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Automatic Tunnel Lighting System for Road Traffic with Auto Exhaust Fan

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Abstract: ***The main objective of this project work is to provide intelligent lighting scheme for the tunnels of hill station roads. Tunnel means tubular passage cut through the hill or underground, these tunnels remain in dark always and inside the tunnels proper lighting system are essential to avoid the accidents. In this regard our government is arranging lights and they are glowing continuously irrespective of traffic and lot of energy is wasted. To avoid energy losses at these places, this efficient and intelligent lighting scheme is developed, which works automatically depending up on the road traffic and minimizes the energy consumption. In addition, all the vehicles release the waste (exhaust) gases that may be stagnated in the tunnel, due to lack of circulation with the outside environment. So, a gas detector/sensor is used for sensing these exhaust gases released from the automobiles and pump them outside the tunnel through an exhaust fan automatically.***

The process begins from the sensors; optical sensors are used for sensing the vehicles and depending up on the traffic density, inside lights of tunnel are controlled automatically. For example, many vehicles entered in to the tunnel from both the sides, all the lights are energized and as the traffic moving forward depending up on the clearance, required lights are energized, during the clearance means no vehicle is inside, all the lights remain in off condition automatically. The system is designed with Microcontroller, four sets of Infra Red sensors are used and they can be arranged either side of the tunnel in by directional mode. All the sensors are interfaced with Microcontroller and the program is prepared such that, depending up on the interrupted signals obtained from the sensors. The sensor used in the project work can detect all types of petroleum gases; in addition, it can detect smoke also. The sensor interfaced with the controller can energize exhaust fan automatically when it detects any type of gas or smoke.

I. INTRODUCTION

The main intention of this project work is to save the electric energy by implementing intelligent lighting scheme in road tunnels. The system is designed for double track roads, separate lighting system is provided for both the tracks, and these lights are controlled independently depending up on the traffic. The idea of implementing this automatic system in tunnels is to switch off all the lights when there is no traffic, there by the energy can be saved considerably.

To implement it practically, a prototype module is constructed with four small lamps and these lamps are arranged at entrance and exit of the tunnel at both the tracks. Similarly, four sets of infrared sensors are also arranged at entrance and exit of tunnel for sensing the entering and exiting vehicles of both side traveling. Infrared proximity detection scheme is implemented for sensing the vehicles, proximity means detecting the object with out making any physical contact to it, in other words it can be called as contact less detecting system. Each proximity detection system is designed with two infrared sensors, namely infrared signal transmitter and infrared signal detector. The infrared signal transmitting LED radiates infrared energy in to space in uni-direction; the other sensor which detects infrared energy can be arranged parallel to the signal transmitting LED. These two sensors are supposed to be arranged parallel to each other at either side of the road in one direction, one set should be installed at starting point of tunnel; similarly, another set can be installed at ending point of tunnel. The other two sets can be installed in same fashion in other direction (second track of the road). In the demonstration module two sections of the road is marked with divider line over a wooden plank.

In some cases, arranging sensors in parallel may not be possible because of the cable; two wires are required to connect the sensor with the obstacle detector circuit. For running these wires under the ground, digging the road is essential, to avoid this problem these sensors can be arranged side by side with a distance of one inch and are kept a side of road. Depending up on the sensor's arrangement, the output of the sensing circuit will become high or low. When both the sensors are arranged in parallel and as long as the signal detector receives signal from the transmitting LED, the sensing circuit out put remains in zero state, whenever any vehicle passes between the sensors, the infrared signal is interrupted and a logic high signal is generated by the sensing circuit. The detailed description of this sensing circuit and arrangement of sensors is provided in the following chapters.

The out puts of all the four sensing circuits is fed to microcontroller, depending up on the interruption signals generated according the vehicles movement, the controller controls the lamps through relays automatically. The main function of this control system is explained in next chapter.

In this project work ATMEL series 89C51 microcontroller is used and it is playing major roll, this is 8-bit micro-controller offering many features can be utilized for many applications. Nowadays with the advancement of technology particularly in the field of micro-controllers, all the activities in our day-to-day living have become part of information technology and we find controllers in each and every application. Thus, the trend is directing towards micro-controller based project works. A micro-controller contains a CPU, clock circuitry, ROM, Ram and I/O circuitry on a single integrated circuit package. The Micro-controller is therefore, a self-contained device, which does not require a host of associated support chips for its operation as conventional microprocessors do. It offers several advantages over conventional multi-chip systems. There is a cost and space advantage as extra chip costs and printed circuit board and connectors required to support multi-chip systems are eliminated. The other advantages include cheaper maintenance, decreased hardware design effort and decreased board density, which is relevant in portable control equipment.

The purpose of this project work is to present control theory that is relevant to the analysis and design of controlled systems, with an emphasis on basic concepts and ideas. It is assumed that a digital micro-controller chip with reasonable software is available for computations and simulations so that many tedious details can be left to the micro-controller. The control system design is also carried out up to the stage of implementation in the form of micro-controller programs.

II. DESCRIPTION AS PER BLOCK & CIRCUIT DIAGRAMS

The functional description of the project work “Automatic Tunnel Lighting System for Road Traffic with Auto Exhaust Fan” is explained in this chapter.

A sensor based infrared technology is adopted in the circuit design to detect the vehicle that is passing between the sensors. As described in the introduction, the sensors arrangement for sensing the presence of a vehicle can be in two types, in the prototype module for the demonstration purpose; these sensors are arranged parallel to each other. If required they can be arranged side by side, in this condition the infrared signal delivered from the transmitting LED travels in the space up to certain extent depending up on the signal strength. The signal delivered from the sensor is called infrared energy and it is radiated in to air, the radiating power is measured in watts. The range is depending up on the radiating power, depending up on the radiating power the signal is traveled up to certain distance. When the sensors are arranged side by side, if any object is passed near by this, the infrared energy delivered from the IR LED hits the object and due to this the energy is reflected, this reflected energy is detected by the sensor. Whenever the sensor receives the IR signal, the sensing circuit out put becomes zero. As long as the receiver doesn’t receives any signal, the sensing circuit out put remains in high state, due to the interruption made by the vehicle, the out put becomes zero momentarily. As described above, here the sensors are arranged parallel to each other. In this condition, whenever any vehicle passes between the sensors, immediately sensing circuit output becomes high and this logic high signal is fed to microcontroller.

The sensing circuit is designed with 567 IC, this is a tone decoder chip generally performs two major functions. One is to generate tone frequency from its out put pin, and the other function is to detect the tone frequency from its input pin through the infrared signal detector. That is the reason this IC is called as tone signal generator cum decoder. Tone signal is nothing but audio frequency ranging from 20Hz to 20 KHz. The IC is having oscillator internally and by connecting external resistor and capacitor, and by varying these two components values, the frequency can be adjusted. Here the circuit is designed to deliver 10 KHz approximately; the out put of the oscillator is taken out from pin number 5 and it is amplified through PNP transistor to increase the signal strength. At the final output (i.e., transistor collector) an infrared LED is connected to radiate the signal. Since it is a prototype module short range commercial type of sensors are used for the demonstration purpose. For real applications, higher range sensors with high radiating power output can be used. To increase the range further more, number of sensors can be paralleled together. Presently the system utilizes low power sensor, there by the range is less then one foot.

The function of two IR sensors in one set differs from each other, and both the sensors are connected to single IC as input and output devices. On receipt of optical signal (the IR sensors also called as optical sensors) the tone decoder part of the IC detects the signal through the optical sensor connected at input side and generates a high signal for the micro controller.

As per the block diagram four sets of sensors are used, each block contains two infrared sensors and one 567 IC. The first block is arranged at the entrance of track – 1, when any vehicle passes through these sensors, a high signal is generated and it is fed to microcontroller. On receipt of high signal from the first interruption signal generator block, the microcontroller energizes first relay. This relay contact is used to energize the lamps on track – 1, once these lights are energized they remains in energized condition until the controller receives another high signal from interruption signal generator block – 2.

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Means the vehicle which passes through block – 1 sensor at entrance, the same vehicle has to pass through the block – 2 sensors at the exit of tunnel on track – 1. After receiving high signal from the second block, the microcontroller de-energizes the same relay and breaks supply to the lamps. This logic indicates that as long as the vehicle is inside the tunnel, the lights remains in energized condition, when the vehicle leaves the tunnel, automatically these lights are de-energized.

A. Infrared Transmitter / Receiver Section

The oscillator output is obtained from Pin No.5 of 567IC, with the help of 10K resistor and 0.047MF capacitor connected externally to Pin No.5 and 6 of this IC; frequency is adjusted at 11.7 KHz approximately. If required this frequency can be varied by varying these two components values. The output is amplified through high frequency PNP switching transistor, the signal radiating IR LED is connected between the collector and ground, and a 47ohm resistor is connected in series with this IR LED to limit the current. The maximum allowable current through the IR LED junction is limited to 50mA, and the voltage applied to the IR LED junction should not exceed more than 1.5V. The signal radiating power is restricted because of these two reasons, there by range is also restricted. Range is nothing but the distance between transmitting IR LED and receiving IR LED, this range can be increased by increasing the radiating power of the transmitting LED. To increase the radiating power, more signals current with more amplitude to be pumped through the IR LED junction, this can be achieved by connecting more IR LEDs in series and parallel combination. Since it is a prototype module, commercially available IR LED is used, and the range is restricted by less than 30cm's, because these IR LEDs will not allow more current through its junction.

The following is the circuit diagram of Intruder Sensor

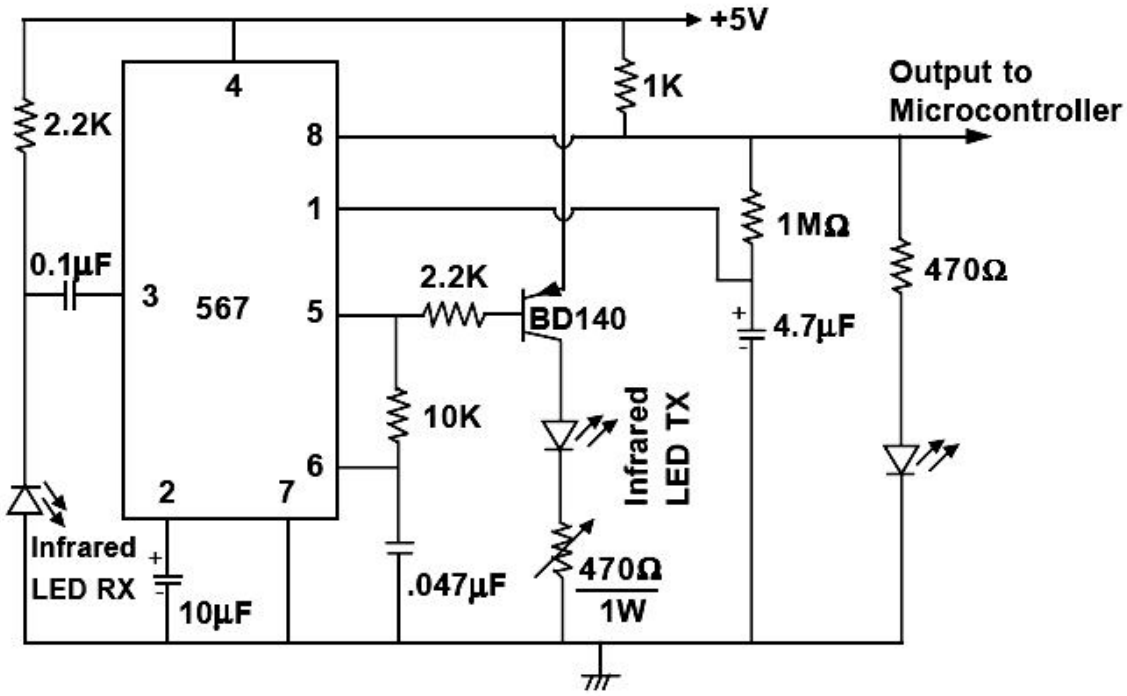

Fig 2.1

For example, three vehicles entered in to the tunnel one after another, and the lights are energized by detecting the first vehicle itself, these lights remain in energized condition until the last vehicle comes out from the tunnel. The logic is quite simple; here the controller monitors both the blocks continuously, if both the block's outputs are equal then the controller switches off the lamps through relay. The function of track – 2 circuits is also similar to this; the controller can identify the interrupted block, if it receives high signals from track – 2 sensing blocks, relay two will be activated and in-activated to control the track – 2 lamps.

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III. DESCRIPTION ABOUT TUNNEL LIGHTING SYSTEM

The most and important precautions to be taken in the tunnels is traffic and fire safety, here in this project work importance is given for the energy saving concept. Generally, in the tunnels most of the accidents are taking place at sharp curves, at these points proper lighting system with caution sign boards are essential to alert the drivers. Since the topic deals with tunnel lighting system, the following is the description.

These include fluorescent, high-pressure sodium, low-pressure sodium, metal halide, and pipe lighting, which is a system that may use one of the preceding light source types. Systems are chosen based on their life- cycle costs and the amount of light that is required for nighttime and daytime illumination. In conjunction with the lighting system, a highly reflective surface on the walls and ceiling, such as tile or metal panels, may be used.

Fluorescent lights typically line the entire roadway tunnel length to provide the appropriate amount of light. In addition, pipe lighting, usually consisting of high-pressure sodium or metal halide lamps and longitudinal acrylic tubes on each side of the lamps, are used to disperse light uniformly.

A. Aim of the Tunnel Lighting Systems

1) To provide sufficient lighting inside the tunnels
2) To control the light intensity automatically depending up on the availability of natural light, especially at starting and ending points of tunnel, where natural light is available
3) Installation of glow sign boards at sharp curves, which indicates speed limits
4) Installation of focusing lamps in emergencies
5) Installation of suitable signaling system

B. Highly Engineered Optics – (Gathered from Website)

Lighting a tunnel is a complex and specialized task. North Star Lighting has developed dedicated lighting systems and services to assist planners from concept to implementation, management and servicing. While luminance levels are used for accurate theoretical assessment, illuminance is more often used in practice.

North Star Lighting's assessment studies, therefore, are executed using luminance values, with the results presented as illuminance values. It is commonly accepted in road lighting that, even with the most accurate calculations and modeling, there is a substantial difference between what the mathematical lighting conditions are and what each individual driver subjectively sees in reality.

C. IN-HOUSE Visibility Modelling Software

At North Star Lighting, we have addressed this problem head on. Continuous research and development has led to a more sophisticated and detailed understanding of lighting and its effects on vision.

Along with rapid advances in IT, this research has allowed us to develop dedicated in-house software, which combines mathematical models of physiological stimuli with conventional lighting modeling parameters to generate results that are, visually, as well as mathematically, accurate beyond alternative visual modeling techniques.

Thanks to an impressive number of variables, our software is a unique and accurate tool, within the allocated time.

IV. BRIEF DESCRIPTION ABOUT GAS LEAKAGE DETECTORS

A gas leak is a non-expected release of gas that can create a potentially dangerous situation - either because the released gas is poisonous or because it can ignite and create an explosion. When traditional gas detection systems detect the leaking gas, the gas detector will in most cases convert the reading into either a concentration readout (ppm - parts per million) or a LEL (Lower Explosive Level) readout.

The physical size of the leak and the gas pressure decide how fast a potentially dangerous concentration is reached. A leak occurring indoors will reach a dangerous level much faster than a leak outdoors. In outdoor installations the leaking gas will simply dilute or drift away with the wind before it is picked up by any gas detector.

The ultrasonic (acoustic) gas leak detectors do NOT detect ppm level or LEL level - instead it detects the ultrasound generated by the escaping gas. The ultrasonic sound is proportional to the leak rate (mass flow rate), meaning that the higher leak rate (large leak), the more ultrasound is generated from the leak. The ultrasound from the leak is not affected by the wind or dilution, and thus the ultrasonic gas leak detection technology is very reliable in outdoor installations.

In the oil/gas industry hydrocarbon gas leaks have been divided into the following categories:
Minor release: 0.1 kg/sec and duration 2 min
Significant release: 0.1-1 kg/sec and duration 2-5 min
Major release: > 1 kg/sec and duration > 5 min
The Gas-sonic acoustic gas leak detectors are designed to detect hydrocarbon gas leaks at a leak rate of 0.1 kg/s at a distance up to 20 meters from the leak source.

V. POWER SUPPLY UNIT DESCRIPTION

A. Introduction

A RPS (Regulated Power Supply) is the Power Supply with Rectification, Filtering and Regulation being done on the AC mains to get a Regulated power supply for Microcontroller and for the other devices being interfaced to it.

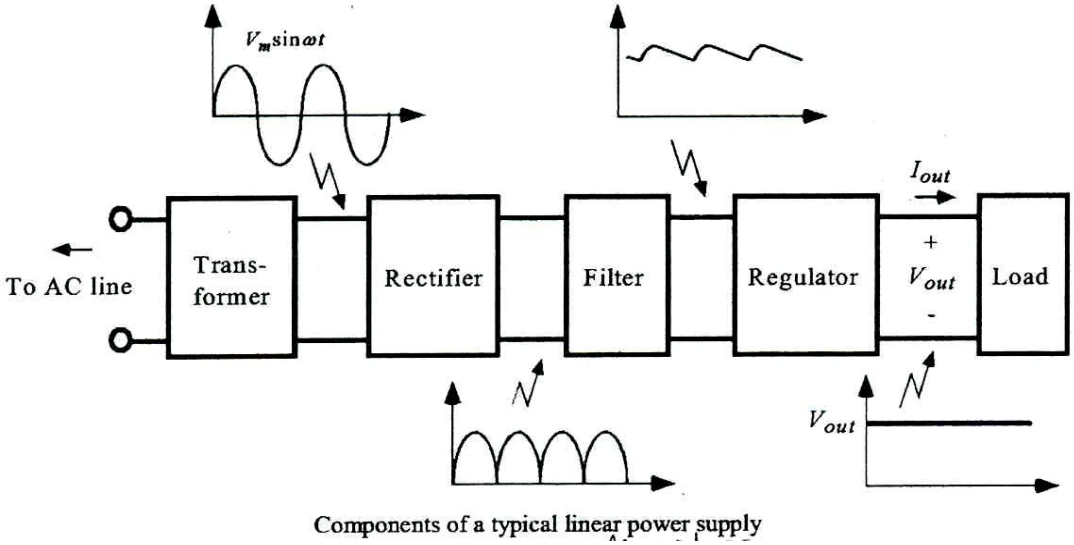

Fig 5.1: Block Diagram of the Power Supply

B. Transformer

A transformer is an electrical device which is used to convert electrical power from one Electrical circuit to another without change in frequency. Transformers convert AC electricity from one voltage to another with little loss of power. Transformers work only with AC and this is one of the reasons why mains electricity is AC. Step-up transformers increase in output voltage, step-down transformers decrease in output voltage. Most power supplies use a step-down transformer to reduce the dangerously high mains voltage to a safer low voltage. The input coil is called the primary and the output coil is called the secondary. There is no electrical connection between the two coils; instead they are linked by an alternating magnetic field created in the soft-iron core of the transformer. The two lines in the middle of the circuit symbol represent the core. Transformers waste very little power so the power out is (almost) equal to the power in. Note that as voltage is stepped down current is stepped up. The ratio of the number of turns on each coil, called the turn's ratio, determines the ratio of the voltages. A step-down transformer has a large number of turns on its primary (input) coil which is connected to the high voltage mains supply, and a small number of turns on its secondary (output) coil to give a low output voltage.

Fig 5.2: An Electrical Transformer

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Turns ratio = $Vp/ V_S = Np/N_S$
Power Out= Power In
V_S x I_S=V_P x I_P
Vp = primary (input) voltage
Np = number of turns on primary coil
Ip = primary (input) current

C. Rectifier

A circuit which is used to convert a.c to dc is known as RECTIFIER. The process of conversion a.c to d.c is called "rectification".

Types of Rectifiers

1. Half wave Rectifier
2. Full wave Rectifier
   (i). Centre tap full wave rectifier.
   (ii). Bridge type full bridge rectifier.

Table: Comparison of Rectifier Circuits

Parameter	Type of Rectifier		
	Half wave	Full wave	Bridge
Number of diodes	1	2	4
PIV of diodes	Vm	2Vm	Vm
D.C output voltage	Vm/ π	$2Vm/ \pi$	$2Vm/ \pi$
Vdc, at no-load	0.318Vm	0.636Vm	0.636Vm
Ripple factor	1.21	0.482	0.482
Ripple frequency	f	2f	2f
Rectification efficiency	0.406	0.812	0.812
Transformer Utilization Factor (TUF)	0.287	0.693	0.812
RMS voltage Vrms	Vm/2	$Vm/\sqrt{2}$	$Vm/\sqrt{2}$

Full-wave Rectifier
From the above comparison we came to know that full wave bridge rectifier as more advantages than the other two rectifiers. So, in our project we are using full wave bridge rectifier circuit.

D. Filter

A Filter is a device which removes the a.c component of rectifier output but allows the d.c component to reach the load

Capacitor Filter
We have seen that the ripple content in the rectified output of half wave rectifier is **121%** or that of full-wave or bridge rectifier or bridge rectifier is **48%** such high percentages of ripples is not acceptable for most of the applications.

Ripples can be removed by one of the following methods of filtering.

(a) Various combinations of capacitor and inductor, such as L-section filter section filter, multiple section filter etc. which make use of both the properties mentioned in (a) and (b) above.

To calculate the value of capacitor(C),

$$C = ¼*\sqrt{3}*f*r*Rl$$

Where,

f = supply frequency,
r = ripple factor,
Rl = load resistance

Note: In our circuit we are using 1000µF hence large value of capacitor is placed to reduce ripples and to improve the DC component.

E. Regulator

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 ('overload protection') and overheating ('thermal protection'). Many of the fixed voltage regulators ICs have 3 leads and look like power transistors, such as the 7805 +5V 1A regulator shown on the right. The LM7805 is simple to use. connect the negative lead to the Common pin and then when you turn on the power, you get a 5-volt supply from the output pin.

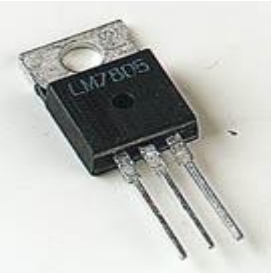


Fig 5.3: A Three Terminal Voltage Regulator

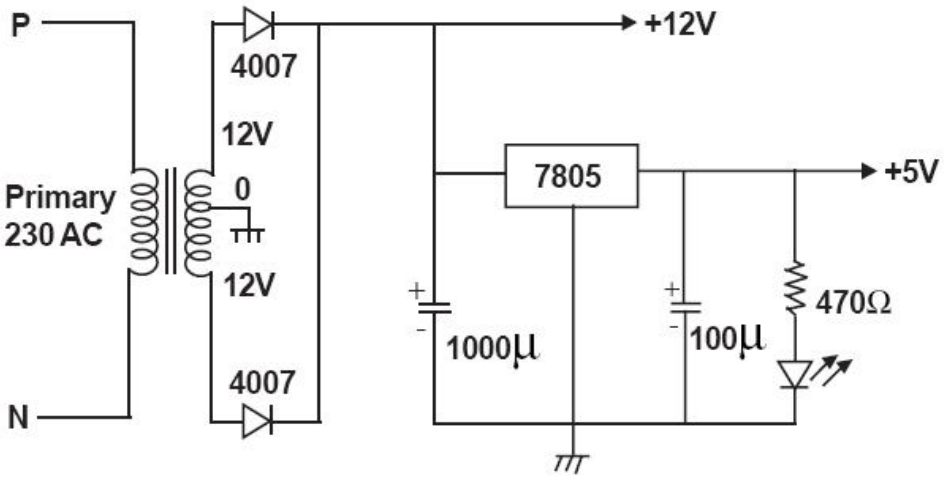


Fig 5.4: Circuit Diagram of Power Supply is shown below:

VI. DESCRIPTION ABOUT IR SENSORS

The applications and advantages of infrared sensors are many; mostly these devices are utilized for various types of security systems by implementing proximity detection theme. In any concept, the proximity detection package contains two devices, namely infrared light emitting diode (IR LED) and infrared light/signal detector (IR sensor). The IR LED is always ON, meaning that this device is constantly emitting light and the sensor is detecting this light. The sensors can be interfaced with trigger circuit to generate logic high/low pulses depending up on the interruptions created by any object.

A. The Following are the Few Applications

1) Proximity Sensor: Generally, proximity sensors are used for counting the objects or for counting the revolutions of a low speed running motor. These sensor packages are readily available in the market; each package contains IR LED and IR sensor. Different sensors are available to suit the requirement, the main criteria is range, as the range increases power consumption of the device also increases. Battery operated sensors range is very less, often less then 10 centi-meters. This type of sensors can be used for constructing the digital tacho-meters.
2) *Object Detection using IR Light:* To prove the concept practically, as shown in the figure, we required 2 simple IR LED's, and they must be arranged side by side to pick-up the reflected IR light. For detecting the reflected IR light, a very simple technique is used by using another IR-LED.

As per the following figure, the infrared signal delivered from one LED hits the object and it is reflected, another infrared LED detects the reflected signal. The signal strength depends up on the current that is passing through the infrared LED; signal strength can be defined as radiating power, which is measured in mill watts.

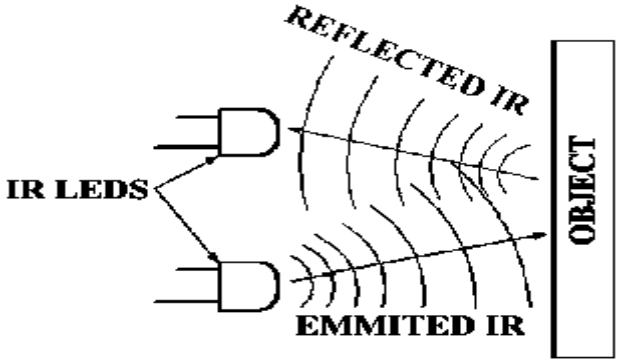


Fig 6.1

The infrared signal detector circuit is designed with Op-Amp which can detect very minute voltage changes also accurately.

- *Wheel Encoder:* The wheel encoder can be used many applications, it can be used as revolutions counter, running speed can be displayed, and distance traveled also can be displayed. To achieve this, the wheel must be arranged with block and white colour packets.
- *Contact-Less Tachometer:* Many commercial contact-less tachometers are designed with infrared sensors because of their cost effectiveness.
- *Contact less Obstacle Detection:* In this design, which is oriented to obstacle detection in robots, our primary target is to reach high ranges, from 25 to 35 cm, depending on ambient light conditions. Increasing the current flowing in the LED extends the range of the sensor.

B. Basics of IR Transmitter

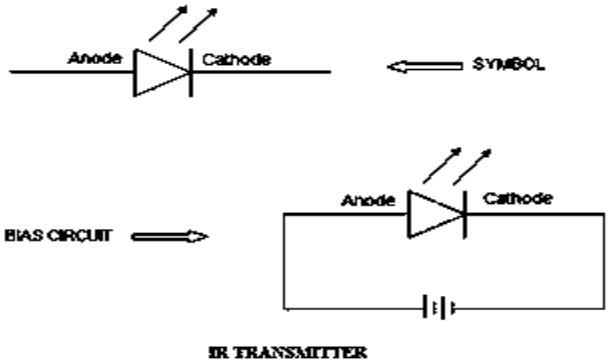


Fig 6.2

C. Basics of IR Receiver

Use of Infrared Detectors Basics

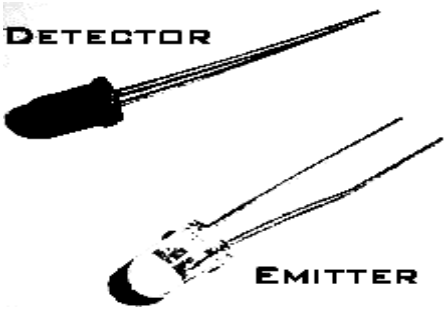
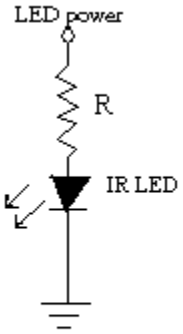
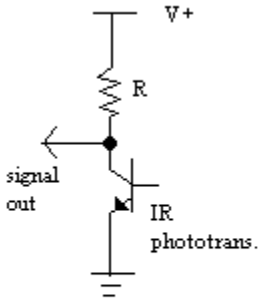


Fig 6.3

IR emitter and IR phototransistor

This voltage is measured as the output of the device



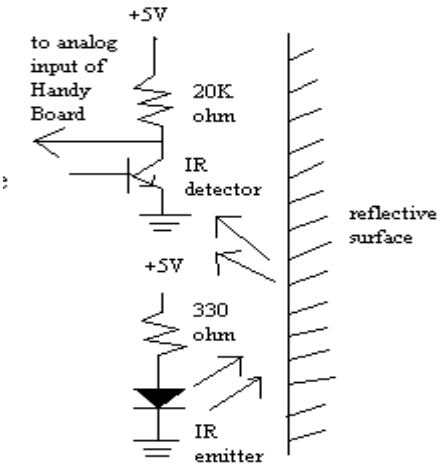


An IR emitter

An IR phototransistor

Fig 6.4

Fig 6.5



Circuit diagram of a infrared reflectance sensor.

Fig 6.6

One of such applications is the line follower of a robot.

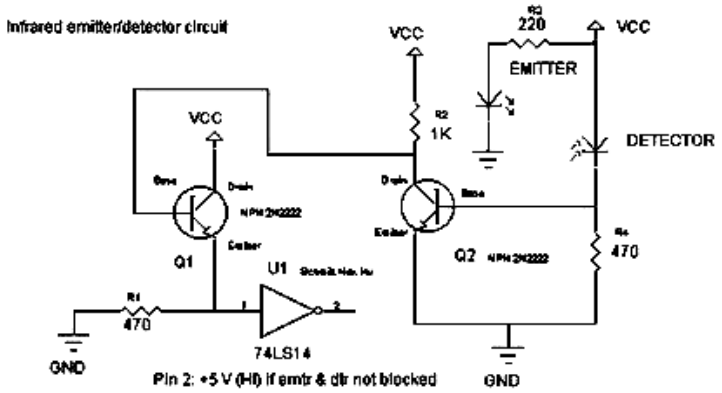


Fig 6.7 : Schematic Diagram for a Single Pair of Infrared Transmitter and Receiver

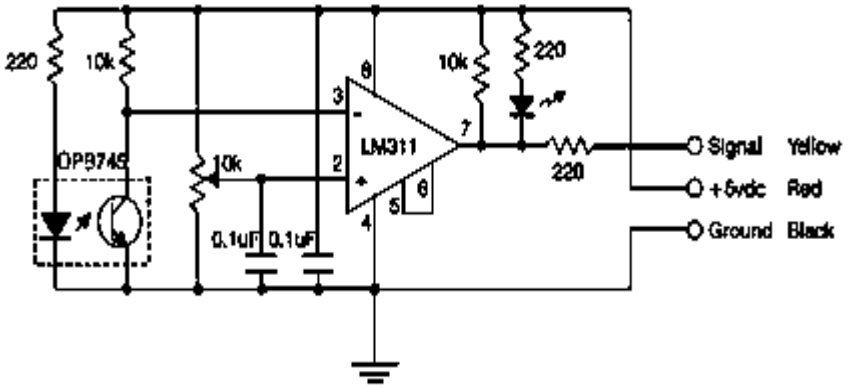


Fig 6.8 : Description of operation of a typical circuit

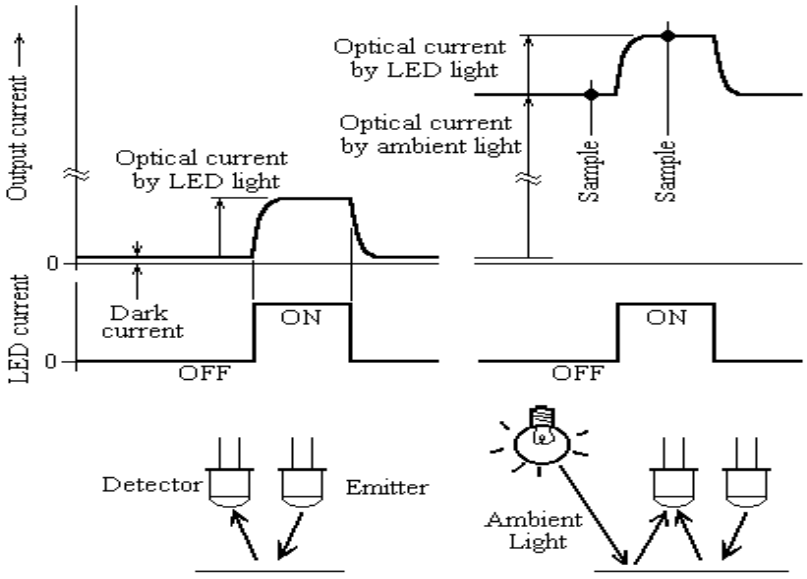


Fig 6.9

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D. Remote Control Application

The term remote control can be also referred to as "remote" or "controller" when abbreviated. It is known by many other names as well, such as clicker.

VII. BRIEF DESCRIPTION ABOUT RELAYS

A. Introduction

It can be described in a broad sense, a form of an electrical amplifier.

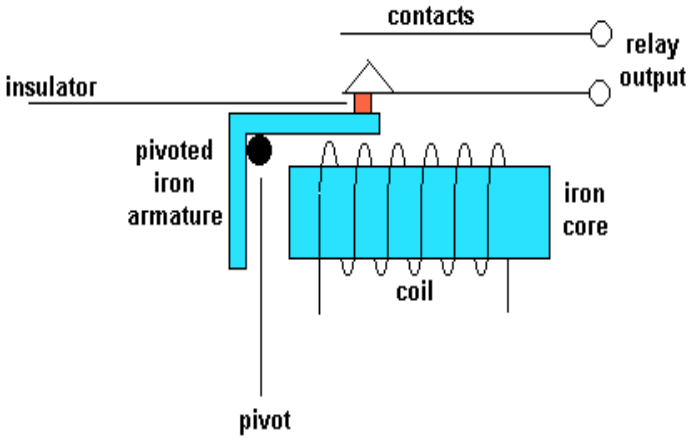

Fig 7.1

Relay: Relays are usually SPDT (single pole double through switch) or DPDT (double pole double through switch) but they can have many more sets of switch contacts.

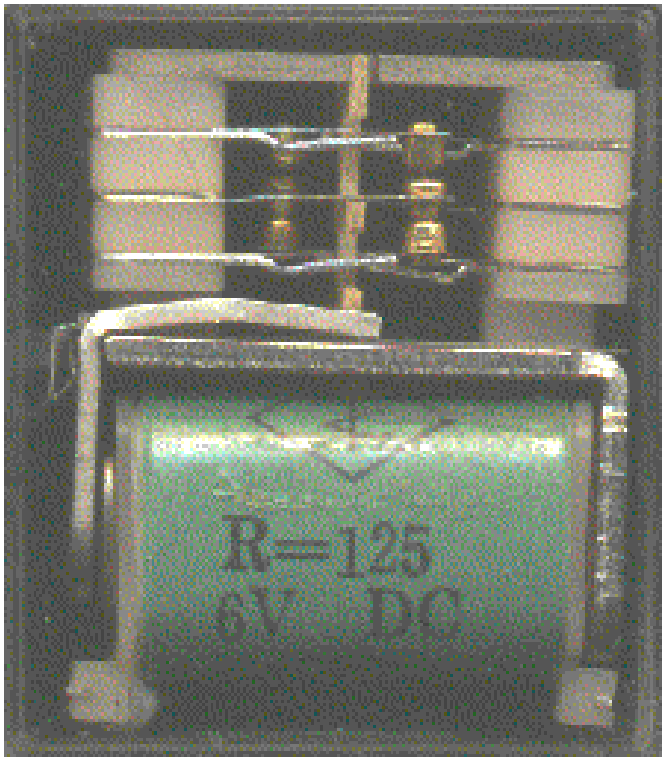

Fig 7.2

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B. Basic Operation of a Relay

An electric current through a conductor will produce a magnetic field at right angles to the direction of electron flow. If that conductor is wrapped into a coil shape, the magnetic field produced will be oriented along the length of the coil. The greater the current, the greater the strength of the magnetic field, all other factors being equal.

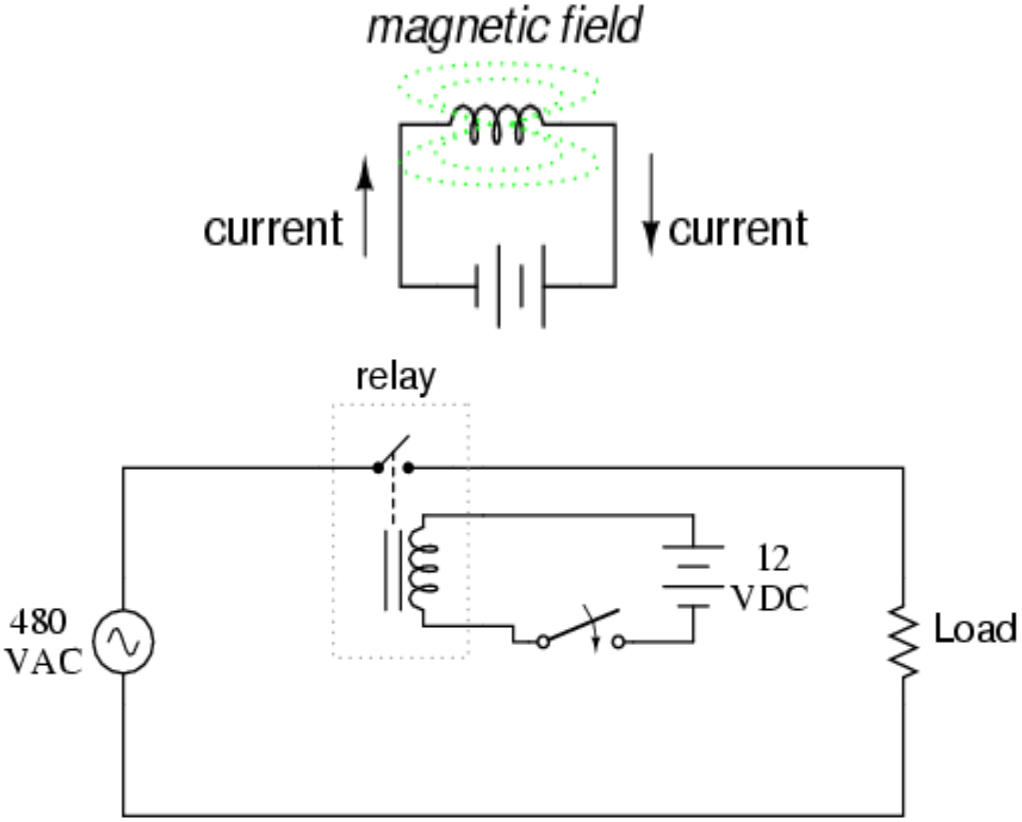

Fig 7.3 : Relay circuit

C. Applications

- To control a high-voltage circuit with a low-voltage signal, as in some types of modems or audio amplifiers,
- To control a high-current circuit with a low-current signal, as in the starter solenoid of an automobile,
- To detect and isolate faults on transmission and distribution lines by opening and closing circuit breakers (protection relays),
- To isolate the controlling circuit from the controlled circuit when the two are at different potentials, for example when controlling a mains-powered device from a low-voltage switch. They may also be controlled by room occupancy detectors in an effort to conserve energy.
- To perform logic functions. For example, the boolean AND function is realized by connecting NO relay contacts in series, the OR function by connecting NO contacts in parallel. The change-over or Form C contacts perform the XOR (exclusive or) function. Similar functions for NAND and NOR are accomplished using NC contacts. The Ladder programming language is often used for designing relay logic networks.
    - Early computing. Before vacuum tubes and transistors, relays were used as logical elements in digital computers. See ARRA (computer), Harvard Mark II, Zuse Z2, and Zuse Z3.
    - Safety-critical logic. Because relays are much more resistant than semiconductors to nuclear radiation, they are widely used in safety-critical logic, such as the control panels of radioactive waste-handling machinery.

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RELAY:

A Relay is a device that opens or closes an auxiliary circuit under some pre-determined condition in the Main circuit. The object of a Relay is generally to act as a sort of electric magnifier, that is to say, it enables a comparatively week current to bring in to operation on a much stronger current. It also provides complete electrical isolation between the controlling circuit and the controlled circuit.

Specifications:

(1) Coil resistance	:	100Ω to 500Ω
(2) Operating voltage	:	6V to 24V DC
(3) No. of contacts	:	1 to 4 change over
(4) Contact current Rating	:	1.5 to 25 Amps

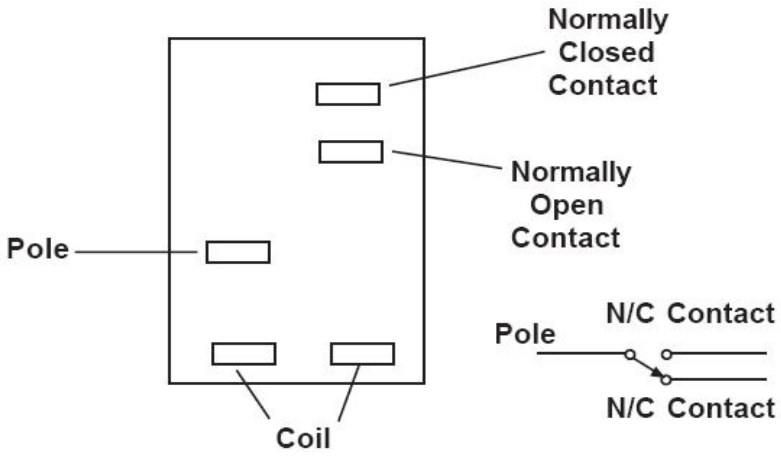

Fig 7.4

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VIII. HARDWARE DETAILS

The following are the web sites that can be browsed for collecting the data sheets.

1) www. Texas Instruments.com
2) www. National semiconductors.com
3) www. Fairchild semiconductors.com

The following are the IC's and other important components used in this project work

- 89C51 Microcontroller Chip
- LM 567 Tone Decoder IC
- TGS 813 Gas Sensor
- LM 324 Quad Op – Amp
- Voltage Regulator
- BC 547 NPN Transistor
- BC 557 PNP Transistor
- Relay

IX. SOFTWARE DESCRIPTION

In our project we used software that is Keil micro vision for the simulation of the program.

A. Keil Software

Keil development tools for the 8051 Microcontroller Architecture support every level of software developer from the professional applications engineer to the student just learning about embedded software.
The industry-standard Keil C Compilers, Macro Assemblers, Debuggers, Real-time Kernels, Single-board Computers, and Emulators support all 8051 derivatives and help you get your projects completed on schedule.

B. Simulation

The µVision Simulator allows you to debug programs using only your PC using simulation drivers provided by Keil and various third-party developers. A good simulation environment, like µVision, does much more than simply simulate the instruction set of a microcontroller — it simulates your entire target system including interrupts, startup code, on-chip peripherals, external signals, and I/O.

X. CONCLUSIONS

The project work intended to control the tunnel lights automatically depending up on the flow of traffic is quite useful for electricity department. By implementing this kind of control systems every where in the tunnels energy can be saved considerably. Generally conventional energy supplied by the electricity department is used for lighting the tunnel lights.
For this purpose, non-conventional energy resources can be utilized effectively, in this regard solar energy is the dependable energy resource, the excess energy available from the Sun can be stored into a big tank designed with batteries and it can be utilized in the nights.
Inside the tunnel maintaining the constant light intensity is another important factor, in many tunnel's luminance methods are implemented, it is nothing but measuring the light intensity. Measurement of light intensity is an important management for many applications. Generally, the light intensity is measured in Lux or Lumens, in some places it is measured in Foot candles also, Lux is the popularly known unit, and therefore the light measuring instrument can be called as "LUX METER". In addition, the gas sensor is used to identify the level of exhaust (toxic) gases and pumps outside using the exhaust fan. An alarm can be used as an acknowledgement that the gas levels have been increased and using wireless networking system the information can be passed to the nearby monitoring station (traffic control room, etc).

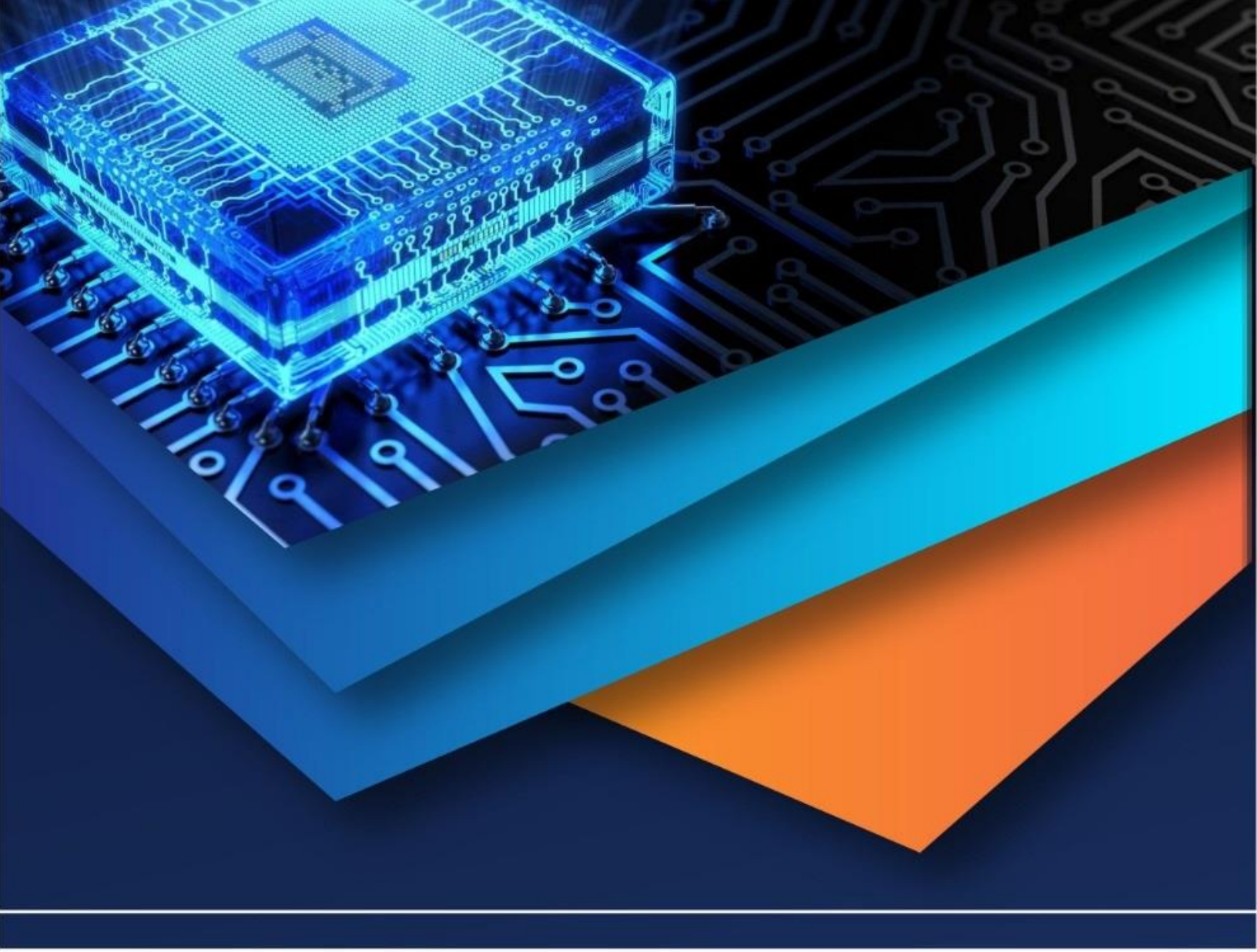
REFERENCES

The maximum information related to the tunnel lighting theory is availed from different websites. Depending up on this information the hardware as well as software is developed, while designing the microcontroller unit, the following are the books related to the microcontrollers referred.

Text Books
[1] Linear Integrated Circuits – By: D. Roy Choudhury, Shail Jain
[2] Digital Electronics. By JOSEPH J. CARR
[3] Relays and their applications - By: M.C. SHARMA
[4] Op-Amps Hand Book - By: MALVIND
[5] The concepts and Features of Micro-controllers - By: Raj Kamal
[6] The 8051 Micro-controller Architecture, programming & Applications - By: Kenneth J. Ayala
[7] Programming and Customizing the 8051 Micro-controller - By: Myke Predko

Catalogs
[1] TEXAS - LINEAR IC's manual
[2] SIGNETICS - DIGITAL IC's manual

Journals:
[1] Electronic Design
[2] Electronics for you
[3] Electronics Text.
[4] Practical Electronics



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