "\"\r"); //Mobile phone number to send
message
 delay(50);
 mySerial.print("Caution: LPG Gas Detected");
 delay(10);
 mySerial.print((char)26);// ASCII code of CTRL+Z
 delay(100);
```

```
}


if (gas_Sensor==HIGH) {
lcd.setCursor(0,0);
lcd.print("LPG");
lcd.setCursor(0,1);
lcd.print("No ");
g_flag=1;
sdata3 = 0;
delay(100);}



////////////////////////// Smoke
if (smoke_Sensor==LOW)
{
lcd.setCursor(6,0);
lcd.print("Smoke");
lcd.setCursor(6,1);
lcd.print("Yes");
sdata4 = 1;
mySerial.println("AT+CMGF=1");
 delay(50);
 mySerial.println("AT+CMGS=\"" + number1 + "\"\r"); //Mobile phone number to send
message
 delay(50);
 mySerial.print("Caution: smoke Detected");
 delay(10);
 mySerial.print((char)26);// ASCII code of CTRL+Z
 delay(100);
 }
```

```
if (smoke_Sensor==HIGH) {
lcd.setCursor(6,0);
lcd.print("Smoke");
lcd.setCursor(6,1);
lcd.print("No ");
sdata4 = 0;
delay(100);}




////////////////Flame//////////////////
if (flame_Sensor==LOW && f_flag==1) // current flame previous no flame
{
 lcd.setCursor(13,0);
lcd.print("Flame");
lcd.setCursor(13,1);
lcd.print("Yes");
sdata5 = 1;
digitalWrite(pump, LOW);
f_flag=0;
 mySerial.println("AT+CMGF=1");
 delay(50);
 mySerial.println("AT+CMGS=\"" + number1 + "\"\r"); //Mobile phone number to send
message
 delay(50);
 mySerial.print("Caution: Flame Detected");
 delay(10);
 mySerial.print((char)26);// ASCII code of CTRL+Z
 delay(100);
//Serial.println("flame detected sms");
```

```
delay(100);  }


if (flame_Sensor==HIGH && f_flag==0) // current no flame previous flame
{
lcd.setCursor(13,0);
lcd.print("Flame");
lcd.setCursor(13,1);
lcd.print("No ");
digitalWrite(pump, HIGH);;
//Serial.println("current no flame  previous flame");
f_flag=1;
sdata5 = 0;
delay(100);}


cdata = cdata+"," +
sdata1+","+sdata2+","+sdata3+","+sdata4+","+sdata5+","+sdata6+","+sdata7+","+sdata8+","
+sdata9;
Serial.print("cdata");
Serial.println(cdata);
cdata = "";
  delay(100);
}
```