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Alcohol sensing based engine locking system

I Rahul Rao
rahulrao.rr26@gmail.com
Government Engineering College, Raipur, Chhattisgarh

Saurabh Sinha
sinhasaurabh204@gmail.com
Government Engineering College, Raipur, Chhattisgarh

ABSTRACT

In today's era where we are blessed with fast-moving automobiles which makes our movement easy as well as fast, it also poses a grave danger of accidents and one of the main causes of such fatal accidents is the case of drunken driving where the person loses his control over the automobile and can become a danger to himself and the surroundings. Controlling such cases manually is practically very difficult.

And thus we came up with an idea of controlling such accidents, we in this project have used the idea of gaseous material sensing for sensing the fumes of alcohol in the breath of the person who is driving. As we know that stopping a person from drinking in today's world is near to impossible so why not stop them from driving after drinking !!!. Our project here will be installed on the steering wheel of the car where the breath of the person driving comes, it will sense the amount of alcohol consumed by him in mg/liter and if the level exceeds then the engine will be stopped and thus decreasing the chance of an accident. This prototype of our can be further modified into a smaller size and with more efficient sensing.

Keywords: *Alcohol, Engine, Sensing.*

1. BLOCK DIAGRAM

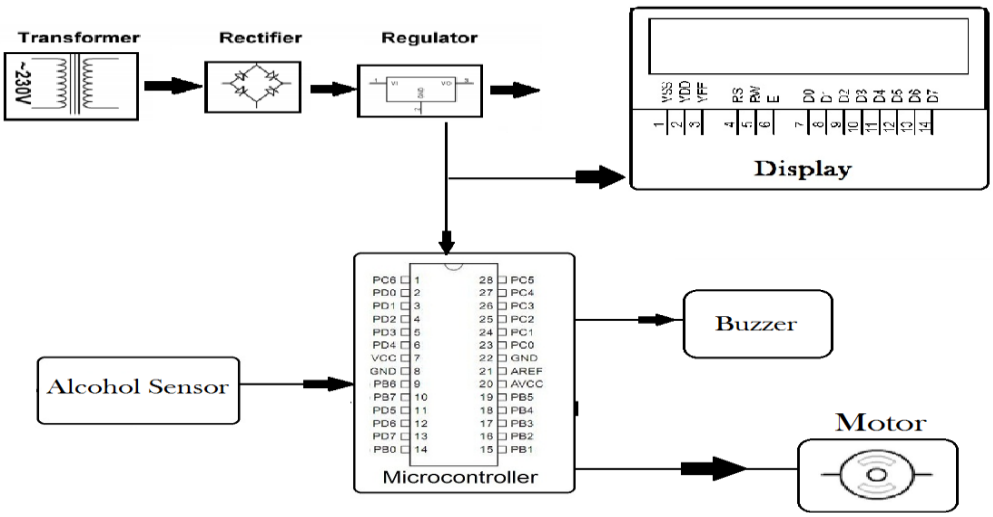

Fig.1 Block diagram of the project

The project we made can be said as the modern and much better and effective version of the breath analyzers usually used by the police department to analyze the alcohol consumption of the driver.

The history of this goes long back, there were many errors and complications that our prototype removes all these things can be known from the literature review that we are going to give.

2. ORIGINS

In the year 1927 a paper produced by researcher Emil Bogen, who collected some sample of air in a football bladder and then tested this air for traces of concentration of alcohol, discovered that the alcohol content of the air was a little more than that of 1 cc of urine. However, the research into the possibility of using breath to the test alcohol concentration in a person's body dates as far back as the year 1874, when Francis E Anstie made the observations in his research that small amounts of alcohol were excreted human body in a breath.

In late 1927, in a case that was in Marlborough, England, Dr. Gorsky, a police surgeon, asked a suspect to fill a football bladder with his breath. Since the 2 liters of the man's breath in the bladder contained 1.5 ml of ethanol, Dr. Gorsky testified before the court that the defendant was near"50% drunk" when the testing was done.

In the year 1931 first practical roadside breath testing device that came into existence and was called drunkometer developed and invented by Rolla Neil Harger of the Indiana University School of Medicine. The drunkometer collected a drivers breath sample into a balloon inside the machine. The breath sample was then pumped through an acidified solution of potassium permanganate. If there was any alcohol in the breath sample, the solution would change the color, more the color change, the more the alcohol present there in the breath.

2.1 Chemistry

When a person exhales into a breath analyzer, the ethanol that is present in their breath is oxidized to acetic acid at the anode:

$CH_3CH_2OH(g) + H_2O(l) \rightarrow CH_3CO_2H(l) + 4H^+(aq) + 4e^-$

At the cathode, atmospheric oxygen is reduced:

$O_2(g) + 4H^+(aq) + 4e^- \rightarrow 2H_2O(l)$

The overall reaction is the oxidation of ethanol to acetic acid and water.

$CH_3CH_2OH(l) + O_2(g) \rightarrow CH_3COOH(l) + H_2O(l)$

The electric current hence produced during this reaction is measured with help of a microprocessor, and it gives an approximate value of overall blood alcohol content (BAC) in the given sample.

3. COMMON SOURCES OF ERROR

3.1 Calibration

Many handheld breath analyzers use a silicon oxide sensor to determine the blood alcohol concentration. The sensors that are used are prone to contamination and interference from substances other than breath alcohol which is problematic and may lead to wrong results. The sensors require recalibration or replacement every six months depending upon usage of the device. Calibration is the process of adjusting the settings of a breath analyzer by comparing it with the defined standards and then adjusting its test results to a known alcohol standard that may be fixed according to the environment around or predetermined value by the law enforcing agencies.

3.2 Mouth alcohol

One of the most common causes of falsely high breath analyzer readings is the existence of mouth alcohol traces. While analyzing a breath sample, the breath analyzer is making the assumption that the alcohol in the sample came from alveolar air and not from any other sources, which actually is a problem. However, alcohol might have come from the mouth, throat or stomach for a number of reasons to be. To nullify the effect of mouth-alcohol contamination problem while the sample is taken, certified breath-test operators are trained to observe and test subject carefully for at least 15 to 20 minutes before administering the test so that the effect of mouth alcohol fades away.

The case with mouth alcohol is that it gets analyzed by the breath analyzer which was not been absorbed through the stomach and intestines and passed through the blood to the lungs. In other words we can say, the machine's computer is mistakenly applying the partition ratio and multiplying the results. As a result of this, very tiny amount of alcohol from the mouth, throat or stomach can have a significant impact on the reading of detector.

3.3 Photovoltaic array

The process works by using photocells to analyze the color change of a redox reaction. The breath sample collected is now bubbled through an aqueous solution of sulfuric acid, potassium dichromate, and silver nitrate.

The silver nitrate acts as a catalyst in this reaction, allowing the alcohol to be oxidized at an appreciable rate. The requisite acidic condition needed for the reaction might also be provided by using sulfuric acid. In the solution, ethanol reacts with the potassium dichromate, reducing the dichromate ion to the chromium (III) ion. This reduction results in a change of the solution's color from reddish orange to green. The reacted solution thus formed is compared to a vial of the non-reacted solution by a photocell, which then creates an electric current proportional to the degree of the colour change; this current now moves the needle that indicates BAC.

Like other methods, breath testing devices using chemical analysis are somewhat prone to false readings. Compounds that have compositions similar to that of ethanol, like reducing agents can also give wrong results and create the necessary color change to indicate increased BAC.

The basic problem with the breath analyzer was its limitation of practical use that is, it did not ensure the surety that every particular person could be stopped from driving after drinking above the permitted level.Police would need to stop every vehicle and analyze the breath of each and every driver, which is tiresome process and is a wastage of time and money and manpower.

The number of road accidents caused due to drunken driving was not reducing as it was needed just by giving breath analyzer into the hands of policemen.

We, therefore, thought of a better instrument that could be installed in a car on the steering wheel which would be always analyzing the breath of the driver, and if the limit of alcohol in the body of the driver exceeds it would alarm the driver and eventually will shut down the engine too. There were many problems that arose with the traditional breathe analyzer which have been put down earlier in literature review section of this thesis.

We had to think about many parameters before starting this project physically, some of the major aspects that we worked out and are the major features of our project are:-

1) The sensitivity of the sensor had to be seen and adjusted so as the driver is not forbidden from the grasp of the sensor but the other passengers also do not come in the area of sensing of the sensor, to come out of this set back we used a sensor with sensitivity adjuster.

2) Size of the project had to be kept in mind as the instrument had to be installed on the steering wheel, and because of which it had to be compact as well as efficient.

3) Cost of production had to be kept in mind according to the market, to control the cost of production less complex hardware was used , with needed efficiency.

This project was not only developed keeping in mind the commerce behind it but also it was made as the social responsibility of ours towards a better society.

4. INTRODUCTION TO EMBEDDED SYSTEMS

4.1 What is the Embedded system?

An Embedded System is the combination of hardware and software.An embedded system is a microcontroller based, software driven and real-time control system, with human or network interactive, operating on diverse physical variables and in diverse environments

- An embedded system is any computer system inside a product other than the computer itself.

4.2 System Design calls

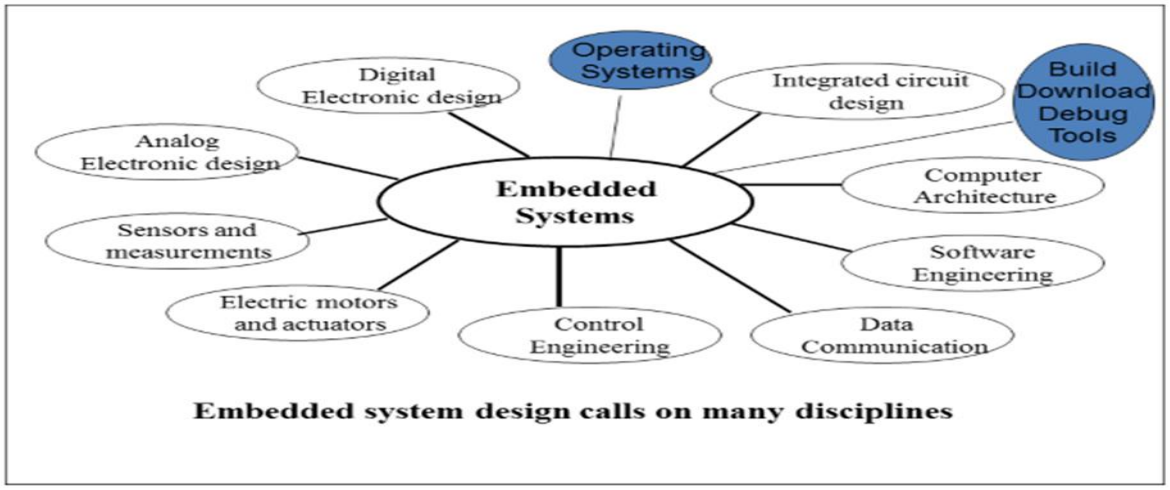

Fig 2. Embedded System design calls

4.3 Applications of the embedded system

1) Communication applications
2) Industrial automation and process control software
3) Solving the complexity of many applications.
4) Reduction of product designing time.
5) Real-time processing of data

4.4 Classification

- Real-Time Systems.
- RTS is one which response to events within a specified time.
- A right answer after the deadline is taken as a wrong answer

5. LAYOUT OF THE PROJECT

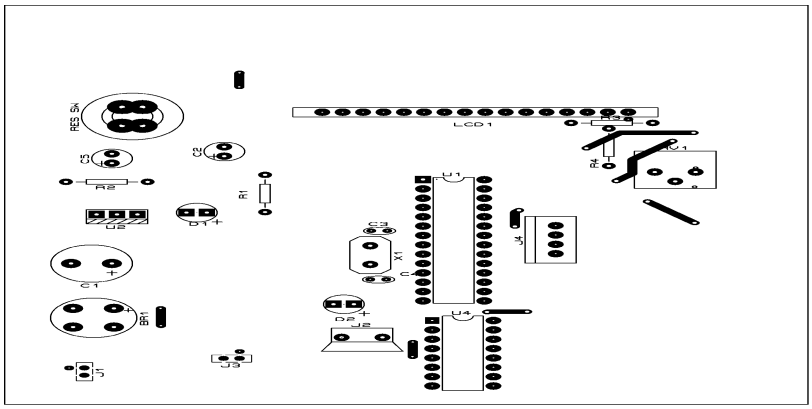

Fig 3. Layout of the project

5.1 Hardware components

1. TRANSFORMER (230 – 12 V AC)
2. VOLTAGE REGULATOR (LM 7805)
3. FILTER
4. RECTIFIER
5. MICROCONTROLLER (ATMEGA 328)
6. LCD
7. ALCOHOL SENSOR
8. MOTOR
9. 1N4007
10. LED
11. RESISTORS
12. CAPACITORS
13. L293D, Push – pull four channel driver

5.2 Transformer

Transformers convert AC from one voltage level to another with some loss of power. Step-up transformers increases the voltage whereas step-down transformers reduces voltage. Most power supplies use a step-down transformer to reduce the high voltage to a safer low voltage easy which is easy to consume.

Fig.4.A typical transformer

The input coil is called the primary coil from where power input is given and the output coil is called the secondary. There are no electrical connections in between the two coils; but they are linked by an alternating magnetic field that is created in the soft iron core of the transformer. Transformers waste little power so the power out is almost equal to the power coming in.

5.3 Voltage regulator 7805

1) Features

- Output Current up to 1A.
- Output Voltages ranging from 5, 6, 8, 9, 10, 12, 15, 18, 24V.
- Thermal Overload Protection.
- Short Circuit Protection.
- Output Transistor Safe Operating Area Protection.

2) Description

The LM78XX/LM78XXA is a series of 3-terminal positive regulators, making them very useful in a wide range of applications in the field of electronics. It employs internal current limiting,which helps in thermal shutdown and safe operating area protection for the device.

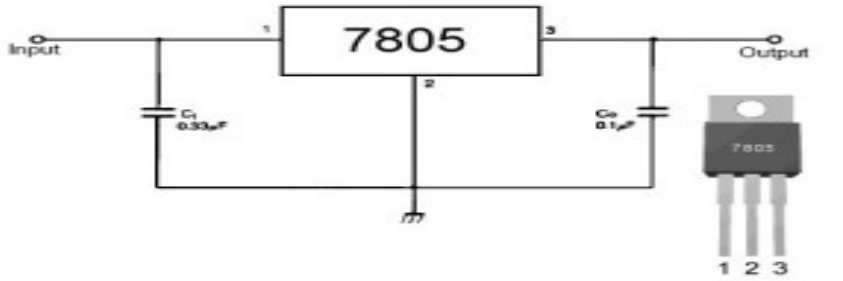

Fig.5. Voltage regulator 7805

5.4 Rectifier

A rectifier is an electrical device which is used to converts AC that we get from supply and which periodically reverses direction, to DC which we need to use for the device ,which does not change the direction, a process known as rectification, this is necessary for us because we need DC to work. The output from the transformer is fed to the rectifier as input. Now it converts A.C. into pulsating D.C. The rectifier may be a half wave or a full wave one. In this project, a bridge rectifier is used because of its qualities like good stability and full wave rectification. In positive half cycle only one pair of diode will conduct, in negative half cycle remaining two diodes will conduct and they will conduct in forward bias condition only.

5.5 Filter

Capacitive filter is used in this project. It removes the ripples from the output of rectifier and also smoothens the D.C. Output which is received from this filter, and is constant until the main voltage and load is maintained constant. However, if either of the two is varied, D.C. voltage received at this point changes. Therefore a regulator is applied at the output stage of the circuit.

The simple capacitor filter is a type of power supply filter. The filter used here is also used in circuits where the power-supply ripple frequency is not critical but can be relatively high and dangerous for the circuit. The given below figure can show how the capacitor charges and discharges.

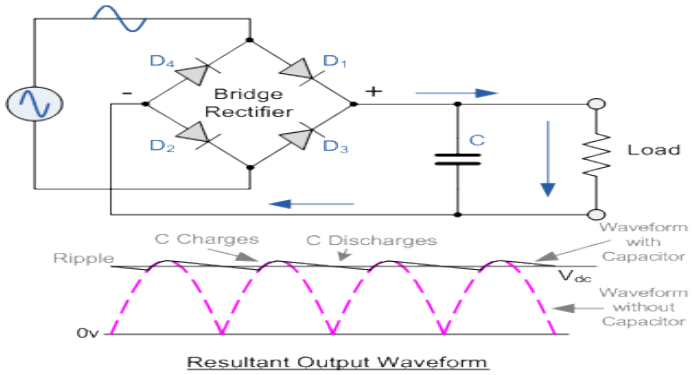

Fig. 6. Bridge rectifier and resultant waveform output

5.6 ATmega328

The computer is designed to perform all the general purpose tasks on a single machine, whereas the microcontrollers are meant to perform only the specific tasks. For example switching the AC off automatically when room temperature drops to a certain defined limit or above a particular point and again turning it ON when temperature rises above a defined limit or decreases below a limit.

1) **Description**

The Atmel ATmega48/88/328 that we use is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. The Atmel ATmega48/88/328 has the following features which make it suitable for the purpose:- 4K/8K/16K bytes of In-System Programmable Flash with Read While Write capabilities, 23 general purpose I/O lines, 32 general purpose working registers,and there are three flexible Timers/Counters with compare modes, internal and external interrupts,

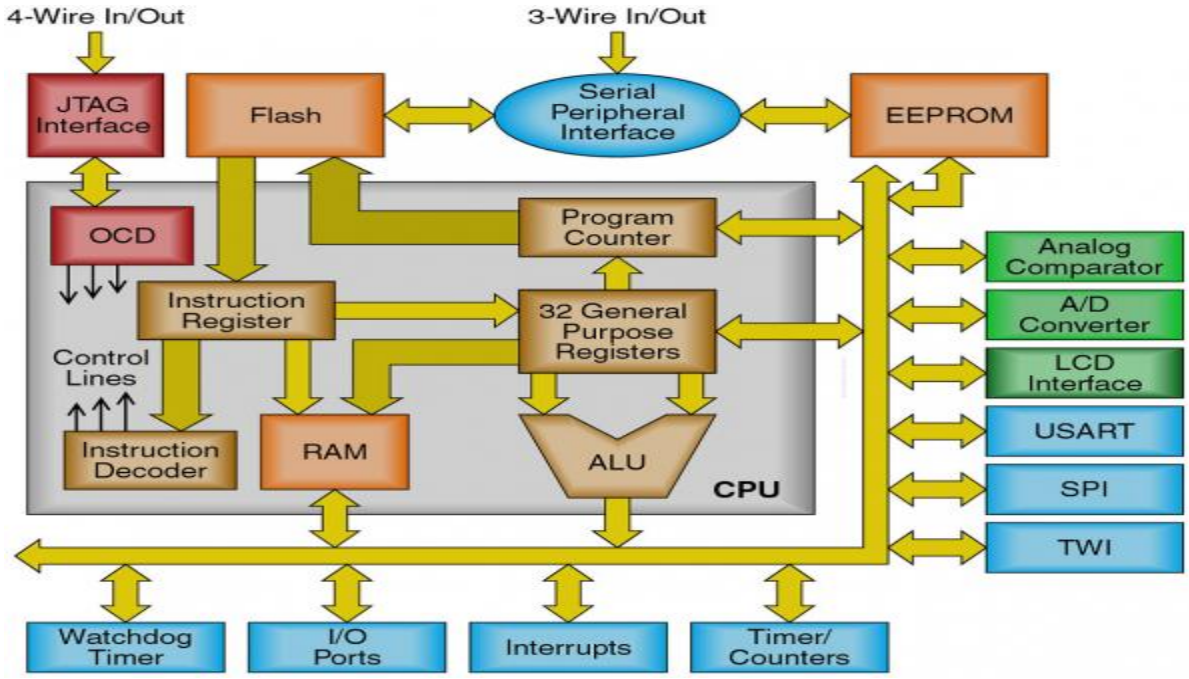

Fig.7 Architecture of ATmega 328

AVR follows is equipped with separate memories and buses for Program and the Data information for the system. Here while an instruction is being executed, the next instruction is pre-fetched from the program memory into it.

ALU: The AVR unit operate directly in connection with all the 32 general purpose working registers. Within a single clock cycle the arithmetic operations between general purpose registers or between a register and an immediate are executed and fetched.

Instruction execution section (IES). It has the most important unit instruction register and instruction decoder to control the flow of the instruction during the processing of data.

Input/output ports: To interact with the physical environment there are different input and output ports in every system. ATMEGA 328 has its input and output ports with different configurations depending on the architecture like only input, only output or bi-directional input output ports. The accessing of this port is referred as input output interface design for microcontrollers. It has analog input port, analog output port, digital input port, digital output port, serial communication pins, timer execution pins etc embedded.

5.7 Liquid crystal display

Liquid crystal display (LCD) has material which combines the properties of both liquid and crystals. They have a temperature range within which the molecules are almost as mobile as they would be in a liquid, but are grouped together in an order form similar to a crystal.

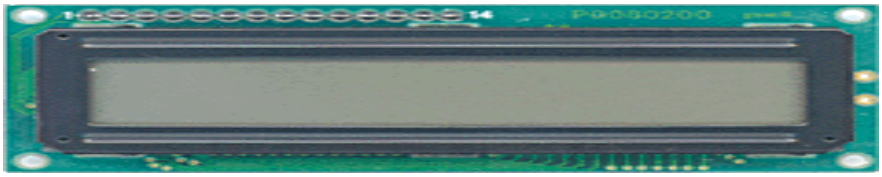

Fig.8 LCD Display

Microcontroller devices use smart LCD displays to output visual information For an 8-bit data bus, the display requires a +5V supply plus 11 I/O lines for working. For a 4-bit data bus it only requires the supply lines plus 7 I/O lines. The LCD also requires 3 control lines from the microcontroller

Enable (E)	This line allows access to the display through R/W and RS lines. When this line is low, the LCD is disabled and it ignores signals. When Enable (E) line is high, the LCD checks for the state of the two control lines connected to it and responds to it accordingly, and works according to the state.
Register Select (RS)	With the help of this line, the LCD finds the type of data on data lines. When it is low, an instruction is given to the LCD. And when it is high, a character is being written on the LCD.

Read data from data lines

Reading data from the LCD is done in the same way, but control line R/W has to be in the high state. When a high signal is sent to the LCD, it will reset and wait for instructions. Typical instructions sent to LCD display after a reset are: turning on the display, turning on the cursor and writing characters. When the LCD is initialized.

5.8 1N4007 Diodes

Diodes are used to convert AC into DC and these are used as half wave rectifier or full wave rectifier. Three points is kept in mind while using any type of diode.

- Maximum forward current capacity
- Maximum reverse voltage capacity
- Maximum forward voltage capacity

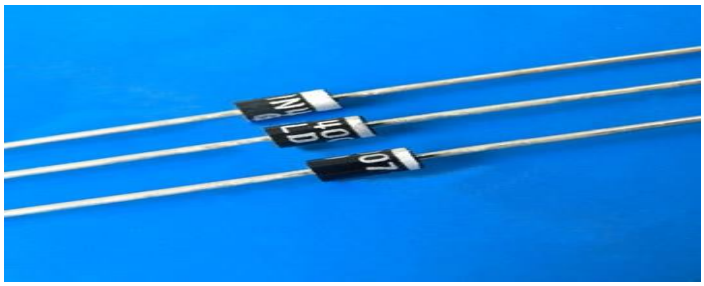

Fig 9. 1N4007 diodes

Some of the important diodes useful to us and available in the market are as follows:

- The diodes IN4007, IN4001, IN4002, IN4003, IN4004, IN4005, and IN4006 have maximum reverse bias voltage capacity of 50V and maximum forward current capacity of 1 ampere which is the need for us for this project.
- Diodes of equivalent capacities can be used in place of one another in the same circuit. Besides this diode of more capacity can be used in place of diode of low capacity but the vice versa is not possible.

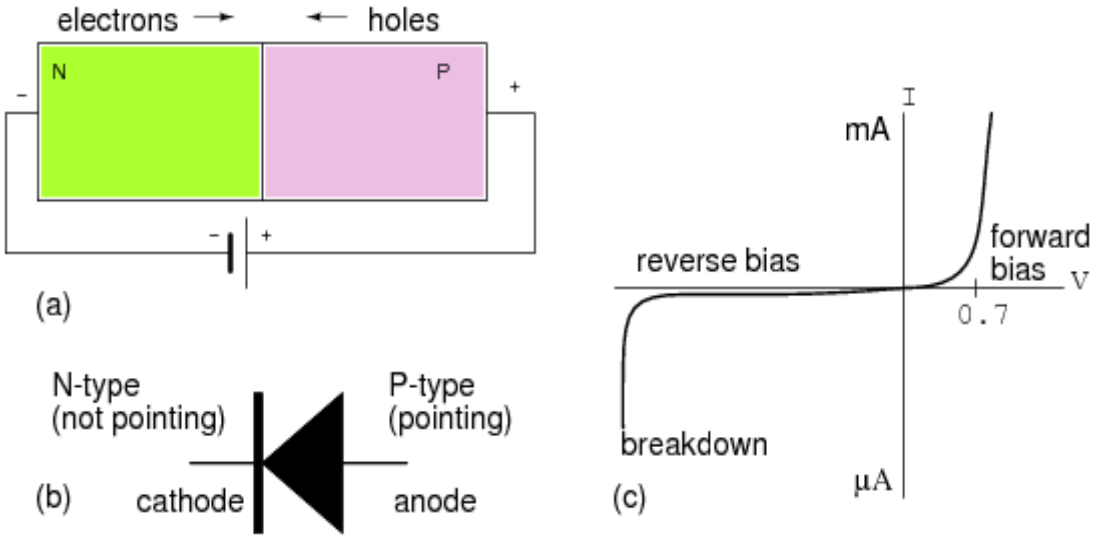

Fig.4.9PN Junction diode

PN Junction Operation

Current Flow in the N-Type Material

Conduction in the N-type semiconductor, or crystal, is very similar to how conduction in a copper wire takes place. When a voltage is applied across the material, electrons will start moving through the crystal just as the current flows in a copper wire. The positive potential of the battery will start attracting the free electrons in the crystal, these electrons will leave the crystal and start flowing into the positive terminal of the battery. As an electron leaves the crystal, an electron from the negative terminal of the battery will now enter the crystal, thus completing the current path and start conducting. Therefore, the major part of current carriers in the N-type material (i.e electrons) are repelled by the negative polarity of the battery and move through the crystal towards the positive pole of the battery.

Current Flow in the P-Type Material

Conduction in the P material is by positive holes, instead of electrons. A hole moves from the positive terminal of the P material to the negative terminal. Electrons enter the negative terminal of the material and fill holes in the vicinity of this terminal and this cycle continues. At the positive terminal, electrons are removed from the covalent bonds, and thus again creating new holes.

5.9 LED

Light Emitting Diodes (LED) have recently become available that are available in white and bright colours. LEDs are semiconductor devices. Like transistors, and other diodes, LEDs are made out of silicon.

When current passes through the LED, it emits photons. Normal light bulbs used excessively before produce light by heating a metal filament inside the bulb until it is white hot, whereas LED's produce photons directly and not via heat, that is why they are far more efficient than incandescent bulbs.

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5.10 Resistors

A resistor is a bi terminal electronic component which is designed to oppose an electric current by producing a voltage drop between its terminals that is in proportion to the current, in accordance with Ohm's law:

$$V = IR$$

They are extremely common place in most of the electronic equipment. Practical resistors are made of various compounds and films, as well as resistance wire.

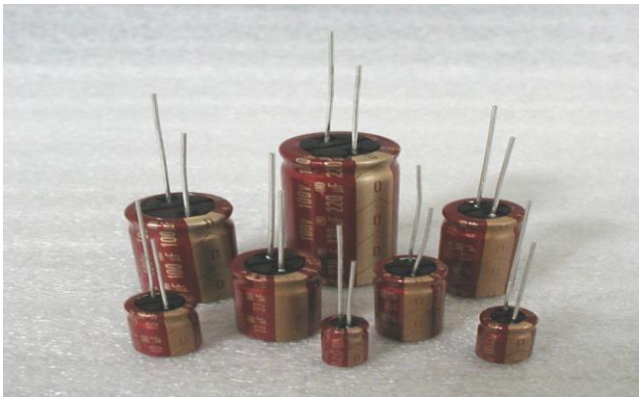
Fig. 10. Different resistors

5.11 Capacitors

A passive electronic component consisting of a pair of conductors separated by a dielectric is a capacitor or condenser as formerly known. When a potential difference is applied between the conductors, an electric field generates in the dielectric. This field in addition to storing energy also produces a mechanical force between the plates. The effect can be increased by using wide, flat, parallel, narrowly separated conductors.

There is a fixed value capacitance for every ideal capacitor which is measured in farads. A Farad is the ratio of the electric charge on each conductor upon the potential difference between the conductors separated by a non conductor. The dielectric between the plates passes a small amount of current or leakage current. The conductors and leads form an equivalent series resistance and the dielectric has an electric field strength limit which results in a breakdown voltage creation and helps in functioning.

The properties of capacitors in a circuit determine various important constraints like the resonant frequency and quality factor of a resonant circuit, power dissipation and operating frequency in a digital logic circuit, energy capacity in a high-power system, and many other important aspects which are very important while designing a circuit.



Fig, 11. Capacitors

The basic function of a capacitor used in electronic circuit is to block the direct current while allowing the alternating current and for smoothing the output power supplies.

5.12 DC Motor

What is DC Motor?

A DC motor is an electric motor that runs on direct current (DC) electricity. In any electric motor, operation is based on simple electromagnetism. A current-carrying conductor placed in an external magnetic field, it will experience a force which is directly proportional to the current in the conductor, and to the strength of the external magnetic field. Like poles repel each other whereas opposite attracts each other.The internal configuration of a DC motor is designed to harness the magnetic interaction between a current-carrying conductor which have a magnetic field of its own and an external magnetic field to generate rotational motion.

Here is a representation of a 2-pole DC electric motor where red and white colored part shows the magnets.

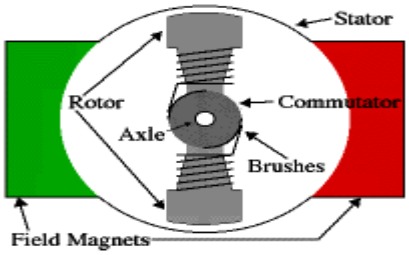


Fig.12 DC motor

The six basic parts of a DC motor -- axle, rotor (a.k.a., armature), stator, commutator, field magnets, and brushes. The external magnetic field in DC motor is, generally, produced by high-strength permanent magnets. The motor casing along with two or more permanent magnet pole pieces, is the stator. The rotor and the stator are synchronized. The rotor consists of windings, the windings being electrically connected to the commutator. The brushes, commutator contacts, and rotor windings are arranged in such a way that when power is applied, there is a misalignment in the polarities of the energized winding and the stator magnet, so the rotor starts rotating until it becomes aligned with the stator's field magnets causing the brushes move to the next commutator contacts, and energize the next winding. In the given example of two-pole motor, there is a reversal in the direction of rotation which in turn reverses the direction of current through the rotor winding, leading to a "flip" of the rotor's magnetic field, driving it to continue rotating.

5.13 Alcohol Sensor

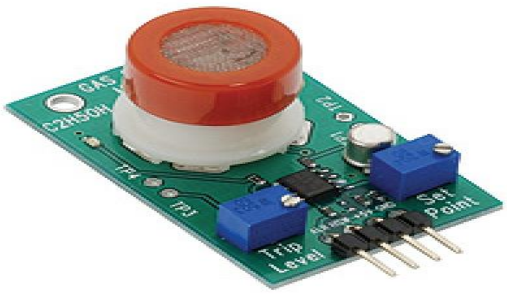


Fig.13 Alcohol Sensor

A simple yet precise sensor is used here. Just like breath analyzer, this sensor detects the level of concentration of alcohol in your breath. It has two advantages

1) high sensitivity

2) fast response time.

Sensor provides an analog resistive output based on the concentration of alcohol detected in your breath. The drive circuit is very minimalistic; all it needs is one resistor. A simple interface of 0-3.3V ADC would be sufficient.

Features

- 5V DC or AC circuit
- Requires heater voltage
- Operation Temperature: -10 to 70 degrees C
- Heater consumption: less than 750mW

Dimensions

- 16.8mm diameter
- 9.3 mm height without the pins

Sensitive material of MQ-3 gas sensor is SnO2, with lower conductivity in clean air. When the target alcohol gas exists and as the concentration of gas increases the conductivity of sensor increases proportionally. Convert change of conductivity to correspond output signal of gas concentration. MQ-3 gas sensor is highly sensitive to Alcohol and with good resistance to disturbance of gasoline, smoke and vapour. This sensor can be used to detect alcohol with different concentration; it is cost effective and suitable for different application and certainly suitable for our purpose. Characteristic configuration includes good sensitivity to alcohol gas and low cost which is durable in long run which has simple application such as vehicles alcohol detector & portable alcohol detector.

5.14 Embedded C

Use of embedded systems in passenger cars, mobile phones, medical equipment, aerospace systems and defense systems is widespread and economic.

As most of the embedded projects have critical cost constraints, so generally low-cost processors like the 8051 family of devices area used. Most such devices have around 256 bytes of RAM. As a result, developing embedded software presents notably new challenges, even for learned desktop programmers anywhere.

6. HARDWARE TESTING

6.1 Continuity test

A continuity test is a basic test to check the electric circuit and see if current flows through the circuit efficiently without break and loss. It is performed by placing a small voltage across the path. If electron flow is disrupted by broken conductors, damaged components, or excessive resistance in the line, the circuit is said to be "open",that means the circuit is not conducting.

Devices that can be used to perform continuity tests include multi meters which measure current and specialized continuity testers which are less expensive, more basic devices, generally with a simple light bulb that glows when current flows.
An important application is to test the continuity of a bundle of; if working properly,there will be a negligible resistance between the ends.

This test is the performed just after doing the hardware soldering and completing the configuration. The aim is to find any electrical open paths in the circuit after the connection is made, the electrical continuity in the circuit may be lost due to improper soldering, wrong and rough handling of the PCB, component failures and presence of errors in the circuit diagram. A multi meter is used to perform this test.

6.2 Power ON Test

To check whether the voltage at different terminals is according to the requirement or not, this test is performed. Take a multi meter in voltage mode. This test is done without microcontroller. Firstly, we check the output of the transformer, whether we get the required 12 v AC voltage.

Then we apply this voltage to the power supply circuit. We do this test without microcontroller because if there is any excessive voltage, then, this may lead to damage to the controller. This 5v output is supplied to the 40th pin of microcontroller. Hence the voltage level at 40^{th} pin is checked. Again, we check for the other terminals for the required voltage to be used. In this way we can assure that the voltage is as per the requirement and won't damage the circuit.

As a result of the work on this project we have got a thorough knowledge on real life development and usage of the engineering studies, the knowledge that we gain should be used for benefit of the society also. All the theory when mixed with practicality gives very good results. A lot have we gained while developing this project.

Development of this project and implementation of this project in reality will produce benefits to the society by decreasing the road accidents due to drunken driving tremendously.

Some of the future aspects of this projects are

1) A GSM module could be installed in this so that whenever a drunken driver tries to drive the car a message is sent to the responsible person with the car to look for the person and the car.

2) A GPS system can be installed so that the car could be tracked anywhere, so as to reach the car with the drunken person easily.

3) This prototype could be made even more compact so the looks are good and the space occupied is even less.

7. CONCLUSION

After the studying and working on this project we conclude that if the errors and technical calculation are avoided properly this project could be used in cars and other 4 wheelers also efficiently.

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