



SAFETY MEASURES IN AUTOMOBILES

A PROJECT REPORT

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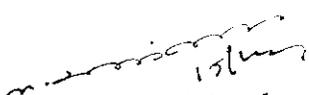
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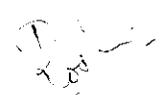
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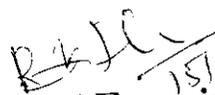
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ABSTRACT

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A recent survey has found that a lot of unusual deaths occur due to road accidents. One of the main reason being careless driving which mainly includes drowsiness felt by drivers due to long journeys. Also accidents, due to overturn of heavy vehicles at sharp bends is a common cause. In order to avoid this and to ensure human safety, a project model is implemented which detects drowsiness and also prevents heavy vehicle roll-over. Our project includes two safety systems embedded in it. Drowsiness detection system provides monitoring of drowsiness felt by the driver in long journeys to take necessary control action and also Stability control System for preventing roll-over of Heavy Vehicles at sharp bends.

The domain of project model is Embedded Systems using PIC Microcontroller (16F877). The drowsiness is detected by the number of blinks of the eye. In overturn system, variable parameters like speed, load and wheel turning radius are measured to control speed of vehicle in sharp bends.

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INTRODUCTION

1. INTRODUCTION

Now-a-days a lot of road accidents occur. These accidents are due to several reasons. The National Sleep Foundation reports that drowsy-driving accidents cause 1,550 unnecessary deaths, 71,000 injuries, and \$12.5 billion in property losses and lost productivity every year. The number of deaths per year per 10000 motor vehicle in India is 10 to 15 times more than that in advance countries. Falling asleep at the wheel causes more than 100,000 car crashes per year. The most common harmful outcomes of ROR crashes were overturning (40%) and fixed object impacts (30%). SUV's were found to have the highest rollover rates. Large vans and compact pickup trucks also had higher than average rollover rates, with high rates of tire tread separation and tire blowouts in the SUV rollovers. Overall, approximately 45% of the rollovers were tripped by grass or soft soil.

1.1 CAUSES FOR ROAD ACCIDENTS

The Federal Motor Carrier Safety Administration (FMCSA), the trucking industry, highway safety advocates, and transportation researchers have all identified driver drowsiness and overturn of heavy vehicles as a high priority commercial vehicle safety issue. Long hours behind the wheel in monotonous driving environments make truck drivers particularly prone to drowsy-driving crashes decreasing an individual's ability to operate a vehicle safely and increasing the risk of human error that could lead to fatalities and injuries.

Another major reason for the accidents includes the over-turn of heavy vehicles in sharp bends. Truck accidents, even minor ones, may well be severe in nature due to the large size and weight of the vehicles involved. This also leads to a lot of unusual number of road accidents.

The main causes for drowsiness include: Sleep loss, Driving patterns, including driving between midnight and 6 a.m.; driving a substantial number of miles each year and/or a substantial number of hours each day; driving in the mid-afternoon hours (especially for older persons); and driving for longer times without taking a break. Use of sedating medications, especially prescribed anxiolytic hypnotics, tri-cyclic antidepressants, and some antihistamines. Untreated or unrecognized sleep disorders, especially sleep apnea syndrome (SAS) and narcolepsy. Consumption of alcohol, which interacts with and adds to drowsiness. **Sleepy drivers exhibit certain observable behaviors, including eye gaze, eyelid movement, pupil movement, head movement, and facial expression etc.,**

Substantial numbers of run off the road (ROR) crashes occurred on rural limited access facilities, involving Alcohol, speed, and abrupt steering input (including overcorrection and evasive manoeuvres) driver inattention or impairment, improper freight handling or loading of the load jackknifed tractor trailer rig. A truck may experience the trailer jackknifing for a variety of reasons. leading to loss of control, overturning or sliding into other vehicles are the most common driver-contributing factors in all ROR crashes.

1.2 NECESSITY FOR SAFETY MEASURES

The above factors have cumulative effects; a combination of them substantially increases accidental risk. To reduce the accidents and to ensure human safety, safety measures has to be taken.

An ordinarily available system for drowsiness detection is using ECG, EEG, and image processing systems. These systems are not accurate, costlier and electrodes has to be placed in the hands and legs of the driver while driving which will be highly uncomfortable. So a model is implemented where the drowsiness of the driver is detected and indicated so as to awake the driver.

In our model, the number of eye blinks is calculated for a particular time using the IR principle and the drowsiness is detected. For overturning of heavy vehicles, parameters like load carried by the vehicle, turning radius of the vehicle and speed are considered. If these parameters cross a certain limit, then the speed of the vehicle is reduced.

OVERVIEW

2. OVERVIEW

2.1 BLOCK DIAGRAM

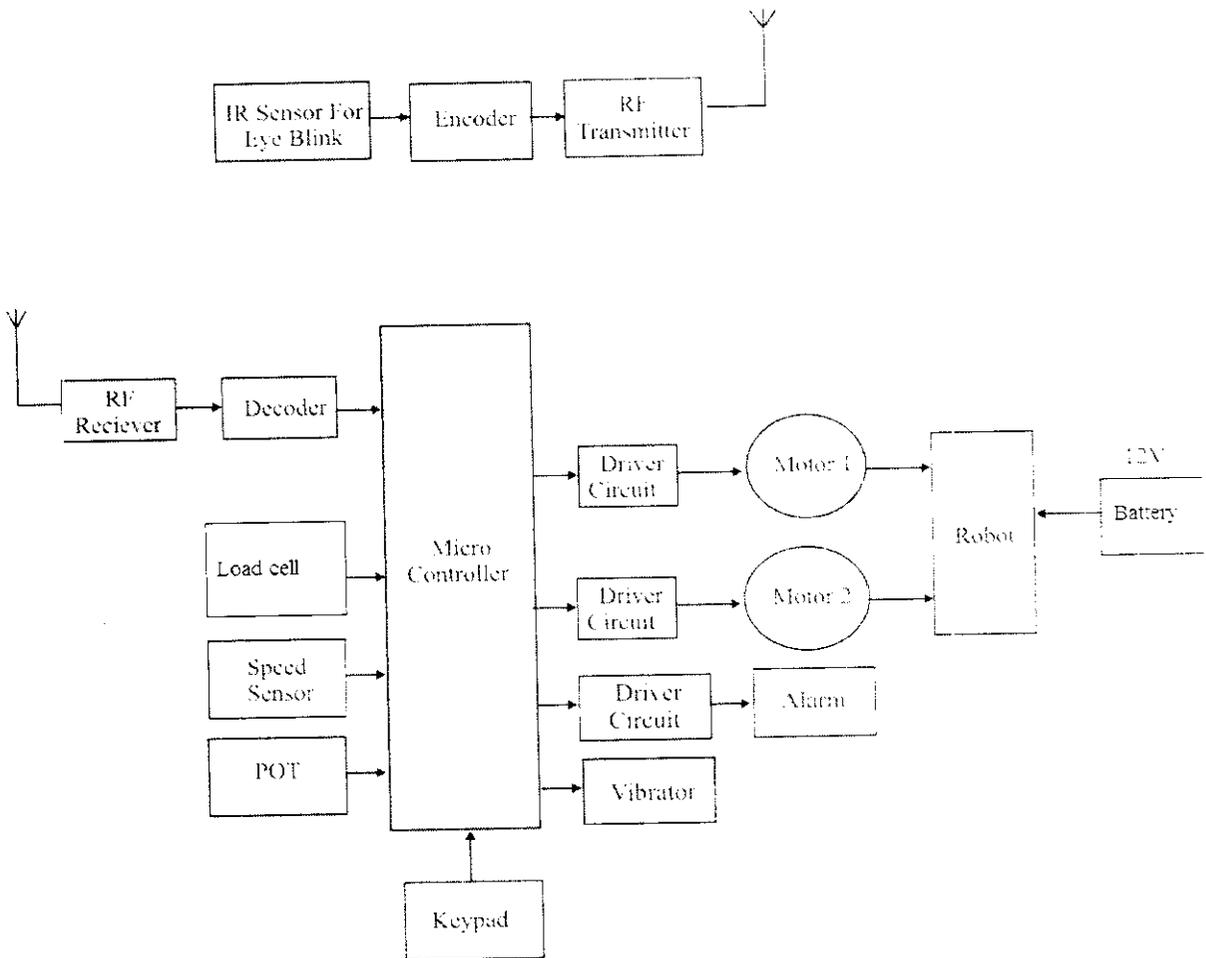


Figure 2.1 BLOCK DIAGRAM

This block diagram includes two modules.

- drowsiness detection module
- overturn stability control module.

For Drowsiness detection, the IR sensor is used. The drowsiness detection system comprises of a wireless spectacles (specs with inbuilt drowsiness detecting circuit using IR sensor) to be worn during driving. The idea behind the model is the number of eye blinks per minute is monitored using IR radiation reflection concept. The IR sensor consists of an IR transmitter and IR receiver. The characteristic wavelength of IR radiation is about 700 nm. The IR transmitter transmits this radiation which is received by the IR receiver and reflected back. When the transmitted IR radiation is reflected back by eye pupil, then there is no eye blink. But, when there is eye blink the radiation reflection is cut off. Thus, output from inbuilt circuit indicates number of counts in digital pulse form. The normal eye blinks vary between 25 to 30 counts PER minute. The sensor is connected to the encoder which is connected to the RF transmitter. This transmits the pulse generated and is received by the RF receiver. The output received is decoded and given to the microcontroller. When the count of eye blink is less than 25 blinks per minute then, the microcontroller is programmed to give an alarm and switch on seat vibrator belt which is driven by the relay (driver circuit) . This model effectively overcomes the disadvantages of wiring and high cost of other methods for drowsiness detection.

In case of prevention system for Over-turn of heavy vehicles model, three essential parameters are measured which are wheel speed, turning radius of wheel and load of the vehicle. To prevent roll-over of heavy vehicles, the speed of vehicle is reduced in sharp bends correspondingly. The wheel speed is measured

using a proximity sensor. The load measurement is done using a load cell. And, the turning radius of wheel is obtained from a potentiometric arrangement. The microcontroller is programmed such that to reduce the speed of the vehicle by comparing with the nominal values given. The model is operated by the keypad circuit. Two motors are attached to vehicle wheel which is driven by the relay circuit.

DROWSINESS MEASUREMENT

3. DROWSINESS MEASUREMENT

3.1 INTRODUCTION

Drowsiness felt during driving can be detected using IR radiation principle. Normally, human blink rate varies from (11 to 15) per 30 secs. The drowsiness is sensed by counting number of eye blinks per 30 secs using IR radiation.

3.2 IR RAYS

IR rays is part of electromagnetic spectrum associated with energy levels. It has some special property such as reflection phenomena. IR radiations are generated by vibration and rotation of molecules within a material whose temperature is above absolute zero. Physical matters emit IR rays, in accordance with black body radiation laws and emissivity. Many IR sources emit continuum of wavelengths. Various IR ranges are: IR A (700nm-1400nm), IR B (1400nm-3000nm) and IR C (3000nm-1).The wavelength of maximum power is determined by

Maximum wavelength = $(2898/\text{Temperature in K})$.

The graph emission of optical radiation from black bodies at various temperatures tells about various properties of IR radiation.

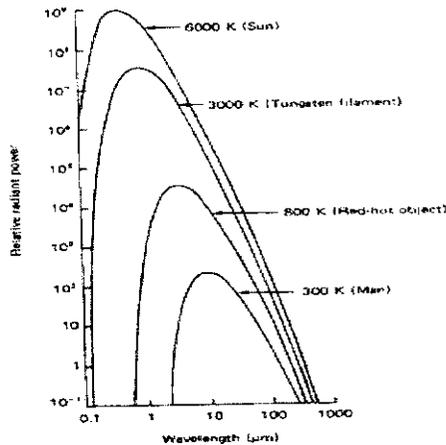


Figure 3.1 OPTICAL RADIATION AT VARIOUS TEMPERATURES

3.3 IR SOURCES

The three basic types of infrared sources: light emitting diodes (LEDs), thermal sources and tuneable diodes. Light-emitting diodes (LED) are PN junction devices that give off light radiation when biased in the forward direction. Important property specifications to be considered in LED include LED type, peak wavelength, viewing angle, optical power output, luminous intensity, forward current, and forward voltage. Thermal sources contain a heat source that can deliver a heat flux, at a distinct temperature, into a sample. They are often combined with a calorimeter, a temperature-measuring device that can read the resultant change in temperature. Tuneable diodes are infrared sources that can be adjusted to emit one of several different wavelengths. An infrared lamp is an infrared light source that consists of a high-power incandescent lamp that emits infrared (IR) radiation.

3.4 IR DETECTORS

An **infrared detector** is a photodetector that reacts to infrared (IR) radiation. The two main types of detectors are thermal and photonic. The thermal effects of the incident IR radiation can be followed through many temperature dependent phenomena. Bolometers and microbolometers are based on changes in resistance. Thermocouples use the thermoelectric effect. Golay cells follow thermal expansion. The response time and sensitivity of photonic detectors can be much higher, but usually these have to be cooled to cut thermal noise. Incident IR photons can cause electronic excitations. In photoconductive detectors, the resistivity of the detector element is monitored. Photovoltaic detectors contain a p-n junction on which photoelectric current appears upon illumination.

3.5 IR REFLECTION PRINCIPLE

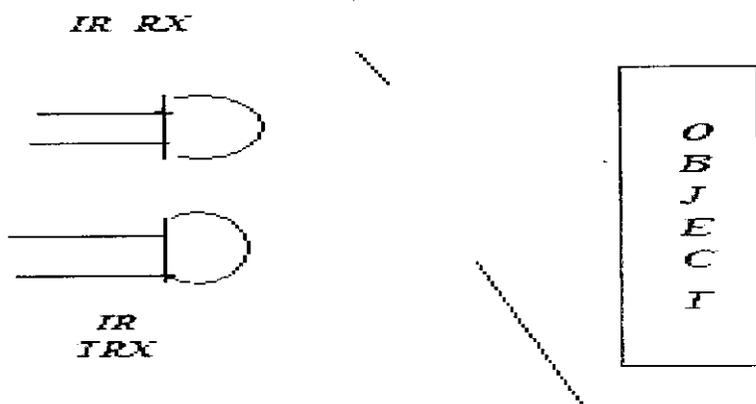


Figure 3.2 IR REFLECTION PRINCIPLE

A Spectacle has to be worn while driving to avoid drowsiness. The spectacle has IR sensing circuit working on IR reflection principle. The diagram above shows IR reflection principle. IR transmitter is IR Light Emitting diode acting as source of IR radiations. IR receiver is Indium Gallium Arsenic (InGaAs) Photodiode with spectral power of (0.7nm-0.9nm). Both IR LED and IR photodiode are in same line.

When IR LED emits IR radiations due to electron excitation of PN diode. Due to reflection from object (ie eye pupil) IR photodiode starts to conduct. Whereas, when there is any block between IR LED and object the reflection of IR radiation is cut off. Thus, now IR photodiode does not conduct. Based on this, number of eye blinks per 30 seconds is measured from IR sensing circuit with comparator.

3.6 IR SENSING CIRCUIT

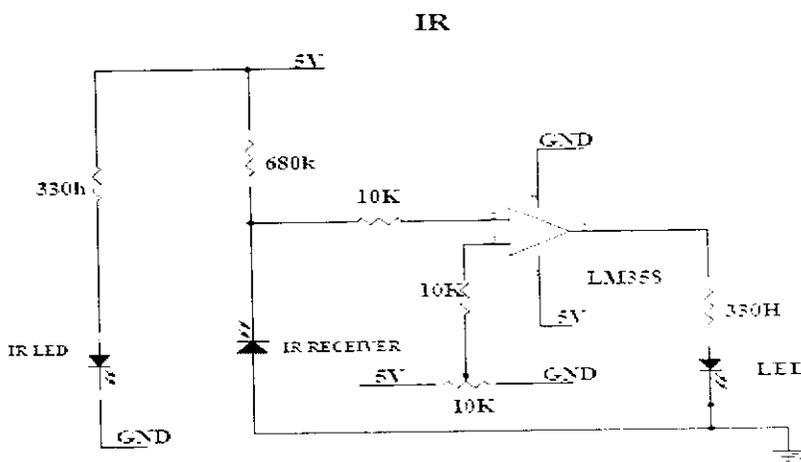


Figure 3.3 IR SENSING CIRCUIT

Infrared transmitter is one type of LED, which emits infrared rays. Similarly IR Receiving photodiode is used to receive the IR rays transmitted by the IR transmitter. Both IR transmitter and receiver should be placed straight line to each other.

The transmitted signal is given to IR transmitter whenever the signal is high. the IR transmitter LED is conducting it passes the IR rays to the receiver. The IR receiver is connected with comparator. The comparator is constructed with LM 358 operational amplifier. In the comparator circuit the reference voltage is given to inverting input terminal. The non inverting input terminal is connected IR receiver. When the IR rays are interrupted between the IR transmitter and receiver. the IR receiver is not conducting. So the comparator non inverting input terminal voltage is higher than inverting input. Now the comparator output is in the range of +5V (ie) the output is digitally "1". When there is no interrupt the IR rays undergo reflection from black pupil. The output is digitally "0". Thus, binary eye blink pulses are generated.

3.7 SPECIFICATIONS OF IR SENSING CIRCUIT

3.7.1 LM358 SPECIFICATIONS

The reasons for choosing the LM358 comparator is

- 8 Pin chip
- Large DC voltage gain: 100 dB

The various other specifications are given below

FEATURES	MAX VALUE	UNIT
I/P offset voltage	7	mV
I/P offset current	50	nA
I/P bias current	250	nA
Supply voltage	3-30	V
Temperature	0-70	C

Table 3.1 SPECIFICATIONS OF LM 358

3.7.2 FEATURES OF LED

Wavelength=700nm- 940 nm ,Chip material =InGaAs with AlGaAs window

Package type: T-1 3/4 (5mm lens diameter)

Matched Photosensor: QSD122/123/124 ,Medium Emission Angle :40°

High Output Power ,Package material and color : Clear, untinted, plastic

3.7.3 FEATURES OF PHOTODIODE

Reverse Voltage, V_R : 30V

Power Dissipation, PD : 100mW

Operating Temperature range, T_{opr} :. -30° to +85°C

3.8 DROWSINESS CONTROL

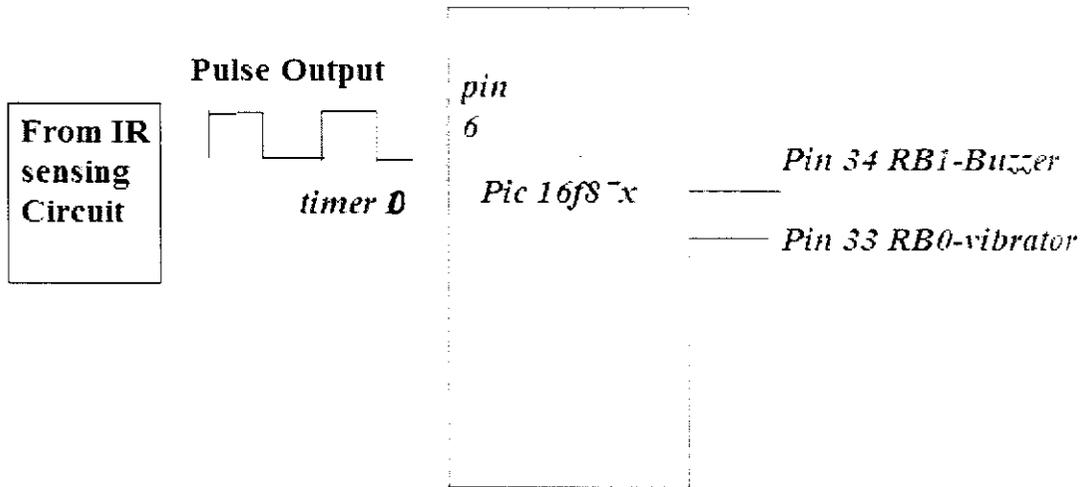


Figure 3.4 DROWSINESS CONTROL

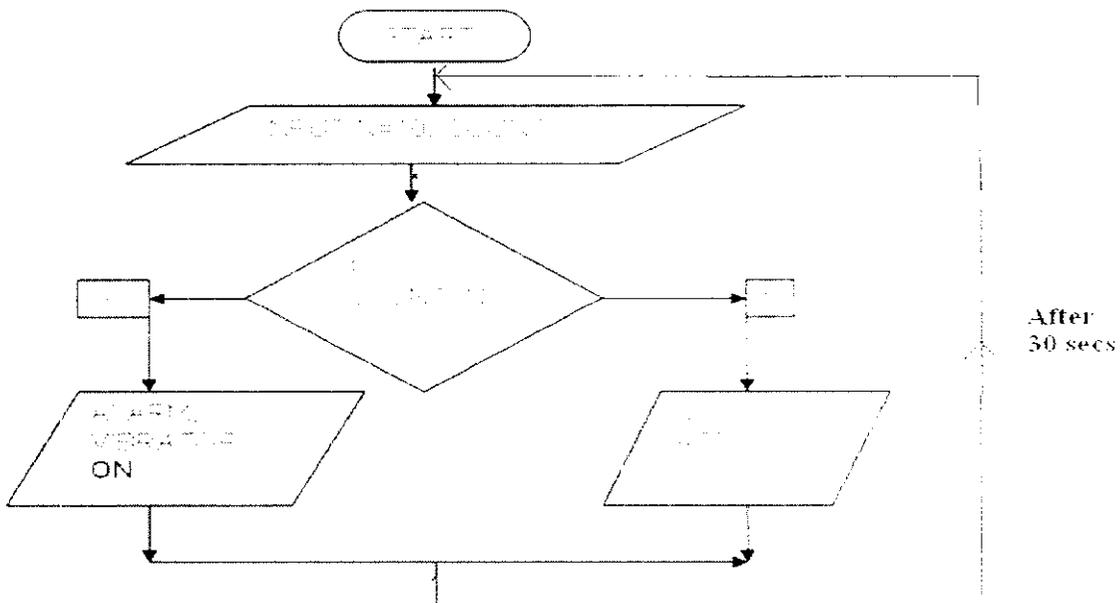
The eye blink pulses from IR sensing circuit is given to port A I/O pin of PIC Microcontroller (16f877). PIC Microcontroller has inbuilt timer in it, which would generate reset pulse after programmed time delay. The inbuilt timer is given input clock pulses in sixth pin of microcontroller.

The number of eye blink pulses counted for 30 seconds is found. The obtained eye blink rate is compared with normal rate to take action. If drowsiness is felt then, the microcontroller triggers up the buzzer and alarm circuit. The buzzer and vibration belts are connected to pins 32 and 33 of output port B in PIC microcontroller. This prevents the driver from falling asleep during driving. Thus controlling the road accidents to an extent.

3.9 ALGORITHM

1. Initialize Normal eye blink rate $N=10$ counts/30secs ;
2. Get the number of eye blinks (Count) value for every 30 seconds ;
3. Compare Count value with normal eye blink rate ;
4. If Count is less than N, then the alarm circuit and the vibrator belt is switched on ;
5. Else , no action is taken ;
6. The output from IR sensor is digital pulses ;
7. Timer is programmed such that it gets reset after every 30 seconds and then starts again from step1.

3.10 FLOWCHART



3.11 EXPERIMENTAL RESULT

No of blinks	Alarm	LED	Vibrator
5	ON	ON	ON
8	ON	ON	ON
14	OFF	OFF	OFF
18	OFF	OFF	OFF

Table 3.2 EXPERIMENTAL RESULT

OVERTURN STABILITY CONTROL

4. OVERTURN STABILITY CONTROL

4.1 WHEEL TURNING RADIUS MEASUREMENT

4.1.1 POTENTIOMETER

A potentiometer is a resistor with three terminals, two that are fixed and one that slides, forming an adjustable voltage divider. When one of the fixed terminals of the potentiometer is used along with the sliding terminal, the resistance provided by the resistor is variable. When the position of the sliding terminal is connected to an outside object, the motion of that object changes the position of the sliding terminal, also called a wiper, and therefore the resistor value scales with position of the outside object. The resistive element of a potentiometer is often made from graphite to provide a low-friction electrical contact. Resistive elements can also be fabricated from a carbon/plastic material.

4.1.2 TYPES OF POTENTIOMETERS

Potentiometers can be used to measure both rotary displacement and linear displacement.

Rotary Displacement - Rotary potentiometers couple the input directly to the central shaft of the potentiometer, so one rotation of the input corresponds to one rotation of the wiper within the potentiometer. For multiple input rotations, the input can be geared to the central shaft, so that multiple input rotations equal one wiper rotation, or a helical resistive element can be used.

Linear Displacement - A string potentiometer uses the same internal component as a rotary potentiometer, but a string is wrapped around the central

shaft and spring loaded, so that extension and retraction of the string corresponds to a rotation of the central shaft. While most potentiometers have a linear relationship between input displacement and resistance, the resistive element can be designed such that the relationship is logarithmic.

4.1.3 POTENTIOMETER IN RADIUS MEASUREMENT

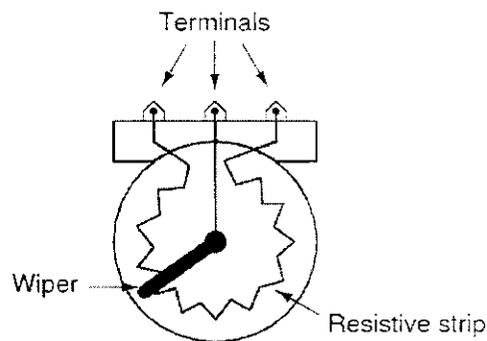


Figure 4.1 POTENTIOMETER

In this project, Rotary potentiometers are used to track the wheel turning radius. Rotary potentiometers are attached to the wheels shaft of the truck model. For input rotations, the input is geared to the central shaft. The Rotary Displacement is measured as follows: The turning path radius of the wheel corresponds to rotation made by the potentiometer's wiper arrangement. The sliding edge of potentiometer's wiper movement produces corresponding electrical output voltage with respect to wheel turning radius. The range potentiometer used is (0-10)Kohms corresponds to (0-5)V.

The experimented results of wheel turning radius measurement is listed in the table below:

POTENTIOMETER(in %)	Output Voltage (in V)
0	0
15	0.72
30	1.58
48	2.392
73	3.46
89	4.302
100	4.81

Table 4.1 EXPERIMENTAL RESULT FOR RADIUS MEASUREMENT

In real time applications, Potentiometer is operated along with Rack-and-Pinion arrangement. Rack and pinion concept and wheel alignment with respect to steering is explained below:

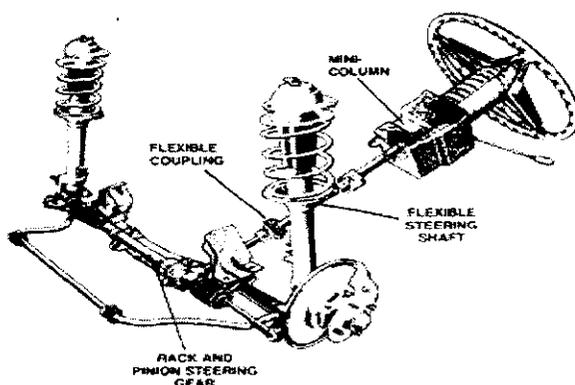


Figure 4.2 RACK AND PINION ARRANGEMENT

Rack-and-pinion steering is quickly becoming the most common type of steering on cars. The pinion gear is attached to the steering shaft. When you turn the steering wheel, the gear spins, moving the rack. The tie rod at each end of the rack connects to the steering arm on the spindle . A rack-and-pinion gear set is enclosed in a metal tube, with each end of the rack protruding from the tube. A rod, called a tie rod, connects to each end of the rack. The rack-and-pinion gear set does two things: It converts the rotational motion of the steering wheel into the linear motion needed to turn the wheels. It provides a gear reduction, making it easier to turn the wheels .On most cars, it takes three to four complete revolutions of the steering wheel to make the wheels turn from lock to lock. Potentiometer is connected to rack and pinion arrangement in real time applications. Therefore, turning radius can be measured automatically.

4.2 LOAD MEASUREMENT

4.2.1 LOAD CELL

Basically, a load cell is used in a measuring device to convert sensed mechanical forces into electrical signals. A typical load cell includes one or more force sensing elements, such as strain gages, which are configured as an electrical bridge circuit. Load cells are used to provide accurate measurements of compressive or tensile forces. Typically, the force creates a strain in the load cell, which is measured by strain gage transducers.

Load cells are widely used in scales designed to weigh large quantities, such as scales for weighing trucks, train cars, tanks, hoppers, or other large loads or machinery. The load cell is typically constructed with a mechanically-deformable sensor plate which operates as a force transducer. When a load is applied to such a

load cell, the sensor elements bonded to the sensor plate produce electrical signals which are proportional to the load applied to the load cell.

Proper selection of Load cell based on application is essential. The general classification of Load cell is as follows:

4.2.2 TYPES

Hydraulic load cells are force -balance devices, measuring weight as a change in pressure of the internal filling fluid. In a rolling diaphragm type hydraulic load cell, a load or force acting on a loading head is transferred to a piston that in turn compresses a filling fluid confined within an elastomeric diaphragm chamber. As force increases, the pressure of the hydraulic fluid rises. This pressure can be locally indicated or transmitted for remote indication or control. Output is linear and relatively unaffected by the amount of the filling fluid or by its temperature. If the load cells have been properly installed and calibrated, accuracy can be within 0.25% full scale or better, acceptable for most process weighing applications.

Pneumatic load cells also operate on the force-balance principle. These devices use multiple dampener chambers to provide higher accuracy than can a hydraulic device. In some designs, the first dampener chamber is used as a tare weight chamber. Pneumatic load cells are often used to measure relatively small weights in industries where cleanliness and safety are of prime concern. The advantages of this type of load cell include their being inherently explosion proof and insensitive to temperature variations. Additionally, they contain no fluids that might contaminate the process if the diaphragm ruptures.

Strain-gauge load cells convert the load acting on them into electrical signals. The gauges themselves are bonded onto a beam or structural member that deforms when weight is applied. In most cases, four strain gages are used to obtain maximum sensitivity and temperature compensation. Two of the gauges are usually in tension, and two in

compression, and are wired with compensation adjustments. When weight is applied, the strain changes the electrical resistance of the gauges in proportion to the load.

Load cells may be damaged because of (shock) overloading, lightning strikes or heavy surges in current, chemical or moisture ingress, mis-handling (dropping, lifting on cable, etc.), vibration, seismic events or internal component malfunctioning. To avoid damages to load cell primarily three factors are considered. They are capacity, accuracy class and environmental protection.

Factors considered during capacity selection of Load cell.

4.2.3 LOAD CELL MEASURING RANGE

The range of values of mass for which the result of measurement should not be affected by an error exceeding the maximum permissible error is.

Safe load limit:

The maximum load that can be applied without producing a permanent shift in the performance characteristics beyond those specified; specified as a percentage of the measuring range (i.e. 150%).

Ultimate overload:

The maximum load that can be applied without physical destruction of the load cell is specified as a percentage of the measuring range (i.e. 300%).

Safe side load:

The maximum load that can act 90° to the axis along which the load cell is designed to be loaded at the point of axial load application without producing a permanent shift in the performance beyond those specified; specified as a percentage of the measuring range (i.e. 100%).

A load cell will perform within specifications until the safe load limit or safe side load limit is passed. Beyond this point, even for a very short period of time,

the load cell will be permanently damaged. The load cell may physically break at the ultimate load limit.

Static overload :

It is defined as a gradual increase in weight over and above the rated capacity of the load cell.

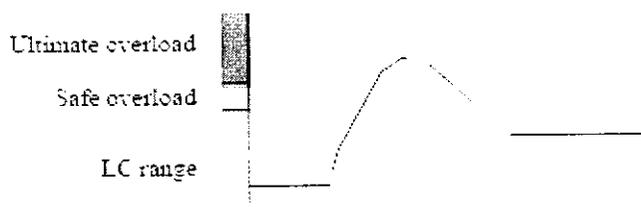


Figure 4.3 STATIC OVERLOAD

Shock overload:

It can be defined as a sudden change in weight, within a very short period of time, over and above the rated capacity of the load cell. This situation specifically occurs when a relatively small non-elastic item is dropped from a considerable height on the scale



Figure 4.4 SHOCK OVERLOAD

Based on accuracy, Load cells are ranked, according to their overall performance capabilities into differing accuracy classes. Some of these accuracy classes are related to standards which are used in legal for trade weighing instruments, while other accuracy classes are defined by the individual load cell

manufacturer. Depending on the standard and the performance of a particular load cell type, an alphanumeric “accuracy grade” is given to the product.

For environmental protection, most manufacturers of Load cells have adopted the International Protection system (IP/IEC 529 or EN 40.050) or National Electrical Manufacturers Association Standards (NEMA publication 250) as Standards.

4.2.4 OPERATION OF STRAIN GAUGE LOAD CELL

A strain gauge load cell is basically a metal structure subject to a load to be measured, with strain gauges sensing strain in the loaded structure. The strain gauges are connected in an electrical bridge circuit. Power is supplied across one bridge diagonal, and an output signal across the other diagonal is used as an indication of the load on the metal structure. The strain gauge load cell is one of the more common means of measuring force. It is a precisely machined structure which responds with a deformation to a given applied force.

A strain gauge bonded to a deformable element exhibits a change in resistance according to the degree of deformation, which results in an electrical signal indicative of the magnitude of the applied force. The output signal from a strain gauge load cell derives entirely from changes in the resistance of the strain gauges. The rated capacities of strain gauge load cells range from 5 N to more than 50 MN. They can be used with high resolution digital indicators as force transfer standards.

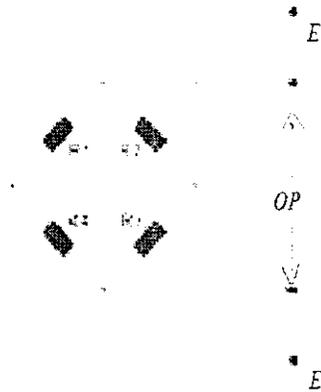


Figure 4.5 WHEATSTONE BRIDGE

Three resistors and a strain gauge are connected into a wheatstone bridge circuit. Initially, the bridge is in balanced condition. Excitation voltage is given. When load is applied, the resistance of strain gauge changes and the bridge is unbalanced. The analog electrical output of the wheatstone bridge is the output signal of the load cell. A result of the detection is converted into a weight of a measuring target object.

Accurate load measurements require that the strain gauges sense the strain in the loaded structure accurately, and also that the strains in the loaded structure are true measures of the load on the metal structure. Accurate load measurements require that the strain gauges sense the strain in the loaded structure accurately, and also that the strains in the loaded structure are true measures of the load on the metal structure.

In heavy capacity applications, the load is distributed over usually at least four load cells and some applications may require sixteen or more load cells. The

sum of the load cell output signals must be obtained to provide a signal representative of the total weight applied to the scale.

4.3 SPEED MEASUREMENT

Usually, speed sensors can be mounted on the different parts of the vehicle to perform different tasks. An engine speed sensor is mounted on the vehicles crankshaft and is used as the speedometer which gets its data. These speed sensors should always in good working condition to provide accurate data. If one of the sensor gives the wrong signal, control functions of the engine ECU(Electronic Control Unit) and ECU will be largely compromised.

Wheel speed sensors are located individually at each wheel or axle generating a signal that changes with wheel speed. A speed sensor signal that suddenly drops off indicates that one or more wheels would lock up.

In our project, wheel speed measurement is done using proximity sensor.

The features of sensor used are:

- Fully potted switch and leads
- High cycle rate capabilities
- High-speed operation
- Compact for limited-space applications
- No moving parts, for longer life
- Corrosion-resistant
- Wide selection of materials
- Engineered designs available

Change in magnetic flux is measured as speed in RPM.

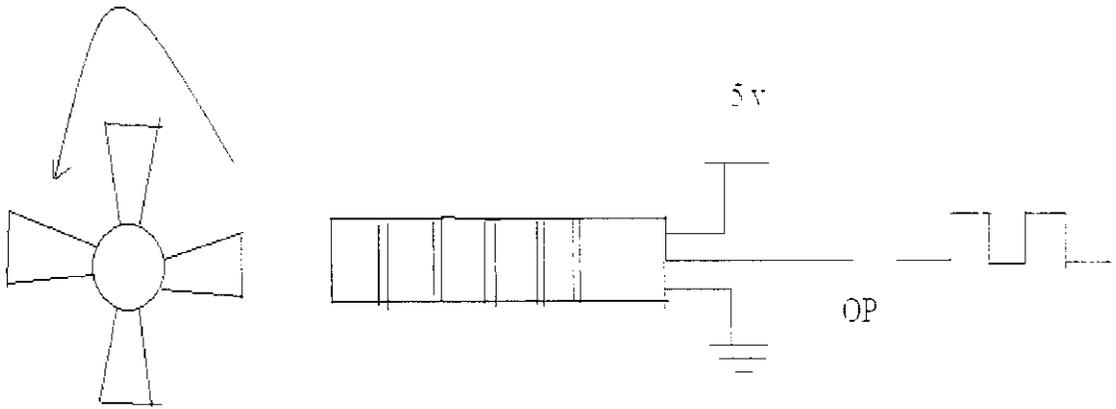
4.3.1 PROXIMITY SENSOR

Inductive proximity sensors are widely used in various applications to detect metal devices. They can be used in various environments (industry, workshop, lift shaft...) and need high reliability.

Inductive proximity sensors generate an electromagnetic field and detect the eddy current losses induced when the metal target enters the field. The field is generated by a coil, wrapped round a ferrite core, which is used by a transistorized circuit to produce oscillations. The target, while entering the electromagnetic field produced by the coil, will decrease the oscillations due to eddy currents developed in the target. If the target approaches the sensor within the so-called "sensing range", the oscillations cannot be produced anymore: the detector circuit generates then an output signal controlling a relay or a switch.

4.3.2 SPEED MEASURING OPERATION

The wheel type metal rod is fixed in the motor shaft. The proximity sensor is placed near the shaft. When the shaft is rotating, the metal rod is crossed the proximity sensors sequentially. Excitation is applied and magnetic field is produced.



Turning wheel

Figure 4.6 PROXIMITY SENSOR IN SPEED MEASUREMENT

When the wheel rotates, it cuts the magnetic flux produced. Thus, change in magnetic flux is measured as speed in RPM as pulses. So the sensor gives the pulse to the microcontroller. Now the microcontroller counts the pulse. By using this pulse count we can find revolution per minute which is equal to speed of the wheel.

4.3.3 SPECIFICATIONS OF PROXIMITY SENSOR

- Supply voltage (4-24)
- Supply current max 10nA
- Temperature (20-100)C

4.4 OVERTURN CONTROL

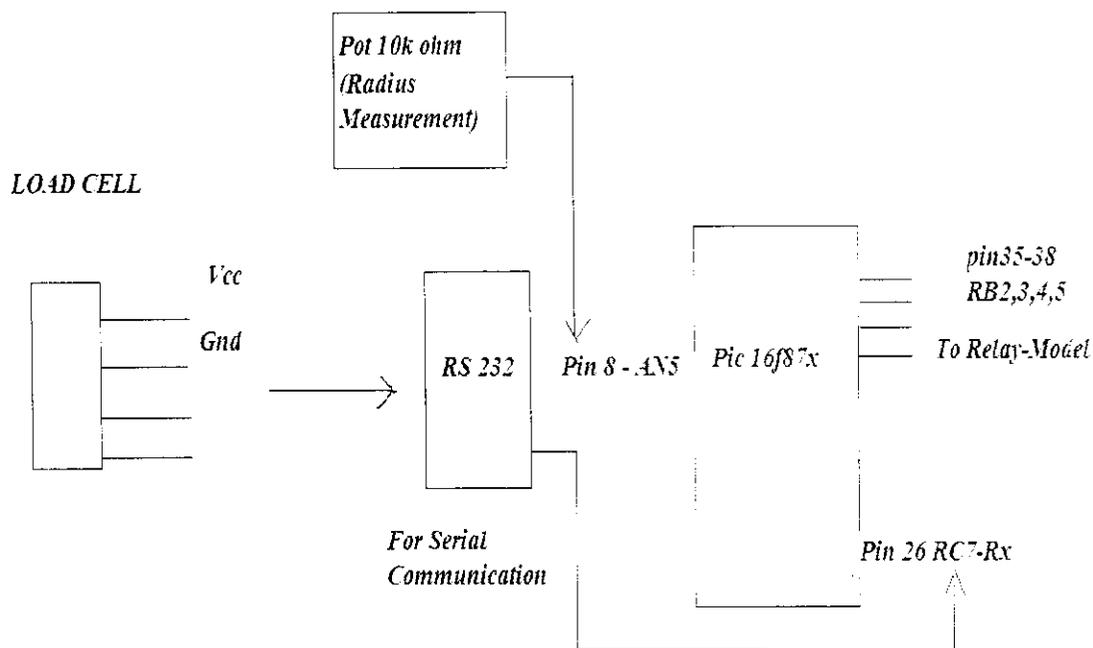


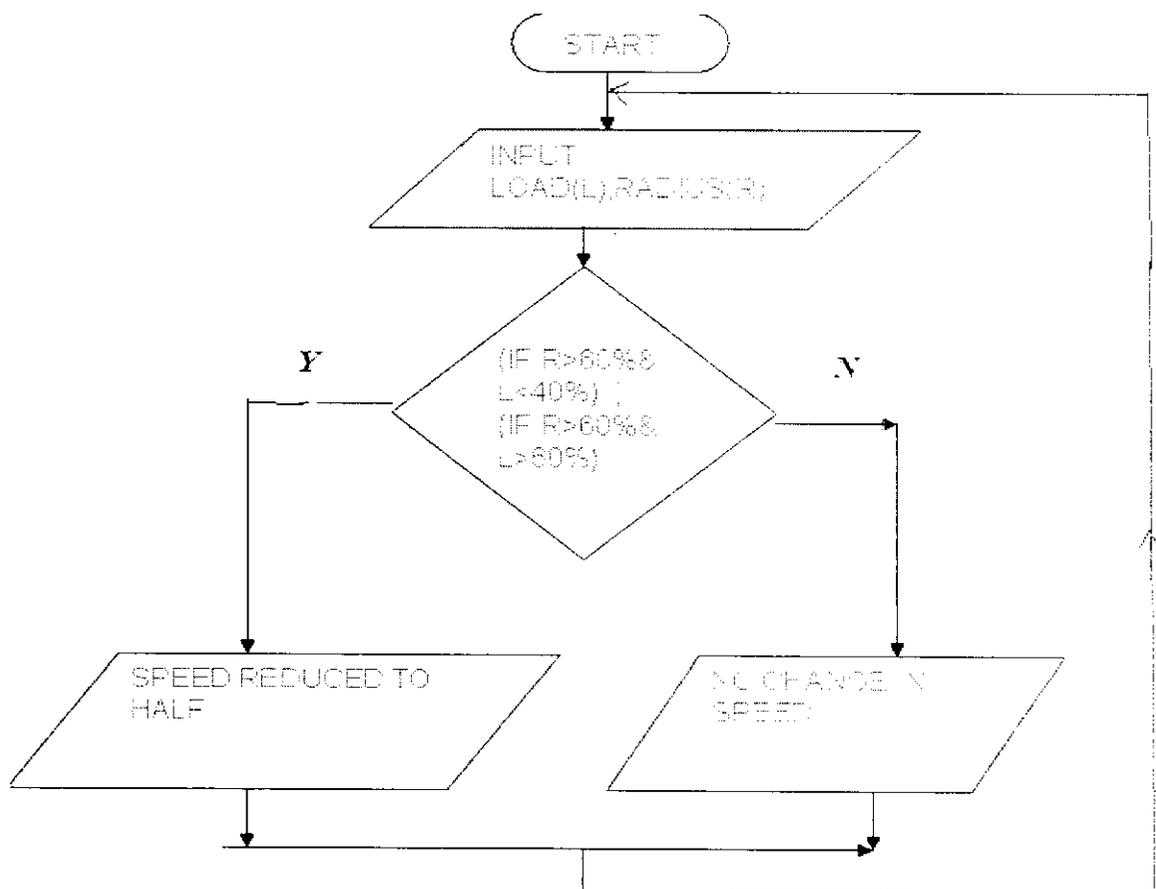
Figure 4.7 OVERTURN CONTROL

The weight of the vehicle is measured using load cell. The load cell output is given to the RS232. The load cell produces serial data. The serial data is given to the pin 26(Asynchronous receiver Rx) through RS 232. The Wheel turning radius is measured using potentiometer. The potentiometer output is given to the pin 8(analog pin AN5) of the microcontroller. The controller is programmed such that the model speed is reduced to half of the original speed. The output of the controller is obtained in pin 35-38(Port B) to which relay is connected to run the model.

4.5 ALGORITHM

1. Get the input parameters load(L) , turning radius(R) ;
2. Nominal range for load and turning radius is assigned as (40-60)%;
3. Compare input values with nominal ranges
4. Either if R is greater than 60% and L is less than 40%, or if R is greater than 60% and L is also greater than 60% , the speed is reduced to half.
5. Else normal speed is maintained.

4.6 FLOWCHART



4.7 EXPERIMENTAL RESULT

LOAD(In Kg)	POTENTIOMETER(in %)	OUTPUT SPEED (rpm)
0.3	10	7
0.9	45	7
0.4	80	3
1.8	40	3
1.8	85	3

CONTROLLER

5. MICROCONTROLLER

Microcontroller is a general purpose device, which integrates a number of the components of a microprocessor system on to single chip. It has inbuilt CPU, memory and peripherals to make it as a mini computer. A microcontroller combines on to the same microchip:

- The CPU core
- Memory(both ROM and RAM)
- Some parallel digital i/o

Micro controller is a stand alone unit ,which can perform functions on its own without any requirement for additional hardware like i/o ports and external memory.

5.1 PIC CONTROLLER

The microcontroller that has been used for this project is from PIC series. PIC microcontroller is the first RISC based microcontroller fabricated in CMOS (complimentary metal oxide semiconductor) that uses separate bus for instruction and data allowing simultaneous access of program and data memory.

The main advantage of CMOS and RISC combination is low power consumption resulting in a very small chip size with a small pin count. The main advantage of CMOS is that it has immunity to noise than other fabrication techniques.

5.2 PIC (16F877)

Various microcontrollers offer different kinds of memories. EEPROM, EPROM, FLASH etc. are some of the memories of which FLASH is the most recently developed. Technology that is used in pic16F877 is flash technology, so

that data is retained even when the power is switched off. Easy Programming and erasing are other features of PIC 16F877.

The PIC start plus development system from microchip technology provides the product development engineer with a highly flexible low cost microcontroller design tool set for all microchip PIC micro devices. The PIC start plus development system includes PIC start plus development programmer and MP lab

The PIC start plus programmer gives the product developer ability to program user software in to any of the supported microcontrollers. The PIC start plus software running under MP lab provides for full interactive control over the programmer.

5.3 SPECIAL FEATURES OF PIC MICROCONTROLLER

5.3.1 CORE FEATURES

- High-performance RISC CPU
- Only 35 single word instructions
- All single cycle instructions except for program branches which are two cycle
- Operating speed: DC - 20 MHz clock input
DC - 200 ns instruction cycle
- Up to 8K x 14 words of Flash Program Memory,
Up to 368 x 8 bytes of Data Memory (RAM)
Up to 256 x 8 bytes of EEPROM data memory
- Pin out compatible to the PIC16C73/74/76/77
- Interrupt capability (up to 14 internal/external
- Eight level deep hardware stack

- Direct, indirect, and relative addressing modes
- Power-on Reset (POR)
- Power-up Timer (PWRT) and Oscillator Start-up Timer (OST)
- Watchdog Timer (WDT) with its own on-chip RC Oscillator for reliable operation
- Programmable code-protection
- Power saving SLEEP mode
- Selectable oscillator options
- Low-power, high-speed CMOS EPROM/EEPROM technology
- In-Circuit Serial Programming (ICSP) via two pins
- Only single 5V source needed for programming capability
- In-Circuit Debugging via two pins
- Processor read/write access to program memory
- Wide operating voltage range: 2.5V to 5.5V
- High Sink/Source Current: 25 mA
- Commercial and Industrial temperature ranges

5.3.2 PERIPHERAL FEATURES

- Timer0: 8-bit timer/counter with 8-bit prescaler
- Timer1: 16-bit timer/counter with prescaler, can be incremented during sleep via external crystal/clock
- Timer2: 8-bit timer/counter with 8-bit period register, prescaler and postscaler
- Two Capture, Compare, PWM modules
 - Capture is 16-bit, max resolution is 12.5 ns,
 - Compare is 16-bit, max resolution is 200 ns,
 - PWM max. resolution is 10-bit

- 10-bit multi-channel Analog-to-Digital converter
- Synchronous Serial Port (SSP) with SPI. (Master Mode) and I2C. (Master/Slave)
- Universal Synchronous Asynchronous Receiver Transmitter (USART/SCI) with 9-bit address detection.
- Brown-out detection circuitry for **Brown-out Reset (BOR)**

5.4 ARCHITECTURE

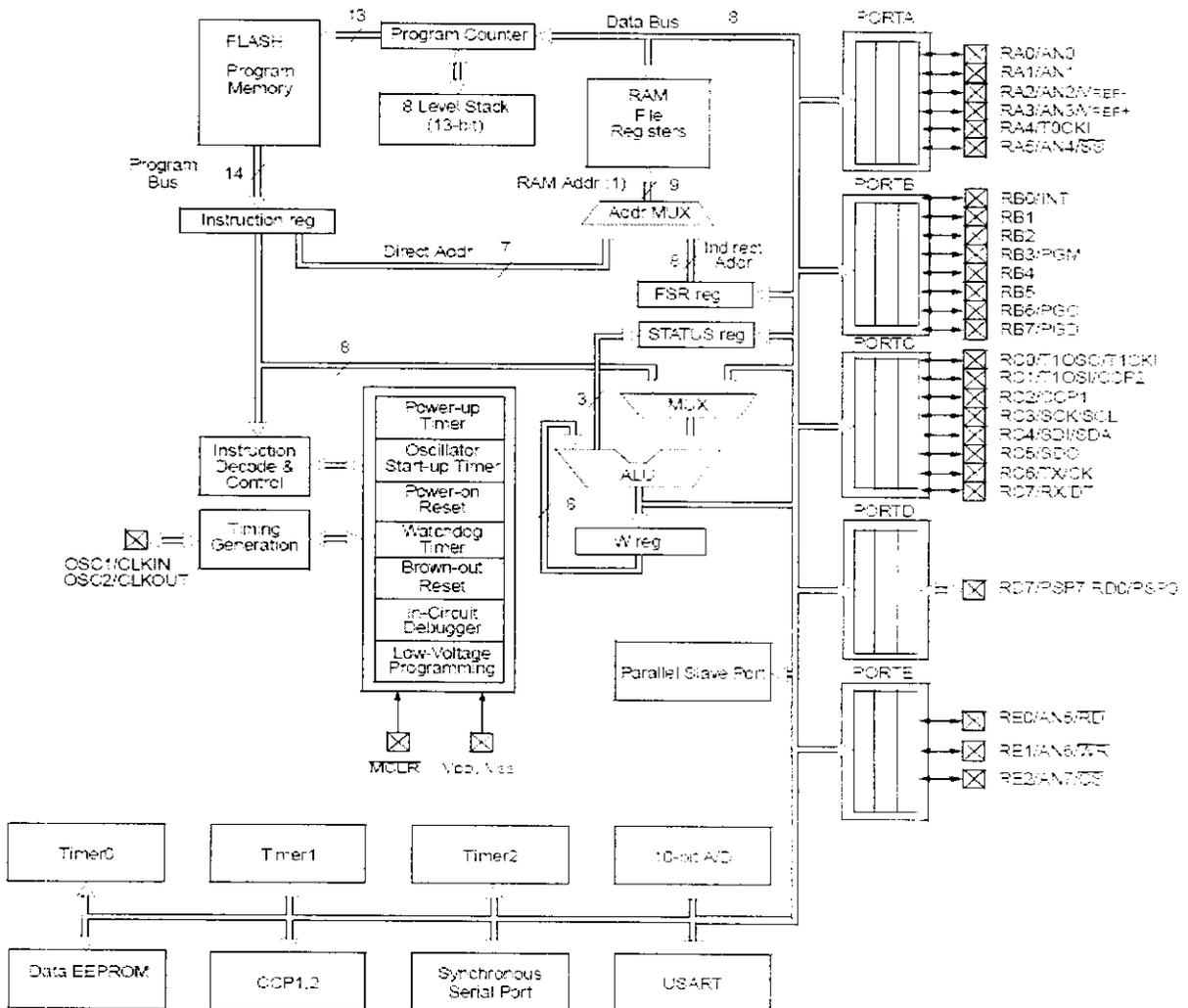


Figure 5.1 ARCHITECTURE OF PIC 16F877

There are three memory blocks in each of these PIC microcontroller. They are FLASH program memory, EEPROM program memory and data memory(RAM). The Program memory and Data memory have separate buses so that concurrent access can occur. There are totally five I/O ports . They are PORT A, PORT B, PORT C, PORT D, PORT E. These I/O ports are multiplexed with an alternate function for the peripheral features on the device. There are also three Timer units. Timer 0, Timer 1, Timer 2. Timer 0 also acts as Watch Dog Timer. The Master Synchronous Serial Port (MSSP) module is a serial interface useful for communicating with other peripheral or microcontroller devices. The Universal Synchronous Asynchronous Receiver Transmitter (USART) module is one of the two serial I/O modules. (USART is also known as a Serial Communications Interface or SCI). There are also pins available for Parallel communication. There is an inbuilt Analog to Digital converter which on process produces 10- bit digital output. There is also 8-bit stack available. There are also Arithmetic and Logic Unit(ALU), Multiplexer, Program Counter etc are also present.

5.5 I/O PORTS

Some pins for these I/O ports are multiplexed with an alternate function for the peripheral features on the device. In general, when a peripheral is enabled, that pin may not be used as a general purpose I/O pin.

In our project the Pins 6,8,26 are used as input pins and pin 33,34,35,36,37, 38 are used as output pins.

5.6 TIMERS

There are three timers used Timer 0, Timer1 and Timer2.

TIMER0

Timer0 is used in our IR module. It is a 8-bit timer/counter with software programmable prescaler. It has an internal or external clock select. It is Readable and writable and it produces an interrupt on overflow.

Timer mode is selected by clearing bit T0CS (OPTION_REG<5>). In timer mode, the Timer0 module will increment every instruction cycle (without prescaler). If the TMR0 register is written, the increment is inhibited for the following two instruction cycles. The user can work around this by writing an adjusted value to the TMR0 register. Counter mode is selected by setting bit T0CS (OPTION_REG<5>). In counter mode, Timer0 will increment either on every rising or falling edge of pin RA4/T0CKI. The incrementing edge is determined by the Timer0 Source Edge Select bit T0SE (OPTION_REG<4>). Clearing bit T0SE selects the rising edge.

OPTION_REG REGISTER:

R/w-0 R/w-0 R/w-0 R/w-0 R/w-0 R/w-0 U-0 R/w-0

RBPU	INTEDG	T0CS	T0CE	PSA	PS2	PS1	PS0
Bit7							Bit0

R = Readable bit

W = Writable bit

U = Unimplemented bit,
read as '0'

- n = Value at POR reset

bit 7: **RBPU**

bit 6: **INTEDG**

bit 5: **T0CS**: TMR0 Clock Source Select bit

1 = Transition on T0CKI pin

0 = Internal instruction cycle clock (CLKOUT)

bit 4: **T0SE**: TMR0 Source Edge Select bit

1 = Increment on high-to-low transition on T0CKI pin

0 = Increment on low-to-high transition on T0CKI pin

bit 3: **PSA**: Prescaler Assignment bit

1 = Prescaler is assigned to the WDT

0 = Prescaler is assigned to the Timer0 module

bit 2-0: **PS2:PS0**: Prescaler Rate Select bits

5.7 ANALOG TO DIGITAL CONVERTER(ADC)

There are two types of analog to digital converter is present in this IC. We use 10-bit ADC. The ADC module can have up to eight analog inputs for a device. The analog input charges a sample and hold capacitor. The output of sample and hold capacitor is the input into the converter. The converter then generates a digital result of this analog level via successive approximation. The A/D conversion of the analog input signal results in a corresponding 10-bit digital number. The A/D module has high and low voltage reference input that is software selectable to some combination of VDD, VSS, and RA2 or RA3.

The A/D module has four registers. These registers are

A/D result high register (ADRESH)

A/D result low register (ADRESL)

A/D control register 0 (ADCON0)

A/D control register 1 (ADCON1)

ADCON0(Address 1Fh)

R/w-0 R/w-0 R/w-0 R/w-0 R/w-0 R/w-0 U-0 R/w-0

ADCS1	ADCS0	CHS2	CHS1	CHS0	GO-DONE	-	ADON
Bit 7							Bit0

R = Readable bit

W = Writable bit

U = Unimplemented bit,

read as '0'

- n = Value at POR reset

bit 7-6: **ADCS1:ADCS0: A/D Conversion Clock Select bits**

00 = FOSC/2

01 = FOSC/8

10 = FOSC/32

11 = FRC (clock derived from an RC oscillation)

bit 5-3: **CHS2:CHS0: Analog Channel Select bits**

000 = channel 0, (RA0/AN0)

001 = channel 1, (RA1/AN1)

010 = channel 2, (RA2/AN2)

011 = channel 3, (RA3/AN3)

100 = channel 4, (RA5/AN4)

101 = channel 5, (RE0/AN5)(1)

110 = channel 6, (RE1/AN6)(1)

111 = channel 7, (RE2/AN7)(1)

bit 2: **GO/DONE:** A/D Conversion Status bit

If ADON = 1

1 = A/D conversion in progress (setting this bit starts the A/D conversion)

0 = A/D conversion not in progress (This bit is automatically cleared by hardware when the A/D conversion is complete)

bit 1: **Unimplemented:** Read as '0'

bit 0: **ADON:** A/D On bit

1 = A/D converter module is operating

0 = A/D converter module is shutoff and consumes no operating current.

5.8 SERIAL COMMUNICATION

The data is received on the RC7/RX/DT pin and drives the data recovery block. The data recovery block is actually a high speed shifter operating at x16 times the baud rate, whereas the main receive serial shifter operates at the bit rate or at FOSC. Once asynchronous mode is selected, reception is enabled by setting bit CREN (RCSTA<4>). The heart of the receiver is the receive (serial) shift register (RSR). After sampling the STOP bit, the received data in the RSR is transferred to the RCREG register (if it is empty). If the transfer is complete, flag bit RCIF (PIR1<5>) is set. The actual interrupt can be enabled/ disabled by setting/clearing enable bit RCIE (PIE1<5>). Flag bit RCIF is a read only bit which is cleared by the hardware. It is cleared when the RCREG register has been read and is empty. The RCREG is a double buffered register (i.e. it is a two deep FIFO). It is possible for two bytes of data to be received and transferred to the RCREG FIFO and a third byte to begin shifting to the RSR register. On the detection of the STOP bit of the third byte, if the RCREG register is still full, the overrun error bit

OERR (RCSTA<1>) will be set. The word in the RSR will be lost. The RCREG register can be read twice to retrieve the two bytes in the FIFO. Overrun bit OERR has to be cleared in software. This is done by resetting the receive logic (CREN is cleared and then set). If bit OERR is set, transfers from the RSR register to the RCREG register are inhibited, so it is essential to clear error bit OERR if it is set. Framing error bit FERR (RCSTA<2>) is set if a stop bit is detected as clear. Bit FERR and the 9th receive bit are buffered the same way as the receive data. Reading the RCREG will load bits RX9D and FERR with new values, therefore it is essential for the user to read the RCSTA register before reading RCREG register in order not to lose the old FERR and RX9D information.

HARDWARE DESCRIPTION

6. HARDWARE DESCRIPTION

6.1 POWER SUPPLY

The operation of power supply circuits is built using filters, rectifiers, and then voltage regulators. Starting with an ac voltage, a steady dc voltage is obtained by rectifying the ac voltage, then filtering to a dc level, and finally, regulating to obtain a desired fixed dc voltage. The regulation is usually obtained from an IC voltage regulator unit, which takes a dc voltage and provides a somewhat lower dc voltage, which remains the same even if the input dc voltage varies, or the output load connected to the dc voltage changes.

BLOCK DIAGRAM

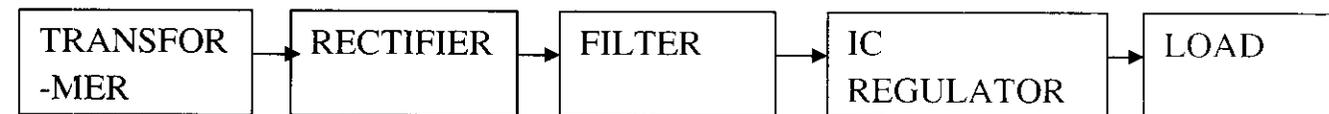


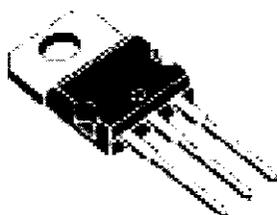
Figure 6.1 BLOCK DIAGRAM OF POWER SUPPLY

The potential transformer will step down the power supply voltage (0-230V) to (0-6V) level. The output from the transformer is given to diode rectifier, which provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a dc voltage. This resulting dc voltage usually has some ripple or ac voltage variation. The regulator circuit removes the ripples and also remains the same dc value even if the input dc voltage varies, or the load connected to the output dc voltage changes.

6.2 IC VOLTAGE REGULATORS

Regulator IC units contain the circuitry for reference source, comparator amplifier, control device, and overload protection all in a single IC. IC units provide regulation of either a fixed positive voltage, a fixed negative voltage, or an adjustably set voltage.

The L7800 series of three-terminal positive regulators is available in TO-220, TO-220FP, TO-3 and D2PAK packages and several fixed output voltages, making it useful in a wide range of applications. These regulators can provide local on-card regulation, eliminating the distribution problems associated with single point regulation. Each type employs internal current limiting, thermal shut-down and safe area protection, making it essentially indestructible. Although designed primarily as fixed voltage regulators, these devices can be used with external components to obtain adjustable voltages and currents.



The series 78 regulators provide fixed positive regulated voltages from 5 to 24 volts. Similarly, the series 79 regulators provide fixed negative regulated voltages from 5 to 24 volts.

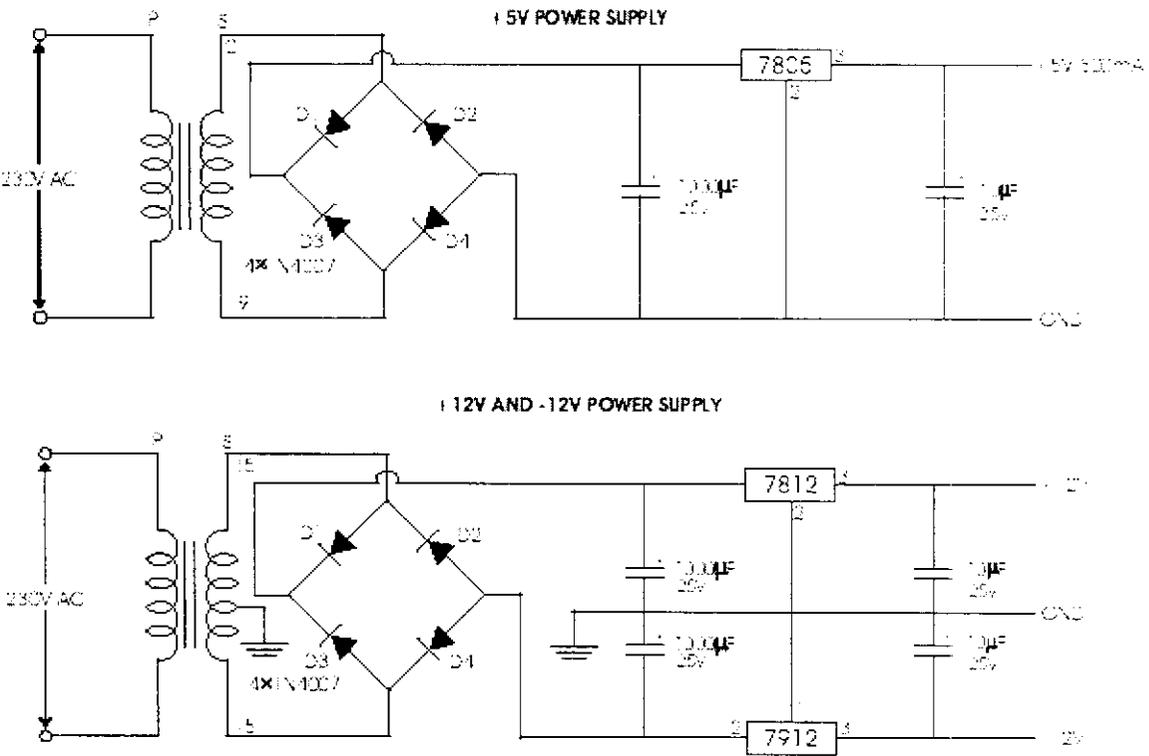


Figure 6.2 power supply

When four diodes are connected as shown in figure, the circuit is called as bridge rectifier. The input to the circuit is applied to the diagonally opposite corners of the network, and the output is taken from the remaining two corners.

There is a positive potential, at point A and a negative potential at point B. the positive potential at point A will forward bias D3 and reverse bias D4. The negative potential at point B will forward bias D1 and reverse D2. At this time D3 and D1 are forward biased and will allow current flow to pass through them; D4 and D2 are reverse biased and will block current flow. The path for current flow is from point B through D1, up through RL, through D3, through the secondary of the transformer back to point B. One-half cycle later, the polarity across the secondary of the transformer reverse, forward biasing D2 and D4 and reverse biasing D1 and D3. Current flow will now be from point A through D4, up through RL, through D2, through the secondary of T1, and back to point A. The current flow through RL is always in the same direction. This current develops a voltage since current

flows through the load (RL) during both half cycles of the applied voltage. this bridge rectifier is a full-wave rectifier.

One advantage of a bridge rectifier over a conventional full-wave rectifier is that with a given transformer the bridge rectifier produces a voltage output that is nearly twice that of the conventional full-wave circuit.

6.3 ALARM

A **buzzer** or **beeper** is a signalling device, usually electronic, typically used in automobiles, household appliances such as a microwave oven, or game shows. It most commonly consists of a number of switches or sensors connected to a control unit and sounds a warning in the form of a continuous or intermittent buzzing or beeping sound. Initially this device was based on an electromechanical system which was identical to an electric bell without the metal gong (which makes the ringing noise).

CIRCUIT DIAGRAM

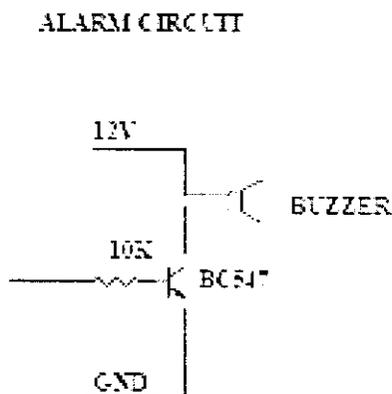


Figure 6.3 ALARM CIRCUIT

The circuit is designed to control the buzzer. The buzzer ON and OFF is controlled by the switching transistor (BC 547). The buzzer is connected in the Q2 transistor collector terminal. When high pulse signal is given to base of the Q2 transistor, the transistor is conducting .Hence Q2 transistor is conducting and buzzer is energized and produces the sound signal. When low pulse is given to base of transistor Q2, the transistor is turned OFF and hence buzzer is OFF.

6.4 KEY PAD

KEYPAD

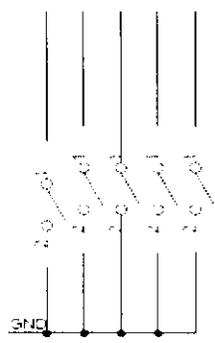


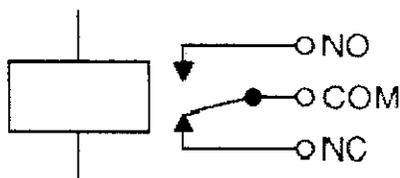
Figure 6.4 KEYPAD

The key pad circuit is used to operate the model. There are five keys namely stop, left, right, forward, reverse. This is used to move the model left or right etc.. When the key is pressed, the switch present here makes the contact and the output 1 is given to the controller which is processed and given to the model.

6.5 RELAY

A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions and

they are double throw (changeover) switches. There is no electrical connection inside the relay between the two circuits; the link is magnetic and mechanical. The coil of a relay passes a relatively large current, typically 30mA for a 12V relay.



The relay's switch connections are usually labeled COM, NC and NO:

- **COM** = Common, always connect to this, it is the moving part of the switch.
- **NC** = Normally Closed, COM is connected to this when the relay coil is **off**.
- **NO** = Normally Open, COM is connected to this when the relay coil is **on**.

CIRCUIT DESCRIPTION

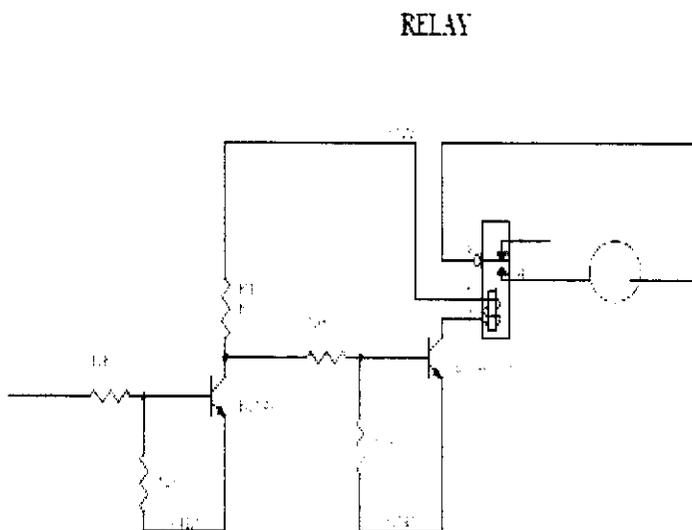


Figure 6.5 RELAY CIRCUIT

This circuit is designed to control the load. The load may be motor or any other load. The load is turned ON and OFF through relay. The relay ON and OFF is controlled by the pair of switching transistors (BC 547). The relay is connected in the Q2 transistor collector terminal. A Relay is nothing but electromagnetic switching device which consists of three pins. They are Common, Normally close (NC) and normally open (NO).

The relay common pin is connected to supply voltage. The normally open (NO) pin connected to load. When high pulse signal is given to base of the Q1 transistors, the transistor is conducting and shorts the collector and emitter terminal and zero signals is given to base of the Q2 transistor. So the relay is turned OFF state.

When low pulse is given to base of transistor Q1 transistor, the transistor is turned OFF. Now 12v is given to base of Q2 transistor so the transistor is conducting and relay is turned ON. Hence the common terminal and NO terminal of relay are shorted. Now load gets the supply voltage through relay.

Voltage signal from microcontroller or pc	Transistor Q1	Transistor Q2	Relay
1	On	Off	Off
0	Off	On	On

Table 6.1 RELAY OPERATION

6.6 ENCODER

In this circuit HT 640 is used as encoder. The 3^{18} encoders are a series of CMOS LSIs for remote control system application. They are capable of encoding 18 bits of information which consists of N address bit and 18-N data bits. Various packages of the 3^{18} encoders offer flexible combination of programmable address/data is transmitted together with the header bits via an RF or an infrared transmission medium upon receipt of a trigger signal.

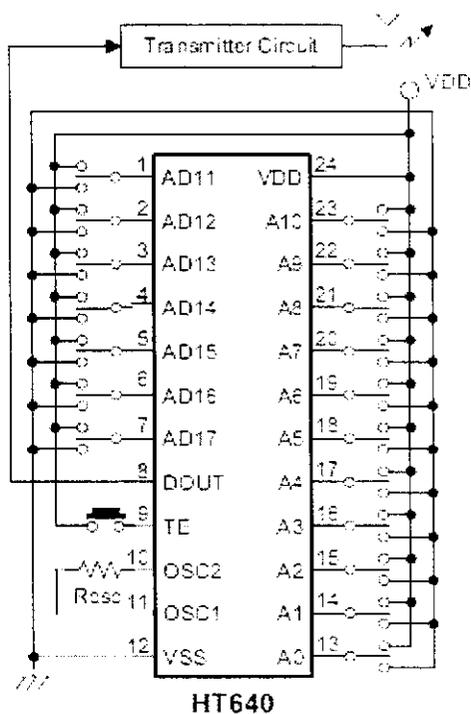


Figure 6.6 PIN DIAGRAM OF HT646

In this circuit the input signal to be encoded is given to AD7-AD0 input pins of encoder. Here the input signal may be from key board, parallel port, microcontroller or any interfacing device. The encoder output address pins are shorted so the output encoded signal is the combination of (A0-A9) address signal

and (D0-D7) data signal. The output encoded signal is taken from 8th which is connected to RF transmitter section.

RF TRANSMITTER

The RF transmitter consists of a transistor BF 494, tank circuit and antennae. When ever the high output pulse is given to base of the transistor BF 494, the transistor is conducting so tank circuit is oscillated. The tank circuit is consists of L2 and C4 generating 433 MHz carrier signal. Then the modulated signal is given LC filter section. After the filtration the RF modulated signal is transmitted through antenna.

6.7 DECODER

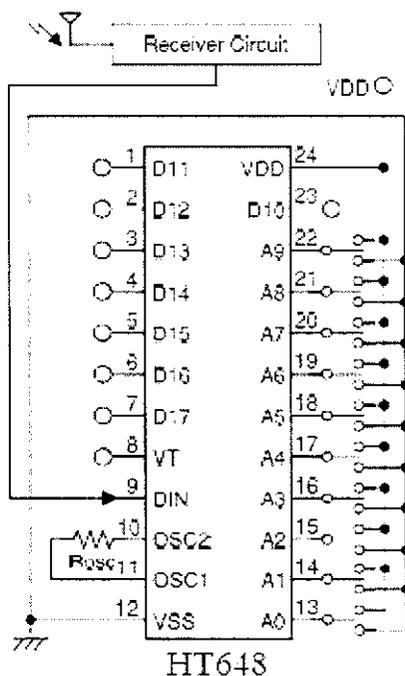


Figure 6.7 PIN DIAGRAM OF HT648

In this circuit HT648 is used as decoder. The 3^{18} decoder are a series of CMOS LSIs for remote control system application. They are paired with 3^{18} series of encoders. For proper operation a pair of encoder/decoder pair with the same number of address and data format should be selected.

RF RECEIVER

The receiver module consists of transistor BC 547, capacitors and comparator LM 358. The RF receiver is used to receive the encoded data which is transmitted by the RF transmitter. Then the received data is given to transistor which acts as amplifier. Then the amplified signal is given to carrier demodulator section in which transistor is turn on and turn off conducting depends on the signal. Due to this the capacitor is charged and discharged so carrier signal is removed and saw tooth signal is appears across the capacitor. Then this saw tooth signal is given to comparator. The comparator circuit is constructed by LM358. The comparator is used to convert the saw tooth signal to exact square pulse. Then the encoded signal is given to decoder in order to get the decoded original signal.

The 3^{18} series of decoder receives serial address and data from that series of encoders that are transmitted by a carrier using an RF or an IR transmission medium. It then compares the serial input data twice continuously with its local address. If no errors or unmatched codes are encountered, the input data codes are decoded and then transferred to the output pins. The VT pin also goes high to indicate a valid transmission.

In this circuit the received encoded signal is 9th pin of the decoder. Now the decoder separate the address (A0-A9) and data signal (D0-D7). Then the output data signal is given to microcontroller or any other interfacing device.

7. CONCLUSION

Thus this model successfully detects and control drowsiness felt by the driver as well as cuts the speed of the heavy vehicles during overturn of heavy vehicles in sharp bends. By implementing our project to real time applications, major accidents can be avoided and the lives of people can be saved.

RECENT ADVANCES

The ESP algorithm holds good only for the load adaptive control. Many parameters like centre of gravity of vehicle's body, turning radius of wheel, and friction can be included in ESP for better overturn stability control.

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- “Analytical Instruments” by R.S.Khandpur.
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APPENDIX

CODING

```
#include<pic.h>
#include"lcd.h"
#include"pic_serial.h"
#include"pic_adc.h"
#define vib RB0
#define buz RB1
#define r1 RB2
#define r2 RB3
#define r3 RB4
#define r4 RB5
#define rel RB6
#define sen RE1
#define k1 RC0
#define k2 RC1
#define k3 RC2
#define k4 RC3
#define k5 RE0
#define k6 RE2
void setvalue();
void tmr_init();
unsigned char i, dat[10], addr, mod, value, setrange, ste, per, rot, count, sec, eye;
unsigned int speed;
void main()
{
    ADCON1=0x02;
```

```

TRISD=0;
TRISC=0xcF;
TRISB=0x00;
TRISE=0b111;
r1=r2=r3=r4=1;
rel=1;
Lcd8_Init();
buz=0;vib=0;
Serial_Init(9600);
Lcd8_Display(0x80," Safety Measure ",16);
Lcd8_Display(0xC0," In Automotives ",16);
Delay(65000);
Delay(500);
Lcd8_Display(0x80,"Wt: Kg St %",16);
Lcd8_Display(0xc0,"Speed: kh ",16);
tmr_init();
while(1)
{
    if(sen)
        {
            rot++;
        }
    if(k6 )
        {
            eye++;
        }
}

```

```
}
```

```
if(count>=100)
```

```
{
```

```
count=0;
```

```
if(!k1){r1=0;r2=1;r3=0;r4=1;Lcd8_Write(0xCC,'F');}
```

```
else if(!k2){r1=0;r2=1;r3=1;r4=0;Lcd8_Write(0xCC,'L');}
```

```
else if(!k3){r1=1;r2=0;r3=0;r4=1;Lcd8_Write(0xCC,'R');}
```

```
else if(!k4){r1=1;r2=0;r3=1;r4=0;Lcd8_Write(0xCC,'B');}
```

```
else if(!k5){r1=1;r2=1;r3=1;r4=1;Lcd8_Write(0xCC,'S');}
```

```
ste=Adc8_Cha(0);
```

```
per=(ste/255.0)*100;
```

```
Lcd8_Decimal3(0x8C,per);
```

```
speed=rot*3.6;
```

```
Lcd8_Decimal3(0xC6,speed);
```

```
rot=0;
```

```
sec++;
```

```
Lcd8_Decimal2(0xCE,sec);
```

```
if(sec>=30)
```

```
{
```

```
if(eye<=10)
```

```
{
```

```
buz=1;
```

```
vib=1;
```

```
}
```

```
else
```

```

    {
        buz=0;
        vib=0;
    }
sec=eye=0;
}
if(i>=8)
    {
        value=(dat[2]-0x30)*100 + (dat[3]-0x30)*10 - dat[5]-0x30;
        if(value<255)
            {
                Lcd8_Write(0x83,value/100+0x30);
            }
        //for(i=0;i<7;i++)Lcd8_Write(0xc0+i,dat[i]);
        i=0;
    }
count=0;
}
if(value>15 || per>60) rel=0;
else if(value>15 || per<40) rel=0;
else if(value<5 || per>60) rel=0;
else rel=1;
}
}

```

```
void tmr_init()
```

```
{  
  
    GIE=1;  
    PEIE=1;  
    T0IE=1;  
    OPTION = 0x07;  
    TMR0 = 0xd9;  
}  
  
void interrupt serial()  
{  
    if(RCIF)  
    {  
        dat[i]=RCREG;  
        if(dat[i]=='+'){ i=0; dat[0]='+';}  
        if(i<9)i++;  
        RCIF=0;  
    }  
    if(T0IF==1)  
    {  
        T0IF=0;  
        count++;  
        TMR0 = 0XD9;  
    }  
}
```

DATASHEETS

LM2904, LM358/LM358A, LM258/ LM258A

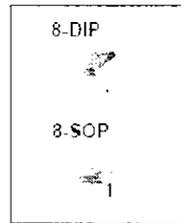
Dual Operational Amplifier

Features

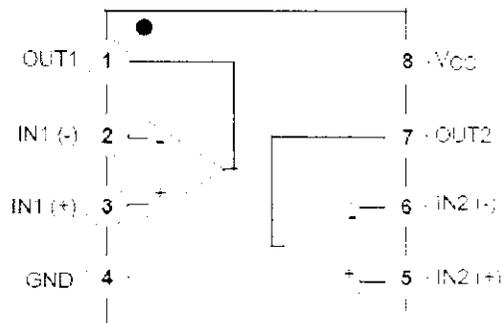
- Internally Frequency Compensated for Unity Gain
- Large DC Voltage Gain: 100dB
- Wide Power Supply Range:
LM258/LM258A, LM358/LM358A: 3V-32V (or ±1.5V - 16V)
LM2904: 3V-26V (or ±1.5V - 13V)
- Input Common Mode Voltage Range Includes Ground
- Large Output Voltage Swing: 0V DC to $V_{CC} - 1.5V$ DC
- Power Drain Suitable for Battery Operation

Description

The LM2904, LM358, LM358A, LM258, LM258A consist of two independent, high gain, internally frequency compensated operational amplifiers which were designed specifically to operate from a single power supply over a wide range of voltage. Operation from split power supplies is also possible and the low power supply current drain is independent of the magnitude of the power supply voltage. Application areas include transducer amplifier, DC gain blocks and all the conventional OP-AMP circuits which now can be easily implemented in single power supply systems.



Internal Block Diagram



Electrical Characteristics

($V_{CC} = 5.0V$, $V_{EE} = GND$, $T_A = 25^\circ C$, unless otherwise specified)

Parameter	Symbol	Conditions	LM258			LM358			LM2904			Unit	
			Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.		
Input Offset Voltage	V_{IO}	$V_{CM} = 0V$ to V_{CC} -1.5V $V_{O(P)} = 1.4V$, $R_S = 0\Omega$	-	2.9	5.0	-	2.9	7.0	-	2.9	7.0	mV	
Input Offset Current	I_{IO}	-	-	3	30	-	5	50	-	5	50	nA	
Input Bias Current	I_{BIAS}	-	-	45	150	-	45	250	-	45	250	nA	
Input Voltage Range	$V_{I(R)}$	$V_{CC} = 30V$ (LM2904, $V_{CC}=26V$)	0	-	V_{CC} -1.5	0	-	V_{CC} -1.5	0	-	V_{CC} -1.5	V	
Supply Current	I_{CC}	$R_L = \infty$, $V_{CC} = 30V$ (LM2904, $V_{CC}=26V$)	-	0.8	2.0	-	0.8	2.0	-	0.8	2.0	mA	
		$R_L = \infty$, $V_{CC} = 5V$	-	0.5	1.2	-	0.5	1.2	-	0.5	1.2	mA	
Large Signal Voltage Gain	G_V	$V_{CC} = 15V$, $R_L = 2k\Omega$ $V_{O(P)} = 1V$ to $11V$	50	100	-	25	100	-	25	100	-	V/mV	
Output Voltage Swing	$V_{O(H)}$	$V_{CC}=30V$ ($V_{CC} = 26V$ for LM2904)	$R_L = 2k\Omega$	26	-	-	26	-	-	22	-	-	V
		$R_L = 10k\Omega$	27	28	-	27	28	-	23	24	-	-	V
	$V_{O(L)}$	$V_{CC} = 5V$, $R_L = 10k\Omega$	-	5	20	-	5	20	-	5	20	mV	
Common-Mode Rejection Ratio	CMRR	-	70	85	-	65	80	-	50	80	-	dB	
Power Supply Rejection Ratio	PSRR	-	65	100	-	65	100	-	50	100	-	dB	
Channel Separation	CS	$f = 1kHz$ to $20kHz$ (Note 1)	-	120	-	-	120	-	-	120	-	dB	
Short Circuit to GND	ISC	-	-	40	60	-	40	60	-	40	60	mA	
Output Current	ISOURCE	$V_{I(+)} = 1V$, $V_{I(-)} = 0V$, $V_{CC} = 15V$, $V_{O(P)} = 2V$	20	30	-	20	30	-	20	30	-	mA	
			10	15	-	10	15	-	10	15	-	mA	
	ISINK	$V_{I(+)} = 0V$, $V_{I(-)} = 1V$, $V_{CC} = 15V$, $V_{O(P)} = 2V$	12	100	-	12	100	-	-	-	-	μA	
Differential Input Voltage	$V_{I(DIFF)}$	-	-	V_{CC}	-	-	V_{CC}	-	-	V_{CC}	-	V	

Note:

1. This parameter, although guaranteed, is not 100% tested in production.

Typical Performance Characteristics

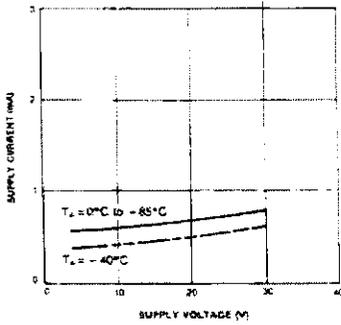


Figure 1. Supply Current vs Supply Voltage

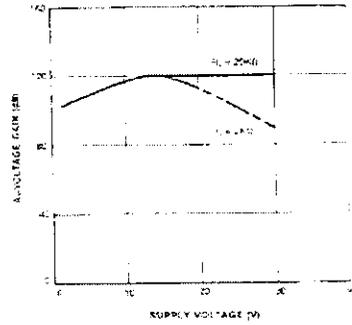


Figure 2. Voltage Gain vs Supply Voltage

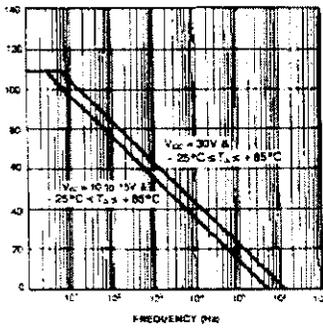


Figure 3. Open Loop Frequency Response

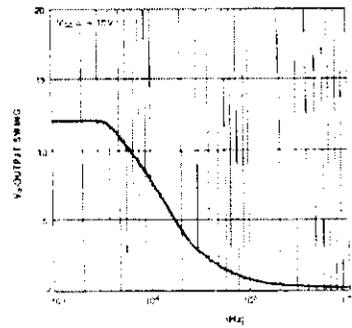


Figure 4. Large Signal Output Swing vs Frequency

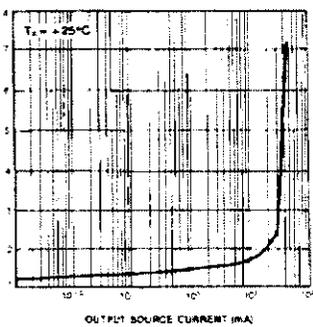


Figure 5. Output Characteristics vs Current Sourcing

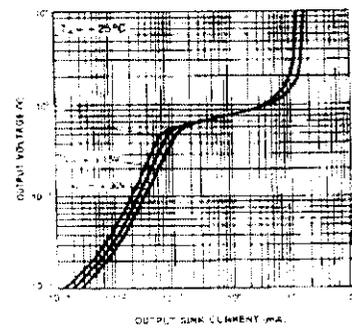


Figure 6. Output Characteristics vs Current Sinking

Typical Performance Characteristics (Continued)

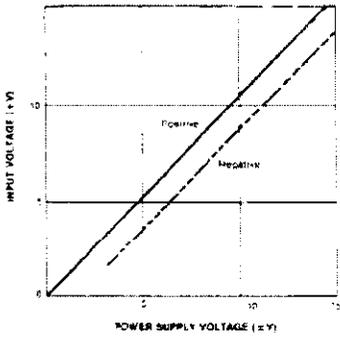


Figure 7. Input Voltage Range vs Supply Voltage

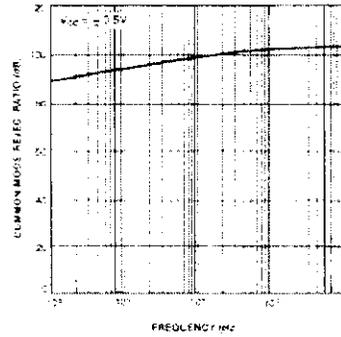


Figure 8. Common-Mode Rejection Ratio

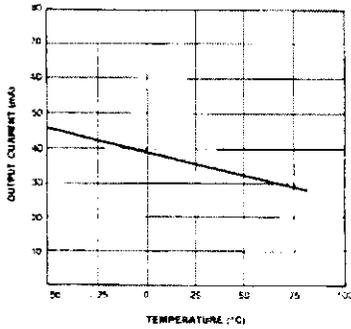


Figure 9. Output Current vs Temperature (Current Limiting)

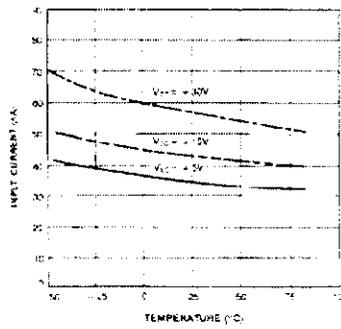


Figure 10. Input Current vs Temperature

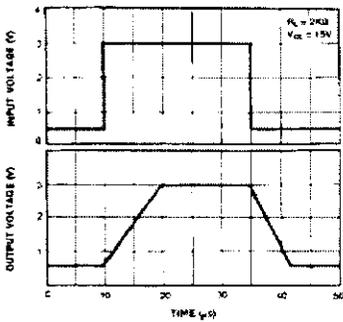


Figure 11. Voltage Follower Pulse Response

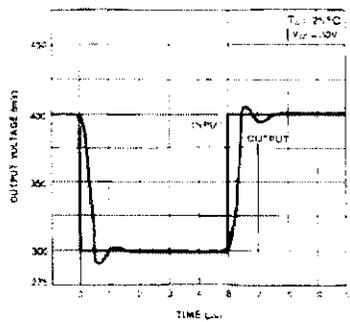
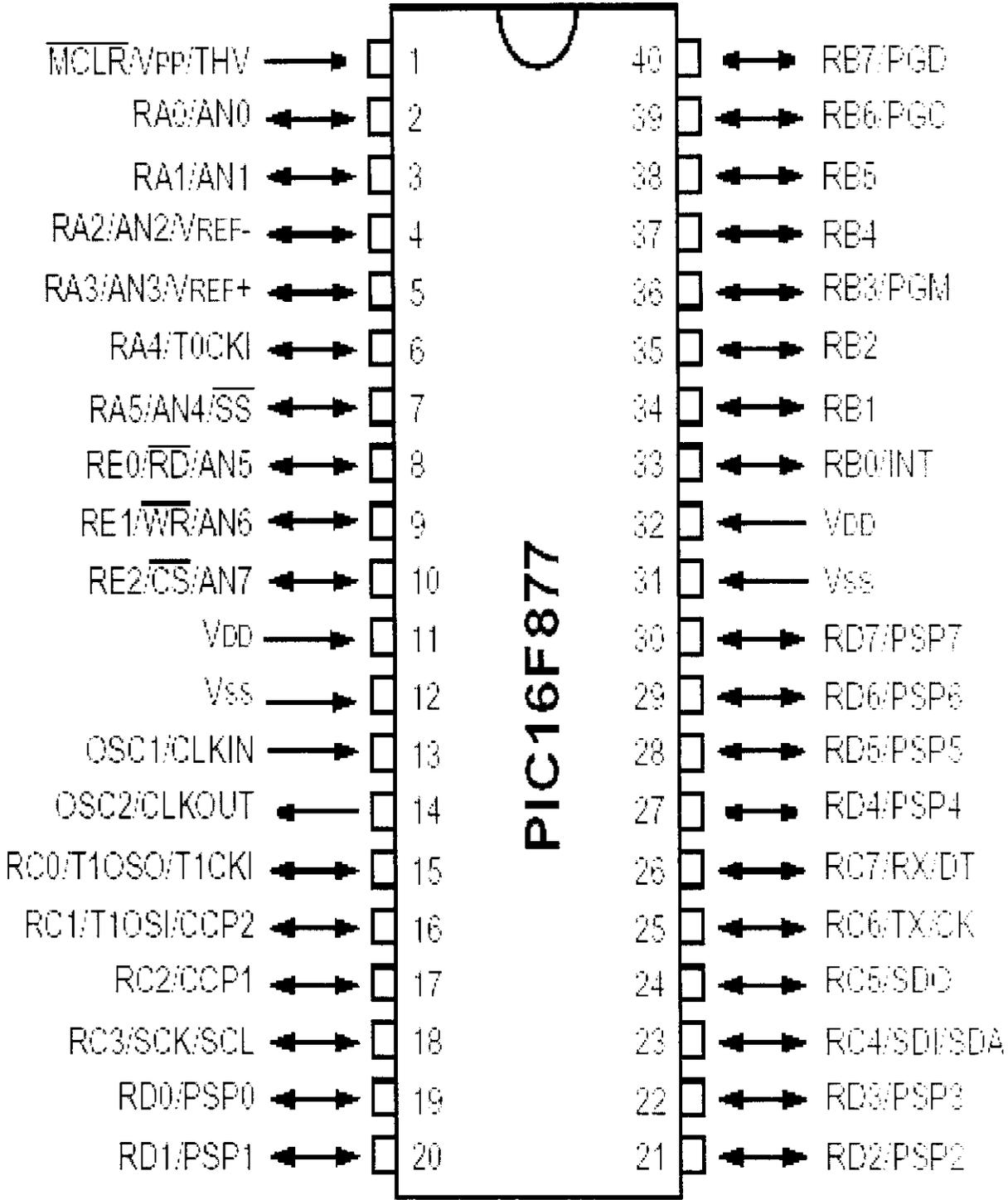


Figure 12. Voltage Follower Pulse Response (Small Signal)

PIC(16F877) PIN DIAGRAM:



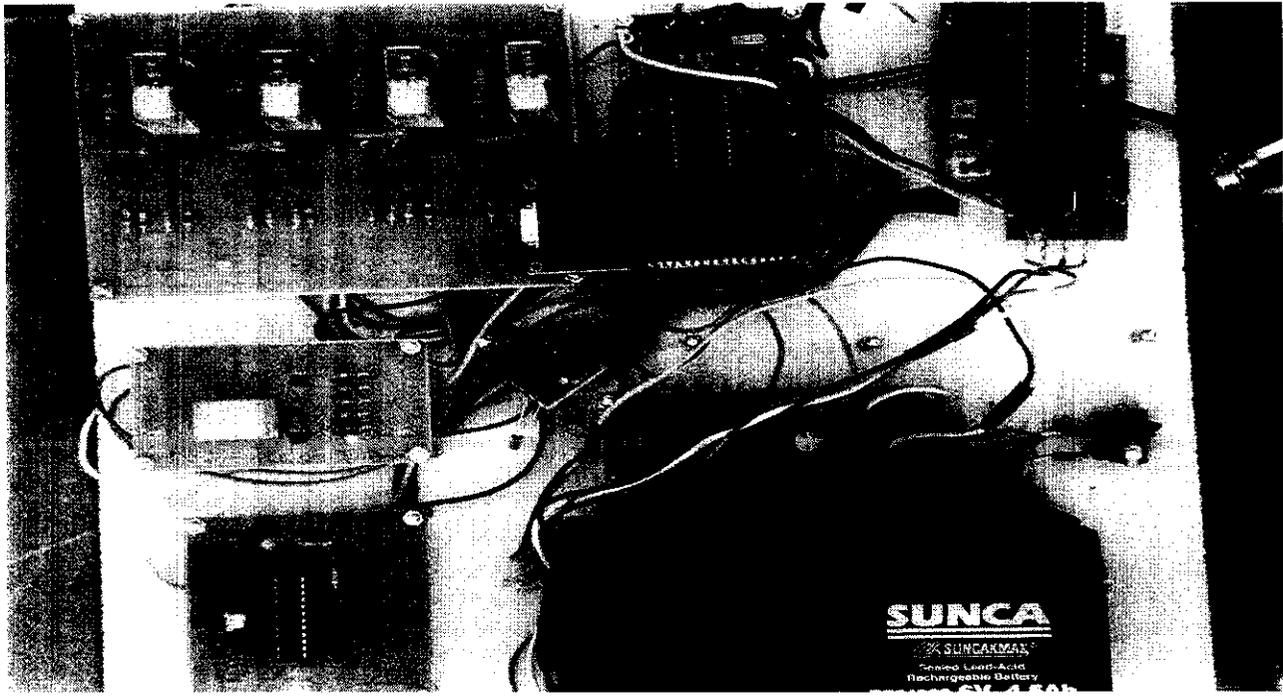
Pin Name	DIP Pin#	PLCC Pin#	QFP Pin#	I/O/P Type	Buffer Type	Description
OSC1/CLKIN	13	14	30	I	ST/CMOS ⁽⁴⁾	Oscillator crystal input/external clock source input.
OSC2/CLKOUT	14	15	31	O	—	Oscillator crystal output. Connects to crystal or resonator in crystal oscillator mode. In RC mode, OSC2 pin outputs CLKOUT which has 1/4 the frequency of OSC1, and denotes the instruction cycle rate.
MCLR/VPP/THV	1	2	18	I/P	ST	Master clear (reset) input or programming voltage input or high voltage test mode control. This pin is an active low reset to the device.
RA0/AN0	2	3	19	I/O	TTL	<p>PORTA is a bi-directional I/O port.</p> <p>RA0 can also be analog input0</p> <p>RA1 can also be analog input1</p> <p>RA2 can also be analog input2 or negative analog reference voltage</p> <p>RA3 can also be analog input3 or positive analog reference voltage</p> <p>RA4 can also be the clock input to the Timer0 timer/counter. Output is open drain type.</p> <p>RA5 can also be analog input4 or the slave select for the synchronous serial port.</p>
RA1/AN1	3	4	20	I/O	TTL	
RA2/AN2/VREF-	4	5	21	I/O	TTL	
RA3/AN3/VREF+	5	6	22	I/O	TTL	
RA4/T0CKI	6	7	23	I/O	ST	
RA5/SS/AN4	7	8	24	I/O	TTL	
RB0/INT	33	36	8	I/O	TTL/ST ⁽¹⁾	<p>PORTB is a bi-directional I/O port. PORTB can be software programmed for internal weak pull-up on all inputs.</p> <p>RB0 can also be the external interrupt pin.</p> <p>RB3 can also be the low voltage programming pin.</p> <p>Interrupt on change pin.</p> <p>Interrupt on change pin.</p> <p>Interrupt on change pin or In-Circuit Debugger pin. Serial programming clock.</p> <p>Interrupt on change pin or In-Circuit Debugger pin. Serial programming data.</p>
RB1	34	37	9	I/O	TTL	
RB2	35	38	10	I/O	TTL	
RB3/PGM	36	39	11	I/O	TTL	
RB4	37	41	14	I/O	TTL	
RB5	38	42	15	I/O	TTL	
RB6/PGC	39	43	16	I/O	TTL/ST ⁽²⁾	
RB7/PGD	40	44	17	I/O	TTL/ST ⁽²⁾	

Pin Name	DIP Pin#	PLCC Pin#	QFP Pin#	I/O/P Type	Buffer Type	Description
RC0:T10SO/T1CKI	15	16	32	I/O	ST	PORTC is a bi-directional I/O port. RC0 can also be the Timer1 oscillator output or a Timer1 clock input.
RC1:T10S/CCP2	16	18	35	I/O	ST	RC1 can also be the Timer1 oscillator input or Capture2 input/Compare2 output/PWM2 output.
RC2:CCP1	17	19	36	I/O	ST	RC2 can also be the Capture1 input/Compare1 output/PWM1 output.
RC3:SCK/SCL	18	20	37	I/O	ST	RC3 can also be the synchronous serial clock input/output for both SPI and I ² C modes.
RC4:SDI/SDA	23	25	42	I/O	ST	RC4 can also be the SPI Data In (SPI mode) or data I/O (I ² C mode).
RC5:SDO	24	26	43	I/O	ST	RC5 can also be the SPI Data Out (SPI mode).
RC6:TX/CK	25	27	44	I/O	ST	RC6 can also be the USART Asynchronous Transmitter Synchronous Clock.
RC7:RX/DT	26	29	1	I/O	ST	RC7 can also be the USART Asynchronous Receiver Synchronous Data.
RD0:PSP0	19	21	38	I/O	ST/TTL ⁽³⁾	PORTD is a bi-directional I/O port or parallel slave port when interfacing to a microprocessor bus.
RD1:PSP1	20	22	39	I/O	ST/TTL ⁽³⁾	
RD2:PSP2	21	23	40	I/O	ST/TTL ⁽³⁾	
RD3:PSP3	22	24	41	I/O	ST/TTL ⁽³⁾	
RD4:PSP4	27	30	2	I/O	ST/TTL ⁽³⁾	
RD5:PSP5	28	31	3	I/O	ST/TTL ⁽³⁾	
RD6:PSP6	29	32	4	I/O	ST/TTL ⁽³⁾	
RD7:PSP7	30	33	5	I/O	ST/TTL ⁽³⁾	
RE0:RD/AN5	8	9	25	I/O	ST/TTL ⁽³⁾	PORTE is a bi-directional I/O port. RE0 can also be read control for the parallel slave port or analog input5.
RE1:WR/AN6	9	10	26	I/O	ST/TTL ⁽³⁾	RE1 can also be write control for the parallel slave port or analog input6.
RE2:CS/AN7	10	11	27	I/O	ST/TTL ⁽³⁾	RE2 can also be select control for the parallel slave port or analog input7.
Vss	12,31	13,34	6,29	P	—	Ground reference for logic and I/O pins.
Vcc	11,32	12,35	7,28	P	—	Positive supply for logic and I/O pins.
NC	—	1,17,26,40	12,13,33,34		—	These pins are not internally connected. These pins should be left unconnected.

IR SENSING CIRCUIT



OVERTURN STABILITY CONTROL CIRCUIT



PROJECT MODEL

