Project Report on

IOT BASED MANHOLE DETECTION AND MONITORING SYSTEM

Submitted in partial fulfillment for
the award of degree of

BACHELOR OF TECHNOLOGY

in

Electronics and Communication Engg.

Submitted By:

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Under the Guidance of:
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INTEGRAL UNIVERSITY, LUCKNOW

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June, 2021

UNDERTAKING FROM THE CANDIDATE

This is to certify that we **Adeeb Saleem Khan (1701014003) & Ankit Pal (1701014005**) have completed the B.Tech Project report work on the topic **IOT Based MANHOLE DETECTION AND MONITORING System** under the Guidance of **MR. Qazi Saeed Ahmad**for the partial fulfillment of the requirement for the Bachelor of Technology (B.Tech.) in Electronics and Communication Engg. from Department of Electronics and Communication Engineering, Integral University, Lucknow. This is an original piece of work & I have not submitted it earlier elsewhere.

Date: Signature

Place: Lucknow Adeeb Saleem Khan

ROLL No.- (1701014003)

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DECLARATION BY THE CANDIDATE

We, **Adeeb SaleemKhan (1701014003) & Ankit Pal (1701014005)** certify that the work embodied in this Project report is our own confide work carried out by us under the Guidance of **MR.QAZI SAEED AHMAD**at Integral University, Lucknow. The matter embodied in this Project report has not been submitted elsewhere for the award of any other degree/diploma. I declare that I have not willfully lifted up some other's work, para, text, data, results, etc. reported in the journals, books, magazines, reports, Project reports, thesis, etc., or available at web-sites.

Date: Signature

Place: Lucknow Adeeb Saleem Khan

ROLL No.- (1701014003)

Signature

Ankit Pal

ROLL No.-(1701014005)

CERTIFICATE

This is to certify that **Adeeb Saleem Khan (1701014003) and Ankit Pal (1701014005)** have carried out the project work presented in the Project report entitled **"IOT Based MANHOLE DETECTION AND MONITORING SYSTEM"** for the award of Bachelor of Technology (B.Tech.) in Electronics and Communication Engg. from Department of Electronics and Communication Engineering, Integral University, Lucknowunder my Guidance. To the best of my knowledge, the contents of this Project report have not been submitted to any other institute or university for the award of any degree.

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Dept. of ECE

ACKNOWLEDGEMENT

"Knowledge in the end is based on acknowledgement."

Every student's project owns a debt to their predecessors to their teachers, friends and their parents. I gratefully acknowledge my deep indebtedness to all of these.

The present work is an effort to highlight and find a solution titled "IOT based Manhole Detection and Monitoring System." The work would not have been possible to come to the present shape without the able guidance and supervision and help to us by a number of people.

With deep sense of gratitude, I acknowledge the encouragement and guidance received by Mr. Qazi Saeed Ahmad for his constant contribution and support in this project. I would also like to express our heartfelt gratitude to our project coordinator Mr. Mohd. JavedKhan , for his valuable time and feedback.

Finally, I would like to thank the faculty and staff of our department for constant support and resources provided. Also, an honorable mention to my family and friends for supporting me in this project. Without him this project would not be possible.

Mere verbal thanking is without an effect, but real thankfulness is always given from the core of heart, so I thank all of you from the bottom of my heart.

ADEEB SALEEM KHAN

ABSTRACT

A smart city is a future goal to have cleaner and better amenities for society. Smart underground infrastructure is an important feature to be considered while implementing a smart city. Drainage system monitoring plays a vital role in keeping the city clean and healthy. Since manual monitoring is incompetent, this leads to slow handling of problems in drainage and consumes more time to solve. To mitigate all these issues, the system using a wireless sensor network, consisting of sensor nodes is designed. The proposed system is low-cost, low maintenance, IoT-based real-time which alerts the managing station through an email when any manhole crosses its threshold values. This system reduces the death risk of manual scavengers who clean the underground drainage and also benefits the public.

Nowadays, accidents due to broken and missing manhole covers are quite frequent. Manholes are not monitored properly in developing countries. These accidents can lead to serious injuries and also death. Hence, here we propose a system to overcome this problem. We have included an array of sensors for complete monitoring of the manhole cover so that such accidents can be prevented. This project includes a gas cover to monitor the gas emitted from the sewage systems so that toxicity can be monitored, the internal temperature is also monitored if a check for a change in the temperature as the property of manhole change with temperature which could need to crack formation, a tilt sensor is introduced to indicate whether the manhole can tilt. Also, a float sensor is used to indicate when the water level goes beyond a certain level, in case of any alert due to any of the parameters we send an SMS to an authority number as well as on the IoT website. Also, all the parameters are continuously updated on the website

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LIST OF ABBREVIATION

DC	Direct Current
UART	Universal asynchronous receiver transmitter
GND	Ground
MCU	Microcontroller Unit
SoC	System on Chip
ADC	Analog to Digital Convertor
USB	Universal Serial Bus
PIC	Peripheral interface Controller
SRAM	Static Random Access Memory
IDE	Independent developing Environment
TCP	Transmission Control Protocol
LCD	Liquid Crystal Display
LED	Light Emitting Diode
RTC	Real Time Clock
NRF	New Regulatory framework
RISC	Reduced Instruction Set Computer
VCC	Voltage common collector
IR	Infrared
KHZ,MHZ	KiloHertz, Mega Hertz
mA	Milliampere
R,L,C	Resistor Capacitor Inductor

CHAPTER- 1

INTRODUCTION

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1.1) Motivation

A smart city is the future goal to have cleaner and better amenities for the society. Smart underground infrastructure is an important feature to be considered while implementing a smart city. Drainage system monitoring plays a vital role in keeping the city clean and healthy. Since manual monitoring is incompetent, this leads to slow handling of problems in drainage and consumes more time to solve. To mitigate all these issues, the system using a wireless sensor network, consisting of sensor nodes is designed. The proposed system is low cost, low maintenance, IoT based real time which alerts the managing station through an email when any manhole crosses its threshold values. This system reduces the death risk of manual scavengers who clean the underground drainage and also benefits the public.

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1.2) Concept

Drainage system monitoring plays an important role to keep city clean. In fact, not all areas have drainage monitoring team. It leads to irregular monitoring of the drainage

condition. The irregular monitoring leads to the blocking of the drainage that imply to the salutation which trigger flood. Manual monitoring is also incompetent. It requires a professional but they can only monitor very finite and maintain low accuracy. Also, sometimes due to lack of knowledge the worker may meets to an accident as they have no idea that how will be the conditions in those manholes. This paper represents the application and design function of a smart and real-time Drainage and Manhole Monitoring System with the help of Internet of Things. The manholes present in the drainage will have a module which is having microcontroller interfaced with gas sensor, level indicator, NRF. The system will monitor if the blockage is occurred in between two manholes and also it will sense the rise in amount of various gases which are harmful to the human beings, and also a system of monitoring the water level then it will trigger an alarm and will provide that information to the health departments from which the particular action will be taken. The system will able to monitor all these things in real-time scenario which will allow us to take proper actions of the particular problem in drainage system

1.3) Objective

The main aim of this project is to provide the user with real-time monitoring of the manhole or sewer conditions using the latest technology from various sensors and microcontrollers this will ultimately result in efficient safe operations of the sewer system with minimal resources. The project consists of multiple sensors which sense temperature, water level, poisonous gases, the tilt of the manhole cap and give this data to a microcontroller which then based on the set parameters decides on what solution needs to be done. For example, if the temperature or harmful gases are detected in the manhole an alert is sent on the site using IoT which helps in taking the necessary precautions. Without causing risk of lives. This whole process can be tracked and the concerned authority can get real-time data on the condition of the manhole without requiring much effort.

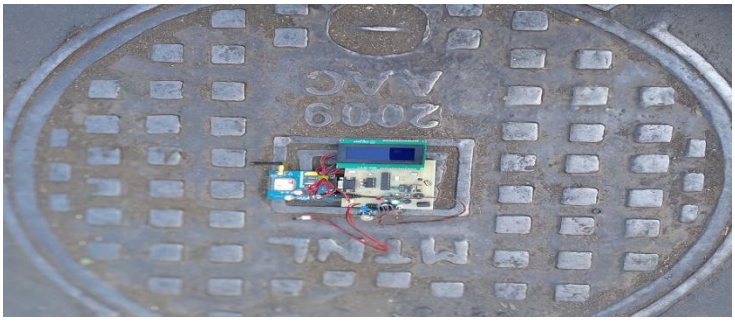


Fig 1: Manhole Monitoring System

Manholes leading to underground supply systems are essential for their maintenance, for example, it concerns telecommunication networks, water supply networks, gas supply networks and electricity networks, and so on. Although it is very crucial to a city's

Monitor, report, predict and optimize your manholes;

- Pick up on unauthorized activities and well plan maintenance schedules.
- 24/7 monitoring with multiple status messages updated per day and instant alarm notification.
- Total flexibility and reliability, can be deployed in urban or rural environments. Operations, the manhole can be one of the least protected and most vulnerable assets.

Applicable to

- Manhole cover
- Sewer cover
- Sewer lid
- Pipe hole cover
- Cable hole cover
- Drain cover
- Square manhole covers
- Concrete manhole covers

CHAPTER 2

2.1 Methodology

In this chapter the objective is to develop and furnish the project. To see step wise how things are implemented and put projects together live. Our manhole monitoring system is used to transport all the sewage from residential areas and industries to waste disposal areas. The main objective is to assist the sewage system to efficiently clear the waste from manholes. The major parameters to be measured, to make it a smart manhole monitoring system is to monitor the water level, gas, temperature and tilt of the manhole lid. All these sensors are connected to an ATMega microcontroller via node MCU. In simple words, on one side the microcontroller collects the data from various sensors and on the other side judges whether any action needs to be taken. The following step guides through the procedure undertaken to make this system.

Step 1: In this above proposal we need multiple sensors (i.e. Temperature, water level etc.) that are used to detect the conditions of the manhole for proper undergoing of the system.

Step 2: Required action by the help of controller (i.e. AtMega328) is to be taken for the deficit of the physical parameters of the manhole for a healthy process.

Step 3: An autonomous system is implemented here for taking the action by supplying an adequate amount of data. Which can be transferred to the concerned authority. Which is automatically done.

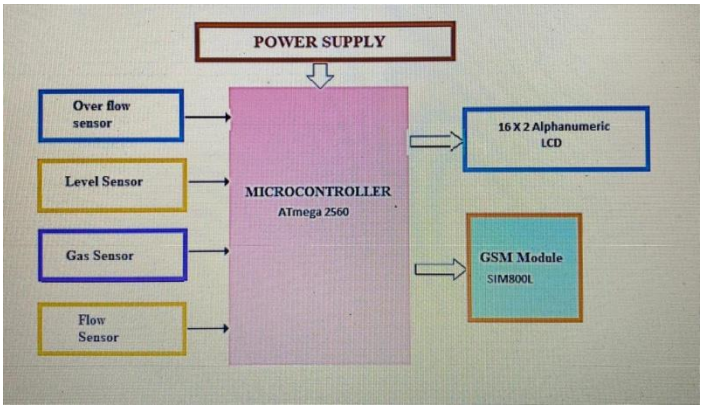


Fig .2: Block diagram of model

2.2) Working Principle

The drainage channels are covered with manholes to operate and to clear the blocking present inside the channel. By placing the sensor node inside of the manhole will detects and transfers the appropriate sensed information about the blockage, harmful gases and conditions to detect elevated flow levels of drainage system. Using the communication modules, it will communicate with the sensor nodes places at nearby manholes. This data will be then transmitted to the base station for further analysis. Sensors will monitor the water levels, blockage in drainage as well as amount of hazardous gases in real time scenarios. Based upon the data values given by the sensors in drainage system the information along with location ID will send to the Gateway and that sends to cloud (server) or concerned authority.

Hardware on the node includes sensors, signal conditioning, gas sensor, raindrop sensor, processor, RTC (Real time Clock), RF (Radio Frequency) modules and supply units. The RF module that is used is NRF. This module requires minimal power and provides reliable delivery of data between remote devices. The modules operate within the ISM (Industrial, Scientific and medical) 2.4GHz frequency band. The output of water level sensors, gas sensor and blockage sensor is conditioned as standard input signal for microcontroller. Output of signal conditioning will be input to the internal ADC (Analog to Digital Converter) of Microcontroller. RTC sets the time of data collection and then RF Module (NRF) sends the data to other sensor nodes. Supply unit can be either battery or solar cell to give power to the sensor node.

In this section, all the sensors used for the monitoring as well as the transmission system, are described. Our system consists of four sensors. MQ2, MQ3,MQ7 and water level sensor. The above sensors senses the intensity levels of water level , smoke and gases such as carbon monoxide ,lpg, alcohol benzine CH4, Hexane, CO Propane.NRF communication modules are used for node to node communication shown in fig no 5.GPRS/Wifi modules are used for sending sensed data to cloud. Offline text sms are also sent from the web to the given predefined mobile number with node information and alert.

2.3) ADVANTAGES

The proposed system prevents water accumulation by generating early alerts when the blockage just starts developing. The system provides an effective solution for proper monitoring of infrastructure management in the city and aims at keeping the city clean, safe and healthy by replacing the manual work of drainage monitoring for safety of the sewer workers

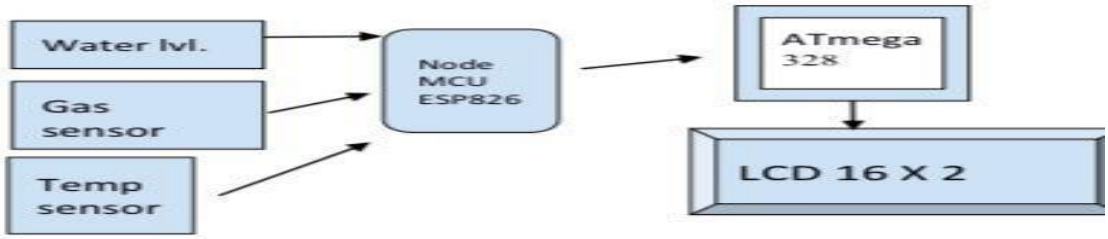
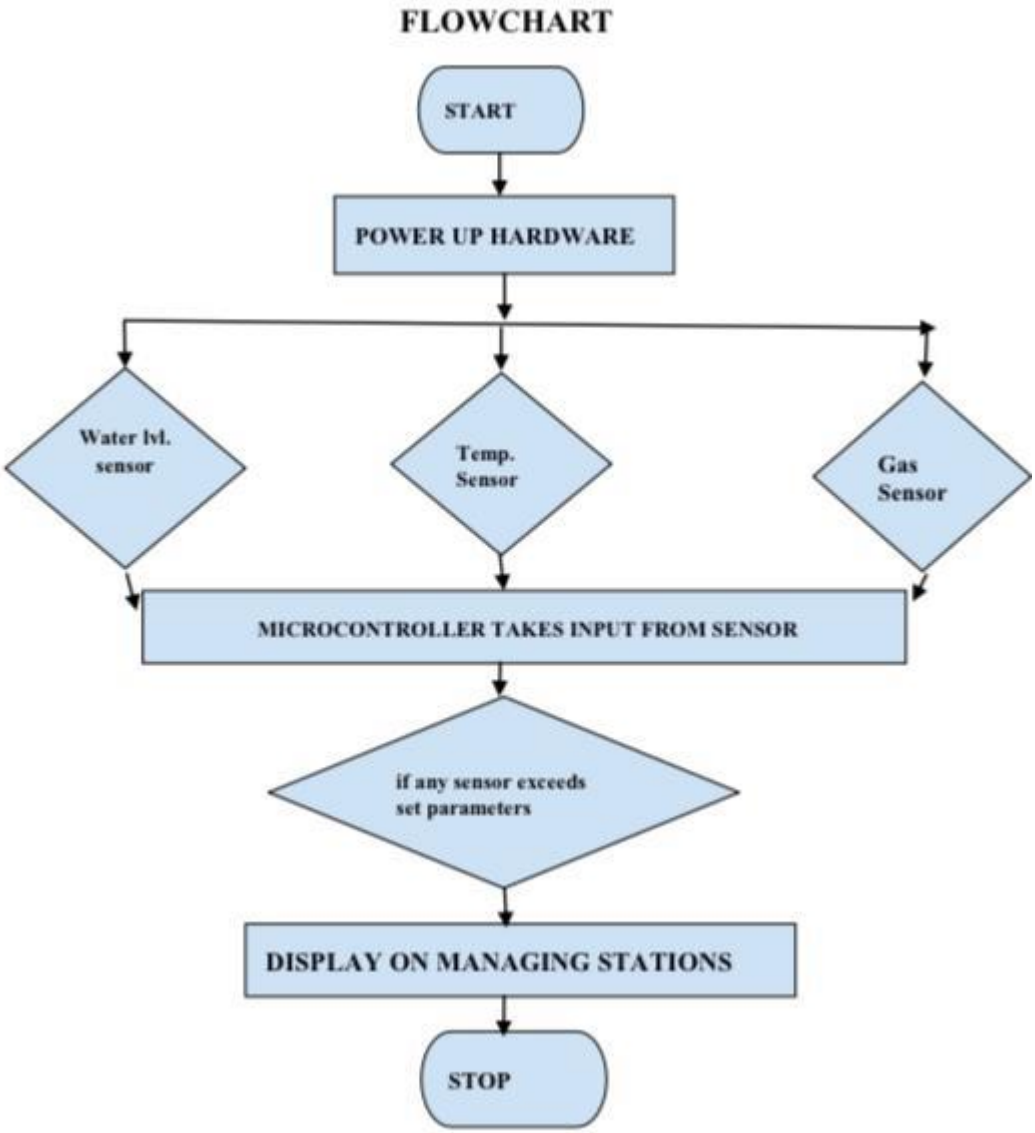


Fig. 3: Block Diagramof the proposed scheme



Chapter-3

Components

3.1) System specifications

Microcontroller Atmega 2560

Atmega 2560 Arduino Mega is a microcontroller board which is based on Atmega 2560. The board has 54 digital I/O pins out of which 15 are used for pulse width modulation and it also has 16 analog pins. The board has a USB cable port that is used to connect and dump code from the computer to the board and it also has a crystal oscillator of 16MHz frequency. There is a reset button and four hardware serial ports called USART which stands for Universal Synchronous/Asynchronous Receiver/Transmitter that is used for setting up communication.

Overflow sensor

Overflow sensor is basically a board which has a coating of nickel in the form of lines and works on the principle of resistance. The module is based on the LM393 op-amp. The sensor is a resistive dipole that shows less resistance because water conducts electricity and connects the nickel lines in parallel and hence reduces resistance and voltage drop across it. The sensor shows more resistance when it is dry.

Level sensor

The level sensor used here is an ultrasonic sensor that is basically used for distance measurement and water level measurement without actual contact with the obstacle. The principle of distance measurement is based on echo. The sensor transmits a sound wave which returns back to the origin as echo after striking the obstacle. Hence the traveling time of the sound wave is noted and the distance is being calculated.

16 x 2 alphanumeric LCD display

The 16 x 2 display has 32 characters overall i.e. 16 in one line and the other 16 in the second line. Each character is made of 50 pixels, therefore, all the pixels must work together to display the character correctly and this function is controlled by another controller (HD44780) in the display unit. Basically, the LCD is used to display the information obtained from the various sensors.

Various other components are described in detail in the component description section of this chapter

3.2) Components Description

3.2.1 ATmega 328

Fig 4 :ATmega 328

Introduction:

The computer on one hand is designed to perform all the general purpose tasks on a single machine like you can use a computer to run a software to perform calculations or you can use a computer to store some multimedia file or to access internet through the browser, whereas the microcontrollers are meant to perform only the specific tasks, for e.g., switching the AC off automatically when room temperature drops to a certain defined limit and again turning it ON when temperature rises above the defined limit.

There are a number of popular families of microcontrollers which are used in different applications as per their capability and feasibility to perform the desired task, most common of these are 8051, AVR and PIC microcontrollers. In this we will introduce you to the AVR family of microcontrollers.

.AVR microcontrollers are available in three categories:

1. Tiny AVR – Less memory, small size, suitable only for simpler applications

2. Mega AVR – These are the most popular ones having a good amount of memory (up-to 256 KB), higher number of in-built peripherals and suitable for moderate to complex applications.
3. Xmega AVR – Used commercially for complex applications, which require large program memory and high speed?

ATmega328P Technical Specifications:

- High performance design
- Low power consumption
- Total number of Analog Input pins are 6
- Contains 32 kilobytes of flash memory
- Contains 2 kilobytes of SRAM
- Contains 1 kilobytes of EEPROM
- 16 megahertz clock speed
- Minimum & maximum temperature -40 degree centigrade to 105 degree centigrade
- Total number of Digital I/O pins are 14
- Advance RISC
- Lock program functionality for programming code security
- Contains total three timers two 8-bit and one 16 bit
- Total number of I/O pins are 23
- Total number of PWM channels are 6
- Minimum and maximum operating voltage from 1.8V DC to 5.5V DC

Features:

- RISC Architecture with CISC Instruction set
- Powerful C and assembly programming
- Scalable
- Same powerful AVR microcontroller core
- Low power consumption
- Both digital and analog input and output interfaces

Description:

The Atmel ATmega48/88/168 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega48/88/168 achieves throughputs approaching 1 MIPS per MHz allowing the system designed to optimize power consumption versus processing speed.

The Atmel ATmega48/88/168 provides the following features: 4K/8K/16K bytes of In-System Programmable Flash with Read-While-Write capabilities, 256/512/512 bytes EEPROM, 512/1K/1K bytes SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible Timer/Counters with compare modes, internal and external interrupts, a serial programmable USART, a byte-oriented 2-wire Serial Interface, an SPI serial port, a 6-channel 10-bit ADC (8 channels in TQFP and QFN/MLF packages), a programmable Watchdog Timer with internal Oscillator, and five software selectable power saving modes. The Idle mode stops the CPU while allowing the SRAM, Timer/Counters, USART, 2-wire Serial Interface, SPI port, and interrupt system to continue functioning.

The ATmega48, ATmega88 and ATmega168 differ only in memory sizes, boot loader support, and interrupt vector sizes. Table 2-1 summarizes the different memory and interrupts vector sizes for the three devices.

ATmega88 and ATmega168 support a real Read-While-Write Self-Programming mechanism. There is a separate Boot Loader Section, and the SPM instruction can only execute from there. In ATmega48, there is no Read-While-Write support and no separate Boot Loader Section. The SPM instruction can execute from the entire Flash.

- Processor architecture

AVR follows Harvard Architecture format in which the processor is equipped with separate memories and buses for Program and the Data information. Here while an instruction is being executed, the next instruction is pre-fetched from the program memory.

ALU: The high-performance AVR ALU operates in direct connection with all the 32 general purpose working registers. Within a single clock cycle, arithmetic operations between general purpose registers or between a register and an immediate are executed. The ALU operations are divided into three main categories – arithmetic, logical, and bit-functions. Some implementations of the architecture also provide a powerful multiplier supporting both signed/unsigned multiplication and fractional format.

.EEPROM data memory: The Atmel ATmega48 /88/168 contains 256/512/512 bytes of data EEPROM memory. It is organized as a separate data space e, in which single bytes can be read and written. The EEPROM has an endurance of at least 100,000 write/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.

Program counter: A program counter is a register in a computer processor that contains the address (location) of the instruction being executed at the current time. As each instruction is fetched, the program counter increases its stored value by 1. After each instruction is fetched, the program counter points to the next instruction in the sequence. When the computer restarts or is reset, the program counter normally reverts to 0. In computing, a program is a specific set of ordered operations for a computer to perform. An instruction is an order given to a computer processor by a program. Within a computer, an address is a specific location in memory or storage. A register is one of a small set of data holding places that the processor uses. Program counter is a very important feature in the microcontrollers.

RAM: RAM stands for random access memory. This type of memory storage is temporary and volatile. You might have heard that if your system is working slowly you say that the RAM processing will increase. Let us understand in detail. Let us consider two cases to execute a task: first the complete task is executed at one place(A), secondthe task is distributed in parts and the small tasks are executed at different places(A,B C)and finally assembled. It is clear the work will be finished in the second case earlier. The A, B, C basically represent different address allocation for temporary processing. This is the case with RAM.

INPUT/OUTPUT PORTS: To interact with the physical environment there are different input and output ports in every system like in PC we have VGA port to connect the monitor, USB port for flash memory connections and many more ports.Similarly, ATMEGA 168 has its input and output ports with different configurations depending on the architecture like only input, only output and bi-directional input output ports. The accessing of this port is referred to as input output interface design for microcontrollers. IT has an analog input port, analog output port, digital input port, digital output port, serial communication pins, timer execution pins etc.

Analog Comparator & A/D converters: The major question is that how a controller manage to detect variation of voltage in-spite it could not understand the voltage but understand only digital sequence

- Inbuilt ADC of AVR

Now you know the basics of ADC let us see how we can use the inbuilt ADC of AVR MCU. The ADC is multiplexed with PORTA that means the ADC channels are shared with PORTA. The ADC can be operated in single conversion and free running more. In single conversion mode the ADC does the conversion and then stop. While in free it is continuously converting. It does a conversion and then start next conversion immediately after that.

- ADC Pre-scalar.

The ADC needs a clock pulse to do its conversion. This clock generated by system clock by dividing it to get smaller frequency. The ADC requires a frequency between 50 KHz to 200 KHz. At higher frequency the conversion is fast while a lower frequency the conversion is more accurate. As the system frequency can be set to any value by the user (using internal or externals oscillators) (In board™ a 16MHz crystal is used). So the Pre-scalar is provided to produces acceptable frequency for ADC from any system clock frequency. System clock can be divided by 2, 4,16,32,64,128 by setting the Pre-scalar.

- ADC Channels

The ADC in ATmega168 has 6 channels that mean you can take samples from eight different terminals. You can connect up to 8 different sensors and get their values separately.

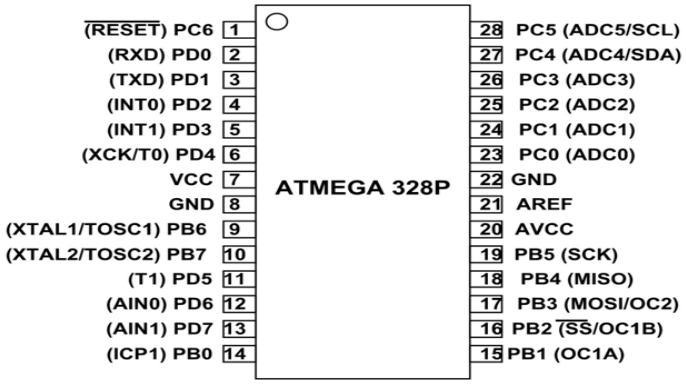


Fig. 5:ATmega 328 Pinout diagram

Where to Use ATMEGA328P

Although we have many controllers ATMEGA328P is most popular of all because of its features and cost. ARDUINO boards are also developed on this controller because of its features.

- With program memory of 32 Kbytes ATMEGA328P applications are many.
- With various POWER SAVING modes it can work on MOBILE EMBEDDED SYSTEMS.
- With Watchdog timer to reset under error it can be used on systems with minimal human interference.
- With advanced RISC architecture, the controller executes programs quickly.
- Also with in chip temperature sensor the controller can be used at extreme temperatures.

These all features add together promoting ATMEGA328P further.

How to Use ATMEGA328P

ATMEGA328 is used similar to any other controller. All there to do is programming. Controller simply executes the program provided by us at any instant. Without programming controller simply stays put without doing anything.

As said, first we need to program the controller and that is done by writing the appropriate program file in the ATMEGA328P FLASH memory. After dumping this program code, the controller executes this code and provides appropriate response.

Entire process of using an ATMEGA328P goes like this:

1. List the functions to be executed by controller.
2. Write the functions in programming language in IDE programs.

   You can download the IDE program for free in company websites. IDE program for AVR controllers is ‘ATMEL STUDIO’. Link for ATMEL STUDIO is given below.

   (Usually Atmel Studio 6.0 for Windows7 [http://atmel-studio.software.informer.com/6.0/],

   Atmel Studio 7 for Windows10 [https://www.microchip.com/avr-support/atmel-studio-7])

3. ATMEGA328P programming can also be done in ARDUINO IDE.
4. After writing the program, compile it to eliminate errors.
5. Make the IDE generate HEX file for the written program after compiling.
6. This HEX file contains the machine code which should be written in controller flash memory.

7 Choose the programming device (usually SPI programmer made for AVR controllers) which establishes communication between PC and ATMEGA328P. You can also program ATMEGA328P using ARDUINO UNO board.
8 Run the programmer software and choose the appropriate hex file.
9 Burn the HEX file of written program in ATMEGA328P flash memory using this program.
10 Disconnect the programmer, connect the appropriate peripherals for the controller and get the system started.3.2.2 Arduino Compiler

ARDUINO COMPILER

INTRODUCTION

Arduino is a tool for making computers that can sense and control more of the physical world than your desktop computer. It's an open-source physical computing platform based on a simple microcontroller board, and a development environment for writing software for the board.

Arduino can be used to develop interactive objects, taking inputs from a variety of switches or sensors, and controlling a variety of lights, motors, and other physical outputs. Arduino projects can be stand-alone, or they can be communicating with software running on your computer (e.g. Flash, Processing, MAX-MSP.) The boards can be assembled by hand or purchased preassembled; the open-source IDE can be downloaded for free.

The Arduino programming language is an implementation of Wiring, a similar physical computing platform, which is based on the Processing multimedia programming environment.

Arduino is a popular open-source single-board microcontroller, descendant of the open-source Wiring platform designed to make the process of using electronics in multidisciplinary projects more accessible. The hardware consists of a simple open hardware design for the Arduino board with an Atmel AVR processor and on-board input/output support. The software consists of a standard programming language compiler and the boot loader that runs on the board.

Arduino hardware is programmed using a Wiring-based language (syntax and libraries), similar to C++ with some slight simplifications and modifications, and a Processing-based integrated development environment

SOFTWARE:

The Arduino IDE is a cross-platform application written in Java, and is derived from the IDE for the Processing programming language and the Wiring project. It is designed to introduce programming to artists and other newcomers unfamiliar with software development. It includes a code editor with features such as syntax highlighting, brace matching, and automatic indentation, and is also capable of compiling and uploading programs to the board with a single click. There is typically no need to edit make files or run programs on a command-line interface. Although building on command-line is possible if required with some third-party tools such as Ino.

The Arduino IDE comes with a C/C++ library called "Wiring" (from the project of the same name), which makes many common input/output operations much easier. Arduino programs are written in C/C++, although users only need define two functions to make a run-able program:

setup () – a function run once at the start of a program that can initialize settings

loop() – a function called repeatedly until the board powers off

A typical first program for a microcontroller simply blinks an LED on and off. In the Arduino environment, the user might write a program like this:

```
#define LED_PIN 13

void setup () {

pinMode (LED_PIN, OUTPUT);     // enable pin 13 for digital output

  }

  void loop () {

digitalWrite (LED_PIN, HIGH);  // turn on the LED

  delay (1000);                // wait one second (1000 milliseconds)

digitalWrite (LED_PIN, LOW);   // turn off the LED

  delay (1000);                // wait one second

  }
```

WHY ARDUINO?

There are many other microcontrollers and microcontroller platforms available for physical computing. Parallax Basic Stamp, and many others offer similar functionality. All of these tools take the messy details of microcontroller programming and wrap it up in an easy-to-use package. Arduino also simplifies the process of working with microcontrollers, but it offers some advantage for teachers, students, and interested amateurs over other systems:

Inexpensive - Arduino boards are relatively inexpensive compared to other microcontroller platforms. The least expensive version of the Arduino module can be assembled by hand, and even the pre-assembled Arduino modules cost less than $50

Cross-platform - The Arduino software runs on Windows, Macintosh OSX, and Linux operating systems. Most microcontroller systems are limited to Windows.

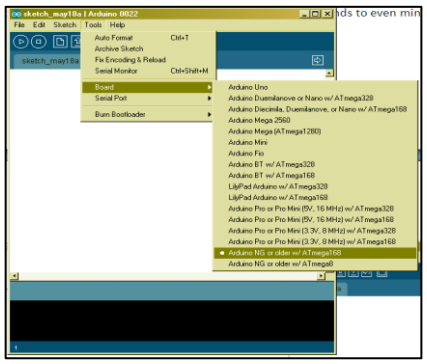
Simple, clear programming environment - The Arduino programming environment is easy-to-use for beginners, yet flexible enough for advanced users to take advantage of as well. For teachers, it's conveniently based on the Processing programming environment, so students learning to program in that environment will be familiar with the look and feel of Arduino

Open source and extensible software- The Arduino software and is published as open source tools, available for extension by experienced programmers. The language can be expanded through C++ libraries, and people wanting to understand the technical details can make the leap from Arduino to the AVR C programming language on which it's based. Similarly, you can add AVR-C code directly into your Arduino programs if you want to.

Open source and extensible hardware - The Arduino is based on Atmel's ATMEGA8 and ATMEGA168microcontrollers. The plans for the modules are published under a Creative Commons license, so experienced circuit designers can make their own version of the module, extending it and improving it. Even relatively inexperienced users can build the breadboard version of the module in order to understand how it works and save money.

WORKING IN ARDUINO:

The Arduino development environment contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions, and a series of menus. Software written using Arduino is called sketches. It has features for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and also displays errors. The console displays text output by the Arduino environment

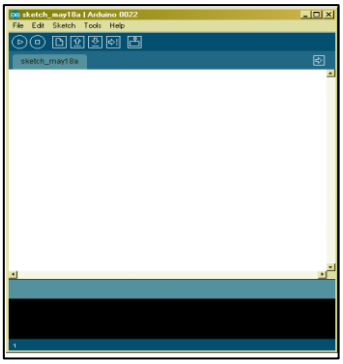


including complete error messages and other information. Now let us install the Arduino into our system and start working with it.

Follow the following steps to install the Arduino in your computer/laptop:

Fig. 6 : ARDUINO COMPILER

Step1. Install the FTDI driver provided in the CD given to you. To install it simply, unzip the FTDI file and install the driver. It may take from few seconds to even minutes to install depending on the computer and operating systems.



Step2. Open the "Arduino-022" folder and click on the Arduino icon. A window will appear as shown here.

Step3. Click on Tools from menu bar and select the board, and then select the board as "Arduino NG or older / ATMEGA 168".

(A)

Note: Please note that this option can be changed depending on the hardware used by the user. This is just an example of the board which is based on Arduino NG based on ATMEGA 168; hence we have selected this option.

Step4. Connect the device with the computer using USB cable. Now we have to select the serial port on which the board will communicate with the computer. Go to Tools->Serial Port->COM X. Here the 'x, varies from computer to computer. See the image.

The code which goes inside the microcontroller is known as 'HEX' code. This code is generated by compilers. The process of loading the code into the (flash memory of) microcontrollers is known as 'Burning' the microcontroller. There are several methods of burning microcontroller like using 'ISP' method, using 'High Voltage Programming' using 'Boot-loaders' etc. Each method has its own merits and demerits.

The easiest way of programming is by using 'Boot-loaders'. Boot-loaders are small programs residing inside the flash of the microcontrollers. The Boot-loaders can burn the program by any interfacing technique. For example in our system, the Boot-loader is there to program the device using serial port (UART).

The board supports both, ISP programming (ISP Header is there on the board) and UART programming method (using USB interface). To program using UART interface make sure the device is Boot loaded. The Arduino works on UART interfaced programming.

Let us explain more about environment of Arduino. There is a menu bar on the top of the window. All the lists in here are self explanatory. We will seldom use these lists. Below menu bar, there is a tool bar frequently used in the environment. The icons of tool bar are explained here. Verify: It is used to verify the code, if there is any syntax error then it gets highlighted. If there is no error, then compilation is done.

Stop: It is used to stop the verification at any time.

New: Used to create a new workspace, but current  workspace will be closed.

Open: It is used to save any saved sketch.

Save: Use to save the current sketch.

Upload: Used to upload the sketch in the  microcontroller.

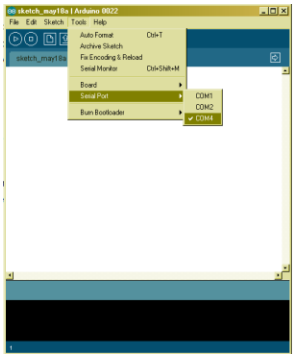
Any error, warning or notification  can be shown in dark black window of the IDE.

The development board provided contains all these connections. Hence we never need to make any such connections unless otherwise stated. For each program described  further may have different circuit.

The circuits are shown if necessary. Now let us start programming. Open the Arduino environment; select the proper com port and board as described earlier. Now, try to compile this code given in figure, it will produce no error. Because it is complete.

There are two functions here:

1 void setup()
2 void loop()



Before discussing about these, let us know what 'function' is. Function is nothing but a group of the statements under a single name. All these statements are assumed to

be executed at once. All the functions start with an opening parentheses ('{') and terminates closing parentheses ('}'). With and More discussion about 'function' is described later in the tutorial.

All the lines written under void setup () function will execute only once as the program starts. Hence everything written under this function will execute only once.

All the programs written under void loop () function will keep on executing as long as the system is kept on as this function keeps on executing continuously.

3.2.2) NODE MCU 328

NodeMCU is an open source IoT platform. It includes firmware which runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which is based on the ESP-12 module. The term "NodeMCU" by default refers to the firmware rather than the DevKit. The firmware uses the Lua scripting language. It 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.

Features Version :DevKit v1.0 Breadboard Friendly Light Weight and small size. 3.3V operated, can be USB powered. Uses wireless protocol 802.11b/g/n. Built-in wireless connectivity capabilities. Built-in PCB antenna on the ESP-12E chip. Capable of PWM, I2C, SPI, UART, 1-wire, 1 analog pin. Uses CP2102 USB Serial Communication interface module. Arduino IDE compatible (extension board manager required). Supports Lua (alike node.js) and Arduino C programming language.

Specifications of ESP-12E WiFi Module

Wireless Standard Frequency Range Power Transmission Receiving Sensitivity Wireless Form IO Capability Electrical Characteristic Operating Temperature Serial Transmission

Wireless Network Type Security Type Encryption Type Firmware Upgrade Network Protocol User Configuration IEEE 802.11 b/g/n 2.412 - 2.484 GHz 802.11b : +16 ± 2 dBm (at 11 Mbps) 802.11g : +14 ± 2 dBm (at 54 Mbps) 802.11n : +13 ± 2 dBM (at HT20, MCS7) 802.11b : -93 dBm (at 11 Mbps, CCK) 802.11g : -85 dBm (at 54 Mbps, OFDM) 802.11n : -82 dBm (at HT20, MCS7) On-board PCB Antenna UART, I2C, PWM, GPIO, 1 ADC 3.3 V Operated 15 mA output current per GPIO pin 12 - 200 mA working current Less than 200 uA standby current -40 to +125 ºC 110 - 921600 bps, TCP Client 5 STA / AP / STA + AP WEP / WPA-PSK / WPA2-PSK WEP64 / WEP128 / TKIP / AES Local Serial Port, OTA Remote Upgrade IPv4, TCP / UDP / FTP / HTTP AT + Order Set, Web Android / iOS, Smart Link APP.

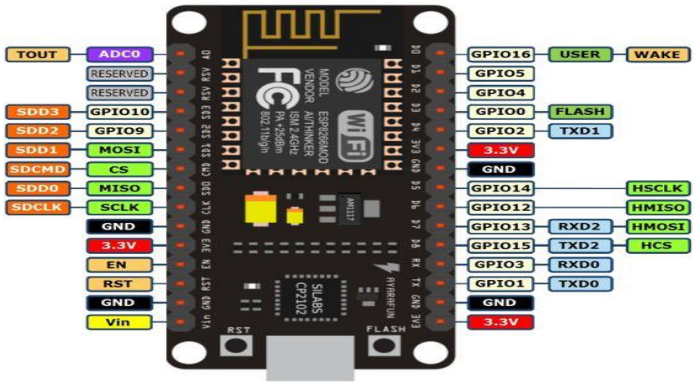


Fig.7:NODE MCU

NodeMCU is famous for the ESP8266E module with LUA programming language. Now this is more powerful NodeMCU with ESP32 on it.

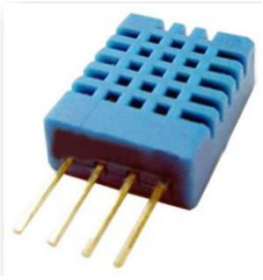
ESP32 is the big brother of ESP8266. It comes with dual core 32-bit processor, built-in WiFi and Bluetooth, more RAM and Flash memory, more GPIO, more ADC, and many other peripherals :)

NodeMCU ESP32 is ESP-WROOM-32 module in breadboard friendly form factor, you can develop your project in using this compact microcontroller on breadboard.

3.2.3)HUMIDITY SENSOR DHT11

INTRODUCTION:

This DHT11 Temperature & Humidity Sensor features a temperature & humidity sensor complex with a calibrated digital signal output. By using the exclusive digital-signal-acquisition technique and temperature & humidity sensing technology, it ensures high reliability and excellent long-term stability. This sensor includes a resistive-type humidity measurement component and an NTC temperature measurement component, and connects to a high-performance 8-bit microcontroller, offering excellent quality, fast response, anti-interference ability and cost-effectiveness.



DHT11 output calibrated digital signal. It utilizes exclusive digital-signal-collecting-technique and humidity sensing technology, assuring its reliability and stability. Its sensing elements are connected with 8-bit single-chip computer. Each DHT11 element is strictly calibrated in the laboratory that is extremely accurate on humidity calibration. The calibration coefficients are stored as programs in the OTP memory, which are used

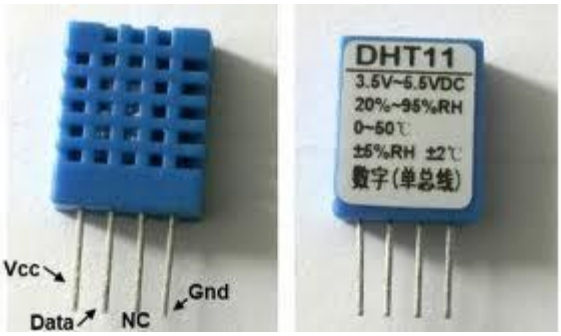


Fig. 8: HUMIDITY SENSOR DHT 11

by the sensor's internal signal detecting process. The single-wire serial interface makes system integration quick and easy. Its small size, low power consumption and up-to-20 meter signal transmission making it the best choice for various applications, including those most demanding ones. The component is 4-pin single row pin package. It is convenient to connect and special packages can be provided according to users' request.

FEATURES AND BENEFIT:

- Digital Output
- Single Wire Output
- Stable &long term accuracy
- Full range temperature compensated
- Relative humidity and temperature measurement
- Calibrated digital signal
- Outstanding long-term stability
- Extra components not needed

- Long transmission distance
- Low power consumption
- 4 pins packaged and fully interchangeable

OPERATING SPECIFICATIONS:

(1) Power and Pins

Power's voltage should be 3-5.5V DC. When power is supplied to sensor, don't send any instruction to the sensor within one second to pass unstable status. One capacitor valued 100nF can be added between VDD and GND for power filtering.

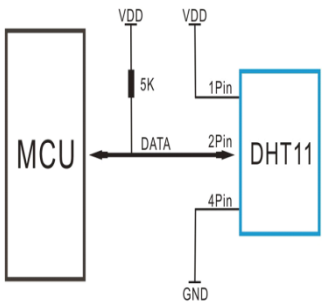


Fig. 9: DHT 11 with MCU

(2) Communication and signal

Single-bus data is used for communication between MCU and DHT11. Single-bus data format is used for communication and synchronization between MCU and DHT11 sensor. One communication process is about 4ms. Data consists of decimal and integral parts. A complete data transmission is 40bit, and the sensor sends higher data bit first.

Data format: 8bit integral RH data + 8bit decimal RH data + 8bit integral T data + 8bit decimal T data + 8bit check sum. If the data transmission is right, the check-sum should be the last 8bit of "8bit integral RH data + 8bit decimal RH data + 8bit integral T data + 8bit decimal T data".

ATTENTIONS OF APPLICATIONS:

Operating conditions

Applying the DHT11 sensor beyond its working range stated in this datasheet can result in 3%RH signal shift/discrepancy. The DHT11 sensor can recover to the calibrated status gradually when it gets back to the normal operating condition and works within its range.

Attention to chemical materials

Vapor from chemical materials may interfere with DHT’s sensitive-elements and debase its sensitivity. A high degree of chemical contamination can permanently damage the sensor.

Temperature Affect

Relative humidity largely depends on temperature. Although temperature compensation technology is used to ensure accurate measurement of RH, it is still strongly advised to keep the humidity and temperature sensors working under the same temperature. DHT11 should be mounted at the place as far as possible from parts that may generate heat.

APPLICATIONS:

- Baby incubators
- Industrial devices parameter monitoring
- Green house monitoring.

3.2.4) MQ-6 Gas Sensor

INTRODUCTION:

Sensitive material of MQ-6 gas sensor is SnO2, which has lower conductivity in clean air. When the target combustible gas exist, the sensor's conductivity is higher along with the gas concentration rising. An electronic design is needed to convert this change of conductivity to correspond output signal as per the gas concentration. MQ-6 gas sensor has high sensitivity to Propane, Butane and LPG, also response to Natural gas. The sensor could be used to detect different combustible gas, especially Methane; it is with low cost and suitable for different application.

Character

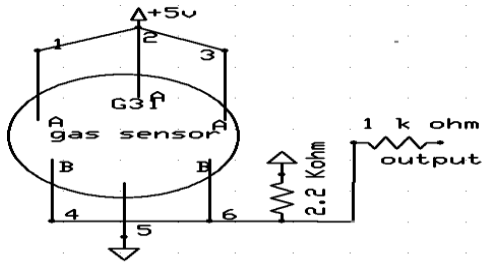
* Good sensitivity to Combustible gas in wide range
* High sensitivity to Propane, Butane and LPG
* Long life and low cost
* Simple drive circuit

INTERFACE DESIGN:

The above is basic test circuit of the sensor. The sensor needs to be put 2 voltages, heater voltage (VH） and test voltage (VC）. VH used to supply certified working temperature to the sensor, while VC used to detect voltage (VRL) on load resistance (RL) whom is in series with sensor. The sensor has light polarity, $V_c$need DC power. VC and VH could use same power circuit with precondition to assure performance of sensor. In order to make the sensor with better performance, suitable RL value is needed:

Power of Sensitivity body (Ps): $Ps=Vc^2 \times Rs/ (Rs+RL)^2$

Resistance of sensor (Rs): $Rs= (Vc/VRL-1) \times RL$



This sensor is capable of detecting many gases depending on its sensitivity which is calibrated using resistance pair (2.2K &1K in this case for LPG and CNG gas detection). The working principle of this sensor is that it converts the heat generated by the combustion of this gas in to voltage. Now, according to the amount of gas present this sensor gives an analog variation of voltage on its data pin (output).

MEASURING THE VOLTAGE VARIATIONS

Make the proper interface of the gas sensor that is Vcc, GND and data as shown above figure.

Put the knob on proper voltage range. Connect the cathode of multi-meter at the ground of power source and anode at the output point of Gas sensor. Check the voltage. The sensor shows some voltage V_1 since atmosphere also contain these gases in small amount. Now bring a gas source near the sensor and measure the voltage at the same point V_2 ($V_2 > V_1$).

Table 1.TECHNICAL DATA:

Model No.			MQ-6
Sensor Type			Semiconductor
Standard Encapsulation			Bakelite (Black Bakelite)
Detection Gas			Isobutane, Butane, LPG
Concentration			300-10000ppm (Butane, Propane, LPG)
Circuit	Loop Voltage	V_c	≤24V DC
	Heater Voltage	V_H	5.0V±0.2V ACorDC
	Load Resistance	R_L	Adjustable
Character	Heater Resistance	R_H	31Ω±3Ω（Room Tem.）
	Heater consumption	P_H	≤900mW
	Sensing Resistance	R_s	2KΩ-20KΩ(in 2000ppm C_3H_8)
	Sensitivity	S	Rs(in air)/Rs(1000ppm C_4H_{10})≥5
	Slope	α	≤0.6($R_{2000ppm}/R_{1000ppm}$ LPG)
Condition	Tem. Humidity		20℃±2℃；65%±5%RH
	Standard test circuit		Vc:5.0V±0.1V； V_H: 5.0V±0.1V
	Preheat time		Over 48 hours

APPLICATIONS:

- Domestic gas leakage detector
- Industrial Combustible gas detector
- Portable gas detector

3.2.5) 16x2 LCD

INTRODUCTION:

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. 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. 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.

Features:-

- 5 x 8 dots with cursor
- Built-in controller (KS 066 or Equivalent)
- + 5V power supply (Also available for + 3V)
- 1/16 duty cycle
- B/L to be driven by pin 1, pin 2 or pin 15, pin 16 or A.K (LED)
- N.V. optional for + 3V power supply

Table 2. PIN DESCRIPTION:

PIN NUMBER	SYMBOL	FUNCTION
1	V_{SS}	GND
2	V_{DD}	+ 3V or + 5V
3	Vo	Contrast Adjustment
4	RS	H/L Register Select Signal
5	R/W	H/L Read/Write Signal
6	E	H?L Enable Signal
7	DB0	H/L Data Bus Line
8	DB1	H/L Data Bus Line
9	DB2	H/L Data Bus Line
10	DB3	H/L Data Bus Line
11	DB4	H/L Data Bus Line
12	DB5	H/L Data Bus Line
13	DB6	H/L Data Bus Line
14	DB7	H/L Data Bus Line
15	A/V_{EE}	+ 4.2V for LED/Negative Voltage Output
16	K	Power Supply for B/L (OV)

SEQUENCE OF WRITING TO THE LCD:

The sequence for writing to the LCD is:

1.1 To begin, E is low

1.2 Select the register to write to by setting RS high (data) or low (control)

1.3 Write the eight bits of data to the LCD

1.4 Set the Enable signal high then low again.

There are certain minimum timing requirements that must be followed when writing to the LCD, such as data setup times and Enable signal pulse width. These are in the order of tens and hundreds of nanoseconds. LCD displays have a 'busy' flag that is set while it is executing a control command. This flag is not accessible because the R/W line has been tied low (write). This is not such a problem because all commands have a maximum execution time. We simply wait for this time to pass before accessing the LCD again, eliminating the need to check the flag and thereby saving on an I/O line. For example: The 'Clear Display' command has an execution time of approx. 1.6mS. After sending this command to the LCD we simply wait 2mS before continuing on. This ensures that the command has finished. Characters to be displayed are written into the LCD's 'data' RAM memory. The amount of RAM available depends on the type of LCD. Let's us consider a LCD having 80 bytes of RAM. An internal address counter holds the address of the next byte to write to. These 80 bytes are broken up into two blocks of 40 bytes. The address range of the first block is from 00h to 27h and the second block from 40h to 67h.

After power up and initialization address 00h is the first character of the top line and address 40h is the first character of the bottom line. The address counter is set to address 00h and is automatically incremented after each byte is written. Only the first 16 bytes of each line are visible. If we now start writing data to the LCD it will be stored from address 00h on but only the first 16 characters will be visible. To display the rest of the characters we need to 'scroll' the display.

Scrolling simply mean changing the start address of each line. If we scroll left one position address 01h becomes the first character of the top line and address 41h the first character of the bottom line. Scrolling right does the opposite – addresses 27h and 67h become the first characters of the top and bottom lines. Each block of addresses 'wrap' around in a circular manner. The next address after 27h is 00h; the next address after 67h is 40h. If we scroll left 40 times we will bring address 00h back into view as the last character on the top line.

The address ranges of each block are not continuous. There is a gap of 24 bytes between the ends of the first block (27h) and the start of the second (40h). So, if we keep writing characters to the display the first 40 will be stored in addresses 00h to 27h, the next 24 will be 'lost' and the next 40 will be stored at addresses 40h to 67h.

The internal address counter is directly accessible so we can set the next address to write to. This is how the characters are written to the second line of the LCD. For

example, we can send 5 characters to the first line, set the address counter to 40h and then start writing characters to the second line

LCD INTERFACE DIAGRAM:

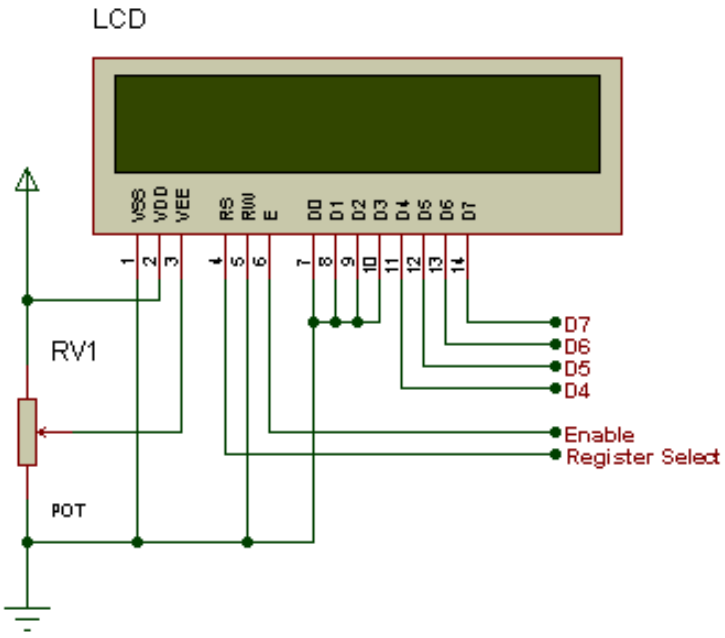


Fig. 10 LCD Interface

Above is the connection diagram of LCD in 4-bit mode, where we only need 6 pins to interface an LCD. D4-D7 is the data pins connection and Enable and Register select are for LCD control pins. We are not using Read/Write (RW) Pin of the LCD, as we are only writing on the LCD so we have made it grounded permanently. If you want to use it, then you may connect it on your controller but that will only increase another pin and does not make any big difference. Potentiometer RV1 is used to control the LCD contrast. The unwanted data pins of LCD i.e. D0-D3 are connected to ground.

3.2.6 Resistance

INTRODUCTION:

There is always some resistance in every circuit.

- A circuit is always made up of some wire, so there will be some resistance there.
- Even the battery has parts that offer resistance to the flow of electrons.
- The only circuits that come near to zero resistance are superconductors.

• This resistance that is from the parts of the circuit itself (especially the battery) is called internal resistance.

• This internal resistance is usually drawn into a circuit diagram (schematic) as shown in Figure 1.

• Notice the squiggly line just before the positive terminal of the battery? That's to show the internal resistance of the circuit.

• That symbol, drawn any other place in the circuit, represents an actual resistor placed in the circuit.

• A resistor is a device found in circuits that has a certain amount of resistance. Why would you ever want to add resistance to a circuit by using a resistor?

• The most common reason is that we need to be able to adjust the current flowing through a particular part of the circuit.

• If voltage is constant, then we can change the resistor to change the current. I=V R If "V" is constant and we change "R", "I" will be different.

ACTUAL RESISTORS:The Example 1: What is the resistance of this resistor?

Notice that the colors on this resistor are (in order) Red, Green, Orange, and Silver.

1. The first line is the first digit → Red = 2
2. The second line is the second digit → Green = 5
3. The third line is the multiplier → Orange = 10^3
4. The last line (if any) is the tolerance → Silver = } 10%

Fig.11 Resistor

So the final answer would be 25 x 10^3 Ω ± 10%

Yes, I know it's not proper scientific notation this way. You can also write it as 25000 Ω (notice there are three zeros), or even 2.5 x 10^2 Ω.

VARIABLE RESISTORS

Adjustable resistors

A resistor may have one or more fixed tapping points so that the resistance can be changed by moving the connecting wires to different terminals. Some wire wound power resistors have a tapping point that can slide along the resistance element, allowing a larger or smaller part of the resistance to be used.

Where continuous adjustment of the resistance value during operation of equipment is required, the sliding resistance tap can be connected to a knob accessible to an operator. Such a device is called a rheostat and has two terminals.

Potentiometers

A common element in electronic devices is a three-terminal resistor with a continuously adjustable tapping point controlled by rotation of a shaft or knob. These variable resistors are known as potentiometers when all three terminals are present, since they act as a continuously adjustable voltage divider. A common example is a volume control for a radio receiver.

METHODS OF MAKING RESISTORS:

There are two main methods that are used to make resistors. The most common is to just have a bunch of wire wound up inside that little cylinder. Known as wire-wound resistors, they depend on the fact that a certain length of a certain piece of wire will have a certain resistance. These resistors tend to be very reliable (with low tolerances), but cost more because of the price of metals used in them and the machinery needed to carefully cut and wind the wire. The other type of resistor is made of a piece of Carbon Known as a composition resistor, they depend on the size of the piece of carbon, and the fact that carbon is a metalloid (has some metal-like properties) that does conduct electricity. Because they are made from cheap Carbon, composition resistors can cost much less than similar wire-wound resistors. The drawback is that the carbon can be cracked while making them, or become cracked in use. They have higher tolerances because of the uncertainty in cutting the carbon.

In some cases it is necessary to have a circuit with resistors that you can adjust. These resistors are known as potentiometers or variable resistors. Often they are just a modified version of a wire-wound resistor, although newer versions use advanced electronics instead. You've used one if you've ever used a dimmer switch for lights in a room, or played with an electric race car set. Most variable resistors are designed so that by turning a dial or sliding a switch, you change the amount of conducting material the current has to go through. The more conducting material the current has to go through, the higher the resistance… less material and the resistance is less. *Fig.12 Construction of resistor*

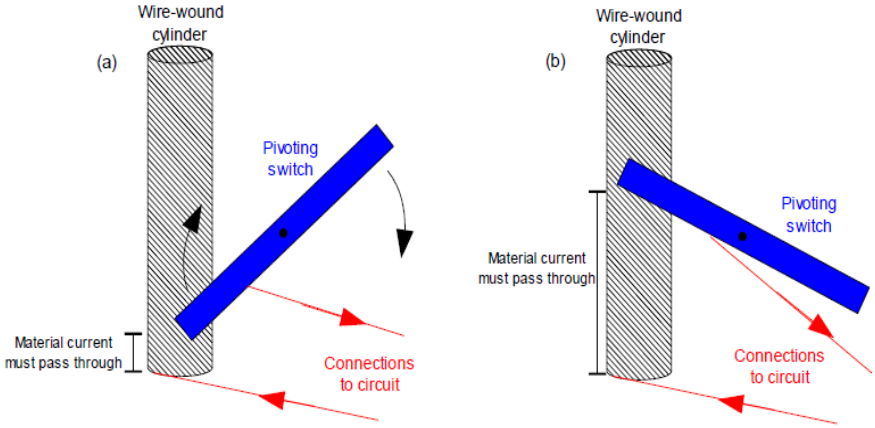
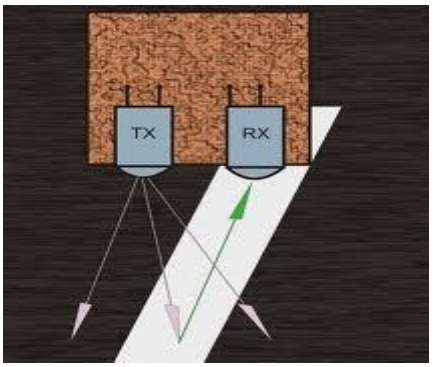


Figure 3: By pivoting the switch from one position (a) to another (b), the amount of material (and resistance) increases.

WATT RATING OF THE RESISTOR AND ITS USE:

The watt rating for any resistors is very important factor. It defines that how much current can flow across the resistor at particular voltage without damaging the resistor. According to the watt rating the thickness of the resistor varies. Now we have to take in consideration how much current is going to flow across the resistor and depending upon the rating we can calculate the power or wattage rating of the resistor. Because of this reason only the resistors having same value come in different wattages like 100ohm, 1/4watt (quarter watt), 100ohm, 1/2watt (half watt), 100ohm, 1watt and many more.

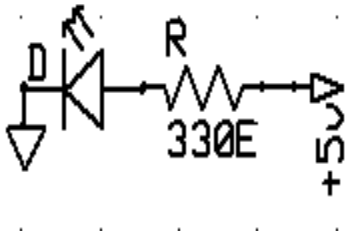


3.2.7) IR TRANSMITTER RECEIVER

INTRODUCTION:

- Infrared (IR) light is electromagnetic radiation with longer wavelengths than those of visible light, extending from the nominal red edge of the visible spectrum at 0.74 micro-meters (μm) to 300 μm. This range of wavelengths corresponds to a frequency range of approximately 400 THz, and includes most of the thermal radiation emitted by objects near room temperature. Infrared light is emitted or absorbed by molecules when they change their rotational-vibration movements. Infrared light is used in industrial, scientific, and medical applications. Night-vision devices using infrared illumination allow people or animals to be observed without the observer being detected. In astronomy, imaging at infrared wavelengths allows observation of objects obscured by interstellar dust. Infrared imaging cameras are used to detect heat loss in insulated systems, to observe changing blood flow in the skin, and to detect overheating of electrical apparatus.
- This sensor finds wide applications. This consists of an IR transmitter and photo-diode as IR receiver. When we apply a potential across the transmitter it transmits IR rays. It should be noted that IR is not a visible ray so one cannot test the IR easily that whether it is transmitting or not. Implant the proper potential across the IR transmitter and see the transmission using a camera.

Fig. 13 IR sensor



- The feature of the IR led almost same(however rays are not visible) as LED so to make the transmitter include a series resistance of 220 ohm- 1.5 K-ohm then apply the desired potential 5V or 9 V. Check the transmitter using the camera. The IR led should be connected in forward bias (that its positive should be connected to positive and negative to the negative).

- The IR receiver is an electronic component whose resistance decreases with increasing IR intensity. It is also called as "Photo diode" The photodiode is reversed biased so the depletion region of the junction is very thick thus the resistance. When IR having energy falls on such a junction more electron hole pairs is generated increasing the conductance making the depletion region thin?

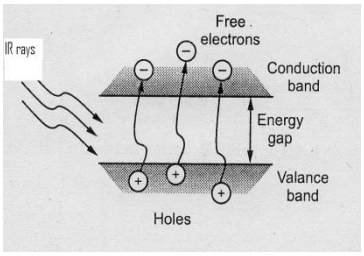


Fig.14 Working of IR

- Due to this additional energy, these electrons/holes become free and jump in to the conduction band. Due to these charge carriers, the conductivity of the device increases, decreasing its resistivity.

MEASURING THE RESISTANCE VARIATION:

Design the transmitter source first than put the receiver in front of the transmitter

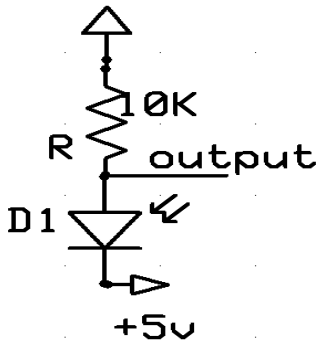
Put the multi-meter knob on the proper resistance range and put the cathode and anode terminal on the terminal of the IR receiver. Put the IR source in front of the photodiode and check the resistance and then put off the IR source and check the resistance. Also vary the IR intensity and check the resistance.

Resistance of photodiode with source	R1
Resistance of photodiode without source	R2

Always R1< R2

MEASURING THE VOLTAGE VARIATIONS

We apply a +5 V power supply across the IR receiver. Now if we put the IR source in front of receiver resistance changes. So if the resistance changes the voltage drop across it must also change. But if the only load is the photodiode than according to Kirchhoff's second law the whole voltage will drop across the photodiode whether its resistance is less or more. So to monitor the voltage variation we implant a series resistance with the photodiode as shown in figure. The resistance value in series should comparatively higher than that of the photodiode (>10K).Secondly IR receiver also cannot directly bear 5V it damages (the series resistance protect it). Keep in mind the photodiode should be reverse biased.



Put the knob on proper voltage range. Connect the cathode of multi-meter at the ground of power source and anode at the interface point of photodiode and the resistor (that is output). Check the voltage in IR source condition and without IR else you can justify it with following circuit, where the intensity of LED varies with varying IR intensity conditions

APPLICATIONS:

This sensor is used in variations applications commercial as well as industrial.

- Security system
- Color detection (white black)
- Object detection.
- Intruder detection
- Conveyor belts and metro station gates.
- TV remote control

One of the drawbacks of this sensor is that it detects the IR of the sun also. So applications with this sensor have to be used ignoring sunlight. To remove this drawback we can use TSOP1738, MOC3041 but they receive the IR intensity at particular frequency only. So the transmitter should transmit at that particular frequency.

3.2.8)MQ-2 Semiconductor Sensor for Combustible Gas Sensitive material

MQ-2 gas sensor is SnO2, which with lower conductivity in clean air. When the target combustible gas exist, The sensor's conductivity is more higher along with the gas concentration rising. Please use simple electrocircuit, Convert change of conductivity to correspond output signal of gas concentration. MQ-2 gas sensor has high sensitity to LPG, Propane and Hydrogen, also could be used to Methane and other combustible steam, it is with low cost and suitable for different application. Character Configuration *Good sensitivity to Combustible gas in wide range * High sensitivity to LPG, Propane and Hydrogen * Long life and low cost * Simple drive circuit Application * Domestic gas leakage detector * Industrial Combustible gas detector * Portable gas detector Technical Data Basic test loop T The above is basic test circuit of the sensor. The sensor need to be put 2 voltage, heater voltage（VH） and test voltage（VC）. VH used to supply certified working temperature to the sensor, while VC used to detect voltage (VRL) on load resistance （RL）whom is in series with sensor. The sensor has light polarity, Vc need DC power. VC and VH could use same

power circuit with precondition to assure performance of sensor. In order to make the sensor with better performance, suitable RL value is needed: Power of Sensitivity body(Ps): Ps=Vc2 ×Rs/(Rs+RL)2 Model No. MQ-2 Sensor Type Semiconductor Standard Encapsulation Bakelite (Black Bakelite) Detection Gas Combustible gas and smoke Concentration 300-10000ppm (Combustible gas) Loop Voltage Vc ≤24V DC Heater Voltage VH 5.0V±0.2V ACorDC Circuit Load Resistance RL Adjustable Heater Resistance RH 31Ω±3Ω（Room Tem.） Heater consumption PH ≤900mW Sensing Resistance Rs 2KΩ-20KΩ(in 2000ppm C3H8) Sensitivity S Rs(in air)/Rs(1000ppm isobutane)≥5 Character Slope α ≤0.6(R5000ppm/R3000ppm CH4) Tem. Humidity 20℃±2℃ ; 65%±5%RH Standard test circuit Vc:5.0V±0.1V ； VH: 5.0V±0.1V Condition Preheat time Over 48 hours Vc VH GND RL VRL Resistance of sensor(Rs): Rs=(Vc/VRL-1)×RL Sensitivity Characteristics Influence of Temperature/Humidity Fig.1 shows the typical sensitivity characteristics of Fig.2 shows the typical temperature and humidity the MQ-2, ordinate means resistance ratio of the sensor characteristics. Ordinate means resistance ratio (Rs/Ro), abscissa is concentration of gases. Rs means of the sensor (Rs/Ro), Rs means resistance of sensor resistance in different gases, Ro means resistance of in 1000ppm Butane under different team. and humidity. sensor in 1000ppm Hydrogen. All test is under standard Ro means resistance of the sensor in environment of test conditions. 1000ppm Methane, 20℃/65%RH Structure and configuration Structure and configuration of MQ-2 gas sensor is shown as Fig. 3, sensor composed by micro AL2O3 ceramic tube, Tin Dioxide (SnO2) sensitive layer, measuring electrode and heater are fixed into a crust made by plastic and stainless-steel net. The heater provides necessary work conditions for work of sensitive components. The enveloped MQ-2 have 6 pin, 4 of them are used to fetch signals, and other 2 are used for providing heating current. Fig1 0.5 0.7 0.9 1.1 1.3 1.5 1.7 1.9 -20 -10 0 10 20 30 40 50 ℃ Rs/R0 60%RH 30%RH 85%RH Fig2 Notification 1 Following conditions must be prohibited 1.1 Exposed to organic silicon steam Organic silicon steam cause sensors invalid, sensors must be avoid exposing to silicon bond, fixature, silicon latex, putty or plastic contain silicon environment 1.2 High Corrosive gas If the sensors exposed to high concentration corrosive gas (such as H2Sz, SOX, Cl2, HCl etc.), it will not only result in corrosion of sensors structure, also it cause sincere sensitivity attenuation. 1.3 Alkali, Alkali metals salt, halogen pollution The sensors performance will be changed badly if sensors be sprayed polluted by alkali metals salt especially brine, or be exposed to halogen such as fluorin. 1.4 Touch water Sensitivity of the sensors will be reduced when spattered or dipped in water. 1.5 Freezing Do avoid icing on sensor ‘surface, otherwise sensor would lose sensitivity. 1.6 Applied voltage higher Applied voltage on sensor should not be higher than stipulated value, otherwise it cause down-line or heater damaged, and bring on sensors’ sensitivity characteristic changed badly. 1.7 Voltage on wrong pins For 6 pins sensor, if apply voltage on 1、3 pins or 4、6 pins, it will make lead broken, and without signal when apply on 2、4 pins 2 Following conditions must be avoided 2.1 Water Condensation Indoor conditions, slight water

condensation will effect sensors performance lightly. However, if water condensation on sensors surface and keep a certain period, sensor' sensitivity will be decreased. 2.2 Used in high gas concentration No matter the sensor is electrified or not, if long time placed in high gas concentration, if will affect sensors characteristic. 2.3 Long time storage The sensors resistance produce reversible drift if it's stored for long time without electrify, this drift is related with storage conditions. Sensors should be stored in airproof without silicon gel bag with clean air. For the sensors with long time storage but no electrify, they need long aging time for stbility before using. 2.4 Long time exposed to adverse environment No matter the sensors electrified or not, if exposed to adverse environment for long time, such as high humidity, high temperature, or high pollution etc, it will effect the sensors performance badly. 2.5 Vibration Continual vibration will result in sensors down-lead response then repture. In transportation or assembling line, pneumatic screwdriver/ultrasonic welding machine can lead this vibration. 2.6 Concussion If sensors meet strong concussion, it may lead its lead wire disconnected. 2.7 Usage For sensor, handmade welding is optimal way. If use wave crest welding should meet the following conditions: 2.7.1 Soldering flux: Rosin soldering flux contains least chlorine 2.7.2 Speed: 1-2 Meter/ Minute 2.7.3 Warm-up temperature : 100±20℃ 2.7.4 Welding temperature : 250±10℃ 2.7.5 1 time pass wave crest welding machine If disobey the above using terms, sensors sensitivity will be reduced.

3.2.9) Miscellaneous Components

A)VOLTAGE REGULATORS

INTRODUCTION:

A voltage regulator is designed to automatically maintain a constant voltage level. A voltage regulator may be a simple "feed-forward" design or may include negative feedback control loops. It may use an electromechanical mechanism, or electronic components. Depending on the design, it may be used to regulate one or more AC or DC voltages.

Electronic voltage regulators are found in devices such as computer power supplies where they stabilize the DC voltages used by the processor and other elements. In automobile alternators and central power station generator plants, voltage regulators control the output of the plant. In an electric power distribution system, voltage regulators may be installed at a substation or along distribution lines so that all customers receive steady voltage independent of how much power is drawn from the line.

Voltage regulator ICs are available with fixed (typically 5, 12 and 15V) or variable output voltages. The maximum current they can pass also rates them. Negative voltage regulators are available, mainly for use in dual supplies. Most regulators include some automatic protection from excessive current (over load protection) and over-heating (thermal protection). Many of fixed voltage regulator ICs has 3 leads. They include a hole for attaching a heat sink if necessary.

Fig 15. Voltage Regulator

3-TERMINAL 1A POSITIVE VOLTAGE REGULATORS

• Output Current up to 1A

• Output Voltages of 5, 6, 8, 9, 10, 12, 15, 18, 24V

• Thermal Overload Protection

• Short Circuit Protection

• Output Transistor Safe Operating Area Protection

VOLTAGE REGULATOR

DESCRIPTION:

The KA78XX/KA78XXA series of three-terminal positive regulator are available in the TO-220/D-PAK package and with several fixed output voltages, making them useful in a wide range of applications. Each type employs internal current limiting, thermal shut down and safe operating area protection, making it essentially indestructible. If adequate heat sinking is provided, they can deliver over 1A output current. Although designed primarily as fixed voltage regulators, these devices can be used with external components to obtain adjustable voltages and currents.

The 78xx (sometimes LM78xx) is a family of self-contained fixed linear voltage regulator integrated circuits. The 78xx family is commonly used in electronic circuits requiring a regulated power supply due to their ease-of-use and low cost. For ICs within the family, the xx is replaced with two digits, indicating the output voltage (for example, the 7805 has a 5 volt output, while the 7812 produces 12 volts). The 78xx line is positive voltage regulators: they produce a voltage that is positive relative to a

common ground. There is a related line of 79xx devices which are complementary negative voltage regulators. 78xx and 79xx ICscan be used in combination to provide positive and negative supply voltages in the same circuit.

PIN ARCHITECTURE:

7805, It is a voltage regulator the 78 indicates a positive regulator the 05 indicates the voltage output. At 1 amp if adequate heats sink is provided. Never fear it has thermal protection to shut it down only if the internal heating exceeds the safety zone. It will not destroy itself by removing or reducing the load it will come- back alive after cooling

NOTE: Every voltage regulator has minimum voltage threshold and Maximum voltage threshold. The minimum threshold input voltage is the should be greater than the output voltage of the regulator like for 7805 it should be greater than +5V. Similarly, the maximum threshold input is also defined for the regulator till which the voltages can be regulated to give the desired output else due to excessive heat the regulator can destroy since beside the regulated voltage the remaining voltage goes as heat loss. So the regulators have heat sink also. Always refer the datasheet for maximum thresholds. Try to put the input voltage minimum as per the requirement like if you require 5 V then put the source of 6V or 9V so that minimum heat is dissipated.

INTERNAL BLOCK DIAGRAM:

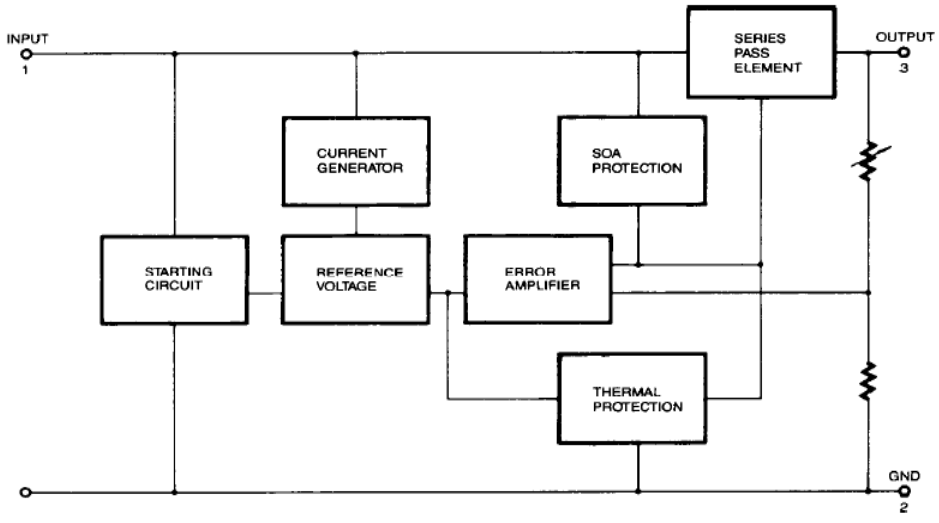


Fig 16. Voltage regulator internal block diagram

FEATURES IN DETAIL:

- Output current in Excess of 1.0 A
- No external component required
- Internal thermal overload protection
- Internal short circuit current limiting
- Output transistor safe-area compensation
- Output voltage offered in 2% and 4% tolerance
- Available I n surface mount D2PAK and standard 3-lead transistor packages
- Previous commercial temperature range has been extended

B) DIODES

INTRODUCTION:

A device having two terminals and has a low resistance to electrical current in one direction and a high resistance in the other direction. Diode is a two-element device which passes a signal in one direction only. They are used most commonly to convert AC to DC, because they pass the positive part of the wave, and block the negative part of the AC signal, or, if they are reversed, they pass only the negative part and not the positive part.

RECTIFICATION DIODE (1N4007)

The stripe stamped on one end of the diode shows indicates the polarity of the diode. The stripe shows the cathode side. The top two devices shown in the picture are diodes used for rectification. They are made to handle relatively high currents. The device on top can handle as high as

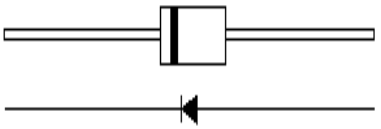


Fig.17 Diode

6A, and the one below it can safely handle up to 1A.However, it is best used at about 70% of its rating because this current value is a maximum rating. The third device from the top (red color) has a part number of 1S1588. This diode is used for switching, because it can switch on and off at very high speed. However, the maximum current it can handle is 120 mA. This makes it well suited to use within digital circuits. The maximum reverse voltage (reverse bias) this diode can handle is 30V.

The device at the bottom of the picture is a voltage regulation diode with a rating of 6V. When this type of diode is reverse biased, it will resist changes in voltage. If the input voltage is increased, the output voltage will not change. (Or any change will be an

insignificant amount.) While the output voltage does not increase with an increase in input voltage, the output current will.

This requires some thought for a protection circuit so that too much current does not flow. The rated current limit for the device is 30 mA. Generally, a 3-terminal voltage regulator is used for the stabilization of a power supply. Therefore, this diode is typically used to protect the circuit from momentary voltage spikes. 3 terminal regulators use voltage regulation diodes inside.

FEATURES

- Low forward voltage drop.
- Diffused Junction
- High Current Capability
- ROHS Compliant

CAPACITORS

INTRODUCTION

The function of capacitors is to store electricity, or electrical energy. The capacitor also functions as filter, passing AC, and blocking DC. The capacitor is constructed with two electrode plates separated by insulator. They are also used in timing circuits because it takes time for a capacitor to fill with charge. They can be used to smooth varying DC supplies by acting as reservoir of charge.

The capacitor's function is to store electricity, or electrical energy. The capacitor also functions as a filter, passing alternating current (AC), and blocking direct current (DC). This symbol (⊣⊢)is used to indicate a capacitor in a circuit diagram. The capacitor is constructed with two electrode plates facing each other but separated by an insulator.

When DC voltage is applied to the capacitor, an electric charge is stored on each electrode. While the capacitor is charging up, current flows. The current will stop flowing when the capacitor has fully charged.

Commercial capacitors are generally classified according to the dielectric. The most used are mica, paper, electrolytic and ceramic capacitors. Electrolytic capacitors use a molecular thin oxide film as the dielectric resulting in large capacitance values. There is no required polarity, since either side can be the most positive plate, except for electrolytic capacitors. These are marked to indicate which side must be positive to maintain the

internal electrolytic action that produces the dielectric required to form the capacitance. It should be noted that the polarity of the charging source determines the polarity of the changing source determines the polarity of the capacitor voltage.

ACTUAL CAPACITANCE

This is a measure of a capacitor's ability to store charge. A large capacitance means that more charge can be stored. It is measured in farad, F. 1F is very large, so prefixes are used to show the smaller values.

Three prefixes are used, u (micron), n (Nano), and p (Pico).

$1uf=10^{-6}$ f

$1nf=10^{-9}$ f

$1pf=10^{-12}$ f

Sometimes, a three-digit code is used to indicate the value of a capacitor. There are two ways in which the capacitance can be written one uses letters and numbers, the other uses only numbers. In either case, there are only three characters used. [10n] and [103] denote the same value of capacitance. The method used differs depending on the capacitor supplier. In the case that the value is displayed with the three-digit code, the 1st and 2nd digits from the left show the 1st figure and the 2nd figure, and the 3rd digit is a multiplier which determines how many zeros are to be added to the capacitance. Pico farad (pF) units are written this way.

For example, when the code is [103], it indicates 10 x 103, or 10,000pF = 10 nano-farad (nF) = 0.01 microfarad (µF).

If the code happened to be [224], it would be 22 x 104 = or 220,000pF = 220nF = 0.22µF.

Values under 100pF are displayed with 2 digits only. For example, 47 would be 47pF.

The capacitor has an insulator (the dielectric) between 2 sheets of electrodes. Different kinds of capacitors use different materials for the dielectric.

BREAKDOWN VOLTAGE

When using a capacitor, you must pay attention to the maximum voltage which can be used. This is the "breakdown voltage." The breakdown voltage depends on the kind of capacitor being used. You must be especially careful with electrolytic capacitors because the breakdown voltage is comparatively low. The breakdown voltage of electrolytic capacitors is displayed as Working Voltage.

The breakdown voltage is the voltage that when exceeded will cause the dielectric (insulator) inside the capacitor to break down and conduct. When this happens, the failure can be catastrophic.

TYPES OF CAPACITORS

There are various types of capacitors available in the market. Some of them are as follows:

- Mica Capacitor
- Paper Capacitor
- Ceramic Capacitor
- Variable Capacitor
- Electrolytic Capacitor
- Tantalum Capacitor
- Film Capacitor

Here we used only two types of capacitor i.e. ceramic capacitor & electrolytic capacitor.

1 Polarized capacitors

2 Un-polarized capacitors

POLARIZED CAPACITORS:

These are the capacitors having polarity. Basically these are of larger values than 1uf. For example below is the diagram of capacitor of 220 microfarad and having breakdown voltage 25V.

Electrolytic capacitors are polarized and they must be connected the correct way round, at least one of their leads will be marked + or -. They are not damaged by heat when soldering.

There are two designs of electrolytic capacitors; axial where the leads are attached to each end (220µF in picture) and radial where both leads are at the same end (10µF in picture). Radial capacitors tend to be a little smaller and they stand upright on the circuit board.

It is easy to find the value of electrolytic capacitors because they are clearly printed with their capacitance and voltage rating. The voltage rating can be quite low (6V for example) and it should always be checked when selecting an electrolytic capacitor. If the project parts list does not specify a voltage, choose a capacitor with a rating which is greater than the project's power supply voltage. 25V is a sensible minimum for most battery circuits.

UN-POLARIZED CAPACITORS (SMALL VALUES, UP TO 1MF)

Small value capacitors are un-polarized and may be connected either way round. They are not damaged by heat when soldering, except for one unusual type (polystyrene). They have high voltage ratings of at least 50V, usually 250V or so. It can be difficult to find the values of these small capacitors because there are many types of them and several different labeling systems.

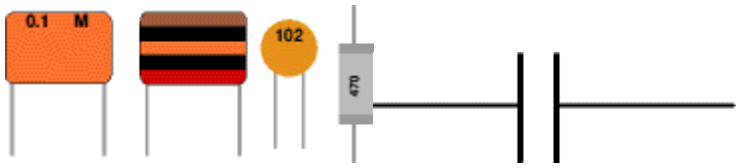


Fig. 18. Capacitor

Many small value capacitors have their value printed but without a multiplier, so you need to use experience to work out what the multiplier should be.

For example 0.1 means 0.1µF = 100nF.

Sometimes the multiplier is used in place of the decimal point:

For example: 4n7 means 4.7nF.

VARIABLE CAPACITORS

Variable capacitors are mostly used in radio tuning circuits and they are sometimes called 'tuning capacitors'. They have very small capacitance values, typically between 100pF and 500pF (100pF = 0.0001µF).

Many variable capacitors have very short spindles which are not suitable for the standard knobs used for variable resistors and rotary switches. It would be wise to check that a suitable knob is available before ordering a variable capacitor.

Fig.19 Variable Capacitor

METHODS OF MAKING CAPACITORS:

One way of making capacitors is to use the two poly-silicon layers in our process. We create a parallel plate capacitor with poly1 and poly2 (“electrode”) forming the two parallel sides. The silicon dioxide between the two poly layers is thin enough to yield good capacitance values per unit area. This is called a poly-poly capacitor.

The other way would be to use the gate oxide and actually build a transistor whose gate area (W x L) would actually give us the capacitance. These are called MOS capacitors, and they only work properly when the transistor is strongly inverted or depleted. Otherwise, the capacitance can vary with the voltage across it.

CRYATAL OSCILLATORS

INTRODUCTION:

A crystal oscillator is an electronic circuit that uses the mechanical resonance of a vibrating crystal of piezoelectric material to create an electrical signal with a very precise frequency. This frequency is commonly used to keep track of time (as in quartz wristwatches), to provide a stable clock signal for digital integrated circuits, and to stabilize frequencies for radio transmitters and receivers. The most common type of piezoelectric resonator used is the quartz crystal, so oscillator circuits designed around them were called "crystal oscillators".

A crystal oscillator is an electronic circuit that produces electrical oscillations at a particular designed frequency determined by the physical characteristics of one or more crystals, generally of quartz, positioned in the circuit feedback loop. A piezoelectric effect causes a crystal such as quartz to vibrate and resonate at a particular frequency. The quartz crystal naturally oscillates at a particular frequency, its fundamental frequency that can be hundreds of megahertz. The crystal oscillator is generally used in various forms such as a frequency generator, a frequency modulator and a frequency converter. The crystal oscillator utilizes crystal having excellent piezoelectric characteristics, in which crystal functions as a stable mechanical vibrator. There are many types of crystal oscillators. One of them is a crystal oscillator employing an inverting amplifier including a CMOS (complementary metal oxide semiconductor) circuit, and used, for example, as a reference signal source of a PLL (phase-pocked poop) circuit of a mobile phone.*Fig 20. Crystal Oscillator*

Crystal oscillator circuits using crystal have a number of advantages in actual application since crystals show high frequency stability and stable

temperature characteristic as well as excellent processing ability. Temperature-compensated crystal oscillators, in which variation in oscillation frequency that arises from the frequency-temperature characteristic of the quartz-crystal unit is compensated, find particularly wide use in devices such as wireless phones used in a mobile environment. A surface mounting crystal oscillator is used mainly as a frequency reference source particularly for a variety of portable electronic devices such as portable telephones because of its compact size and light weight.

COMMONLY USED CRYSTAL FREQUENCIES:

The Crystals can be manufactured for oscillation over a wide range of frequencies, from a few kilohertz up to several hundred megahertz. Many applications call for a crystal oscillator frequency conveniently related to some other desired frequency, so certain crystal frequencies are made in large quantities and stocked by electronics distributors.

Table 3. CRYSTAL OSCILATORS OF DIFFERENT FREQUENCIES WITH USES

Frequency (MHz)	Primary uses
0.032768	Real-time clocks, quartz watches and clocks; allows binary division to 1 Hz signal ($2^{15} \times 1$ Hz)
1.8432	UART clock; allows integer division to common baud rates. (= $2^{13} \times 3^2 \times 5^2$. 16 × 115200 baud or 96 × 16 × 1200 baud)
2.4576	UART clock; allows integer division to common baud rates up to 38400
3.2768	Allows binary division to 100 Hz (32768 × 100 Hz, or $2^{15} \times 100$ Hz)
3.575611	PAL M color subcarrier
3.579545	NTSC M color subcarrier. Because these are very common and inexpensive they are used in many other applications, for example DTMF generators
3.582056	PAL N color subcarrier
3.6864	UART clock (2 × 1.8432 MHz); allows integer division to common baud rates
4.096	Allows binary division to 1 kHz ($2^{12} \times 1$ kHz)

CRYSTAL OSCILLATORS USED IN MICROCONTROLLERS

A microcontroller is disclosed that includes a crystal oscillator circuit that is programmable to provide multiple different levels of start-up current. In the present

embodiment, the crystal oscillator circuit includes logic devices for receiving programming indicating one of a plurality of different start-up current levels and a resistor chain. The logic devices are coupled to the resistor chain for controlling the resistance of the oscillator circuit such that, upon receiving programming indicating a particular start-up current level, the crystal oscillator circuit generates a corresponding start-up current. In addition, the crystal oscillator circuit includes provision for selecting one of a plurality of different levels of capacitance. Furthermore, the crystal oscillator circuit includes a gate pass that includes circuitry for assuring predetermined start-up conditions are met. A feedback loop that includes an amplifier provides for steady-state operations that have low power consumption.

APPLICATIONS

A crystal oscillator is an electronic oscillator circuit that uses the mechanical resonance of a vibrating crystal of piezoelectric material to create an electrical signal with a very precise frequency. This frequency is commonly used to keep track of time (as in quartz wristwatches), to provide a stable clock signal for digital integrated circuits, and to stabilize frequencies for radio transmitters and receivers.

Virtually all microprocessors, micro-controllers, PICs and CPU's generally operate using a

QUARTZ CRYSTAL OSCILLATORas its frequency determining device to generate their clock waveform because as we already know, crystal oscillators provide the highest accuracy and frequency stability compared to resistor-capacitor(RC), inductor-capacitor (LC) oscillators. Quartz crystals are manufactured for frequencies from a few kilohertz up to several hundred Megahertz.

CHAPTER 4

4.1) ADVANTAGES

1 This system is effective and safe
2 The system requires very less maintenance and most of the work is automated.
3 The system uses microcontrollers and sensors which are both robust and durable providing accurate data.
4 This system requires minimal manual work thus reducing the load on sanitation workers.

4.2) APPLICATIONS

1)For developing a smart city with integrated monitoring system for sewers and sanitation.

2) The system can be implemented to aid sanitation workers in assessing the manhole and sewer conditions without actually opening the manhole.

3) Prevent injuries or death due to explosions or manhole cap not placed properly.

4) For constant monitoring of several manholes simultaneously for maintenance work.

5)Helps in detecting harmful gases and overflow from manhole.

4.3) FUTURE SCOPE

Sensor networks are considered as the key enablers for IoT aradigm. This project addresses a;; about smart and real time drainage monitoring system through IoT applications. By suing Various sensors such as water level temperature and gas sensors to provide blockage detection we can monitor the real time scenario of the manhole system by detecting the problem in the drainage system. By doing this we are able to take a particular action on the problemas well as receive the early alerts of blockage as well as increase. This can be used to design the smart and real time manhole system for monitoring as well as trouble shooting purpose.

In the future, Smart cities infrastructure could be modified for intelligent communication and management of traffic signals, street lights, transit applications, active lanes, and so on. With the integration of smart devices in a city, infrastructure can make life in a city a lot easier. Also further by using PLC controller and SCADA systems, drainage water can be controlled, monitored and also this water can be used to irrigate plants, clean toilets, etc. These PLC and SCADA systems can be used as a treatment system for drainage water. Primarily, PLC controls the process of the sewage treatment plant and SCADA is a remote terminal unit, which monitors and controls the entire area.

Sensor networks are considered as the key enablers for the IoT paradigm. This paper addresses all about smart and real-time Drainage monitoring systems through IoT applications. By using various sensors such as flow sensors, water level as well as blockage detection we can monitor the real time scenario of the drainage system by detecting the problems in the drainage system. By doing this we are able to take particular action on the problems as we will receive the early alerts of blockage as well as increase. This can be used to design the smart and real time drainage system for monitoring as well as troubleshooting purposes.

4.4) CONCLUSION

Underground drainage monitoring is a challenging problem. This project proposes different methods for monitoring and managing underground drainage systems. It explains various applications like underground drainage and manhole identification in real time. Various parameters like flow and level of water are being monitored and updated on the internet using the Internet of Things. This enables the person in-charge to take the necessary actions regarding the same. By using this project, we can reduce the manpower and time consumption to verify the manhole blocking and underground drainage pipe lines and also avoid the hazards. If the person in charge doesn't have a smartphone to access the blink application or he/she is unable to check email regularly, we can send the notification through SMS alert, but we have not added this SMS module to our project which is the limitation.

The sensor unit automatically senses and updates the live values of the physical parameters like temperature, humidity, water level and flow rate, blockages, and manhole cap is open or closed through IoT. This makes the system smart and automated. The deployment of Wireless Sensor Networks (WSN), helps in the implementation of Smart cities in developing countries. This WSN can also be useful in designing environmental monitoring systems, which helps in monitoring volcanic activities, flood detectors, and other systems. By a small modification in the

implementation, this project can be used in agriculture fields or other environmental fields to monitor and control the systems.

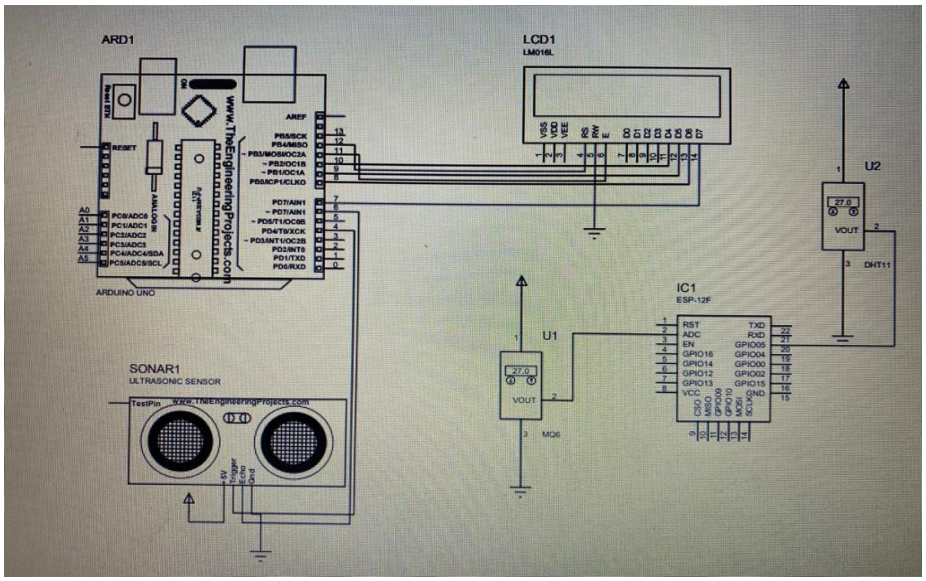
Appendix A

Program:

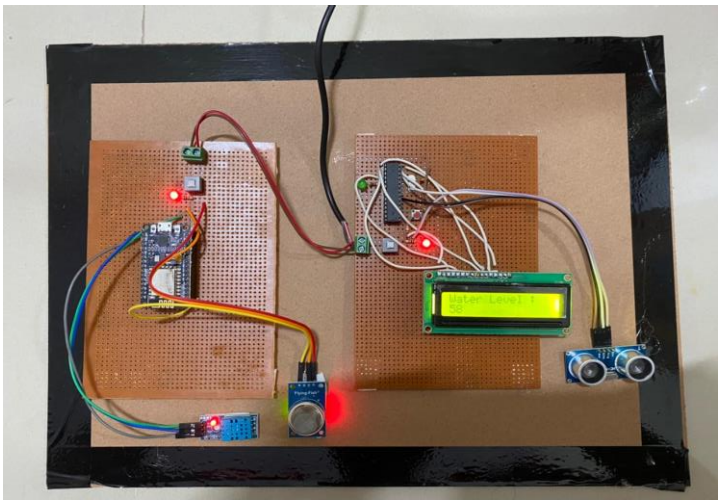
```
#include <ESP8266WiFi.h>

#include "Adafruit_MQTT.h"

#include "Adafruit_MQTT_Client.h"

#include "DHT.h" // including the library of DHT11 temperature and humidity sensor

#define DHTTYPE DHT11   // DHT 11

#define dht_dpin D6

DHT dht(dht_dpin, DHTTYPE);

//#define S3 D0

//#define S2 D1

//#define S1 D2

//#define S0 D3

//#define analogpin A0

int S1=A0;

//int moisture_percentage;

 int sensor_analog;

/************************* WiFi Access Point *************************/

#define WLAN_SSID "io123"

#define WLAN_PASS "io123456"

/************************* Adafruit.io Setup *************************/

#define AIO_SERVER "io.adafruit.com"

#define AIO_SERVERPORT 1883 // use 8883 for SSL

#define AIO_USERNAME "main123"

#define AIO_KEY "aio_dtGP25Ngflse6i6h5i9pDJmCkcia"

/************ Global State (you don't need to change this!) ******************/
```

```
// Create an ESP8266 WiFiClient class to connect to the MQTT server.

WiFiClient client;

// or... use WiFiFlientSecure for SSL

//WiFiClientSecure client;

// Setup the MQTT client class by passing in the WiFi client and MQTT server and login details.

Adafruit_MQTT_Clientmqtt(&client, AIO_SERVER, AIO_SERVERPORT, AIO_USERNAME, AIO_KEY);

/************************** Feeds ***************************** *******/

// Setup a feed called 'photocell' for publishing.

// Notice MQTT paths for AIO follow the form: <username>/feeds/<feedname>

Adafruit_MQTT_Publish sensor_1 = Adafruit_MQTT_Publish(&mqtt, AIO_USERNAME "/feeds/sensor-1");

Adafruit_MQTT_Publish sensor_2 = Adafruit_MQTT_Publish(&mqtt, AIO_USERNAME "/feeds/sensor-2");

Adafruit_MQTT_Publish sensor_3 = Adafruit_MQTT_Publish(&mqtt, AIO_USERNAME "/feeds/sensor-3");

Adafruit_MQTT_Publish sensor_4 = Adafruit_MQTT_Publish(&mqtt, AIO_USERNAME "/feeds/sensor-4");

// Setup a feed called 'onoff' for subscribing to changes.

//Adafruit_MQTT_Subscribeonoffbutton = Adafruit_MQTT_Subscribe(&mqtt, AIO_USERNAME "/feeds/onoff");

// Should be called in the loop function and it will take care if connecting.

void MQTT_connect() {

  int8_t ret;

  // Stop if already connected.

  if (mqtt.connected()) {

    return;

  }
```

Circuit Diagram:



Actual picture if the model:


Water Level :
%