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CLASSIFICATION OF EEG SIGNALS FOR DROWSINESS DETECTION IN BRAIN AND COMPUTER INTERFACE

G.Rajendra Kumar[1] ,Dr.Samuel Vara Prasada Raju[2], D. Santhosh Kumar[3]

I.T Dept., C.S.E Dept., Eng. Physics Dept, , K L University, Andhra University, VCEW
Vijayawada,Visakhapatnam, Bargarh, India
[1]rajendragk@rediffmail.com, [2]gsvpraju2011@yahoo.com, [3]dhavalasanthoshkumar@gmail.com

Abstract

Drowsiness detection system is based on identifying suitable driver-related and/or vehicle-related variables that are correlated to the driver's level of drowsiness A brain-computer interface (BCI) is a system that enables control of devices or communication with other persons, only through cerebral activity, without using muscles. The main application for BCIs is assistive technology for disabled persons. Examples for devices that can be controlled by BCIs are artificial limbs, spelling devices, or environment control systems. The system uses electroencephalogram (EEG) signals. An electroencephalogram (EEG) is a test used to detect abnormalities related to electrical activity of the brain. This procedure tracks and records brain wave patterns. Small metal discs with thin wires (electrodes) are placed on the scalp, and then send signals to a computer to record the results.

Keywords: *EEG, BCI, Disabled users, Neuro, Cortical, Micro System, Sensors, Implant, Drowsiness.*

1. Introduction

Drowsiness is transition state between awaking and sleep during which a decrease of vigilance is generally observed. After staying awake for 24 hours straight, a person will be about as impaired as if he had had enough alcohol to be legally drunk in most states, a study says. Australian researchers tested 40 people to create a "blood alcohol equivalent" for different levels of impairment from sleeplessness.

In one experiment, participants stayed awake for 28 hours. In the other, they drank alcohol every half hour until they reached a blood alcohol concentration of 0.10 percent. That's the drunken-driving standard in most American states. Every half hour, the subjects took a computerized test of hand-eye coordination. Results showed that after 24 hours of sleeplessness, participants were about as impaired as they were at the 0.10 percent level of blood alcohol. After 17 hours, they were about as impaired as they were with an alcohol level of 0.05 percent, which many Western countries define as legally drunk, the researchers said.

The design of a drowsiness detection system is based on identifying suitable driver-related and/or vehicle-related variables that are correlated to the driver's level of drowsiness. Researches on driver state monitoring has begun about thirty years ago and are still very active. The driver state monitoring systems can be classified into three kinds of system: those focusing on the vehicle behavior, those focusing on the driver physical behavior and those focusing on the driver physiological behavior.

The first systems developed were the ones using sensors monitoring the vehicle behavior. The main features studied are the steering wheel movements, the lateral position of the car on the road, the standard deviation of lateral position (SDLP) and the time to line crossing (TLC). The purpose is to detect an abnormal behavior of the car, due to the driver drowsiness. The problems encountered by this kind of methods are that the features used depend on the shape of

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the road and how one drives, which may change a lot from one driver to another.

To overcome these problems, researches have focused on systems using sensors monitoring drivers' awareness. One widespread technique to monitor the driver state is the use of a video camera. Indeed, a lot of information can be extracted from the driver face to monitor fatigue such as gaze, frequency and duration of eye blinking and yawning or percentage of eyelid closure. A lot of examples using camera to monitor the driver state can be found in the literature. These kinds of systems focus on the drivers' visual attention. Face, mouth and eye tracking algorithms are used to detect the face. Once the face, the eyes and the mouth are located, it is easy to detect eye blinking or yawning and calculate their frequency and duration. Frequency and duration of yawning or eye blinking too high indicate a decrease of attention. The gaze can be calculated with the eyes and the face position or using a stereoscopic camera. Then, it allows the driver to be warned when he is not looking at the road.

However, many differences can be observed between drivers, which makes it hard to monitor fatigue with only one feature . An interesting way of merging the different features (eye blinking, yawning, gaze...) is used by Jietal. They use probabilistic networks which allow all features to contribute to the decision of the level of attention. Moreover, external factors (weather, hour of the day, etc...) can contribute in these networks to determine the level of attention.

However, video features are not the best indicators of drowsiness. According to Dinges, the best indicators of fatigue are the physiological indicators. The electroencephalogram (EEG) and the electro-oculogram (EOG) are mainly used to study drowsiness. Yet, several researches have focused on other physiological indicators such as the electrocardiogram (ECG) to monitor drivers' heart rate or the drivers' temperature.

The EOG is the measurement of the resting potential of the retina. It gives an accurate measurement of eyes movements. Many features can be extracted from this information such as eyelid opening and closing parameters, blinks frequency, blinks amplitude, blinks duration... According to Galley et al, EOG is a relevant measure to monitor fatigue since some extracted features are really sensitive to drowsiness. One of the most efficient features extracted is the PERCLOS (PERcentage of eyelid CLOSure). This feature has been defined by Wierwille. It is the percentage of eyelid closure over the time. Knippling showed that PERCLOS is a good indicator of drowsiness that increases with fatigue.

Electroencephalography measures the electrical activity of the brain from electrodes placed over the scalp. Drowsiness appears into the EEG spectrum by an increase of activity in the frequency bands predominantly in the parietal and central regions of the brain. In the same time, a decrease of activity in the band can also be observed, as beta activity increases with cognitive tasks and active concentration. This has been shown in several studies. EEG is so efficient in detecting drowsiness that it is often used as a reference indicator. In this case, the reference is built by expert doctors who visually observe the proportion of alpha and theta activity on a short-time window as in . The analysis is done off-line and is time consuming.

In order to make the analysis of drowsiness in an automatic way, the EEG power spectrum can be computed using Fast Fourier Transform or using wavelets Transform but none of these techniques seems better than the other. The number of EEG channels used to monitor drowsiness fluctuates from a few to about thirty. The advantage of using a large number of EEG channels is to obtain spatial information on how the EEG energy is shifting from one frequency band to another. However, using only a few EEG channels is faster and easier to compute.

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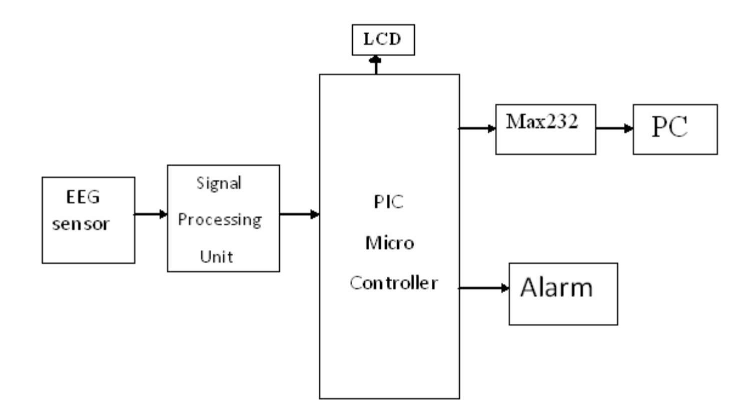

Block Diagram for Drowsiness Detection

2. Block Diagram

2.1 EEG Sensor:

The EEG sensor detects and amplifies the small electrical voltages that are generated by brain cells (neurons) when they fire. Similarly to muscle fibers, neurons of different locations can fire. The frequencies most commonly looked at, for EEG, are between 1 and 40 Hz. The EEG sensor records a “raw” EEG signal, which is the constantly varying difference of potential between the positive and negative electrode, and the software processes that signal by applying a variety of digital filters to the recorded signal, in order to extract frequency-domain information.

An electroencephalogram (EEG) is a test used to detect abnormalities related to electrical activity of the brain. This procedure tracks and records brain wave patterns. Small metal discs with thin wires (electrodes) are placed on the scalp, and then send signals to a computer to record the results. Normal electrical activity in the brain makes a recognizable pattern. Through an EEG, doctors can look for abnormal patterns that indicate seizures and other problems. In neurology, the main diagnostic application of EEG is in the case of epilepsy, as epileptic activity can create clear abnormalities on a standard EEG study. A secondary clinical use of EEG is in the diagnosis of coma, and brain death.

The most common reason an EEG is performed is to diagnose and monitor seizure disorders. EEGs can also help to identify causes of other problems such as sleep disorders and changes in behavior. EEGs are sometimes used to evaluate brain activity after a severe head injury or before heart or liver transplantation.

2.2 Signal processing unit:

This unit is used to processes EEG signal from EEG sensor. We know that signal from any sensor has low signal to noise ratio. This unit will help amplify and increases SNR.

This unit generally contains instrumentional amplifiers, filters, isolation circuits, modulators and demodulator’s etc. instrumentional amplifier is one of the important circuits in this unit which gives relevant signal to microcontroller.

2.3 PIC micro controller:

Micro controller is a standalone unit, which can perform functions on its own without any requirement for additional hard ware like I/O ports and external memory. It is also called as ‘computer on chip’.

Microcontrollers are destined to play an increasingly important role in revolutionizing various industries and influencing our day to day life more strongly than one can imagine. Since its emergence in the early 1980's the microcontroller has been recognized as a general purpose building block for intelligent digital systems. It is finding using diverse area, starting from simple children's toys to highly complex spacecraft. Because of its versatility and many advantages, the application domain has spread in all conceivable directions, making it ubiquitous. As a

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consequence, it has generate a great deal of interest and enthusiasm among students, teachers and practicing engineers, creating an acute education need for imparting the knowledge of microcontroller based system design and development. It identifies the vital features responsible for their tremendous impact; the acute educational need created by them and provides a glimpse of the major application area.

The microcontroller that has been used for this project is from PIC series. PIC microcontroller is the first RISC based microcontroller fabricated in CMOS (complementary 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.

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.

2.4Alarm:

An alarm gives an audible or visual warning of a problem or condition.

Alarm includes:

Burglar alarms, designed to warn of intrusions; this is often a silent alarm the police or guards are warned without indication to the burglar, which increase the chances of catching him or her. Alarm clocks can produce an alarm at given time. Distributed control manufacturing system or DCS's found in nuclear power plants, refineries and chemical facilities also generate alarm to direct the operator's attention to an important event that he or she needs to address. Alarm in an operation and maintenance monitoring system, which informs the bad working state of system under monitoring.

Alarms have the capability of causing a fight-or-flight response in humans; a person under this mindset will panic and either flees the perceived danger or attempt to eliminate it, often ignoring rational thought in either case. We can characterize a person in such a state as "alarmed".

With any kind of alarm, the need exists to balance between on the hand the danger of false alarm (called "false positive") - the signal going off in the absence of a problem –and on the other hand failing to signal an actual problem (called a "false negative"). False alarm can waste resource expensively can even be dangerous.

2.5Max232:

RS-232 is a standard by which two serial devices communicate:

- The connection must be no longer than 50 feet.
- Transmission voltages are –15V and +15V.
- It is designed around transmission of *characters* (of 7 bits of length).

RS-232 communication is dependent on a set timing speed at which both pieces of hardware communicate. In other words, the hardware knows how long a bit should high or low be. RS-232 also specifies the use of "start" and "stop" bits.

2.6 Personal computer:

Personal computer is used to visualize electroencephalograph by using graphical user interface (GUI) i.e., by using visual basics software. This graph helps us to diagnose level of consciousness.

2.7 Liquid Crystal Display (Lcd):

Liquid crystal displays (LCD's) have materials, which combine the properties of both liquids and crystals. Rather than having a melting point, they have a temperature range within which the

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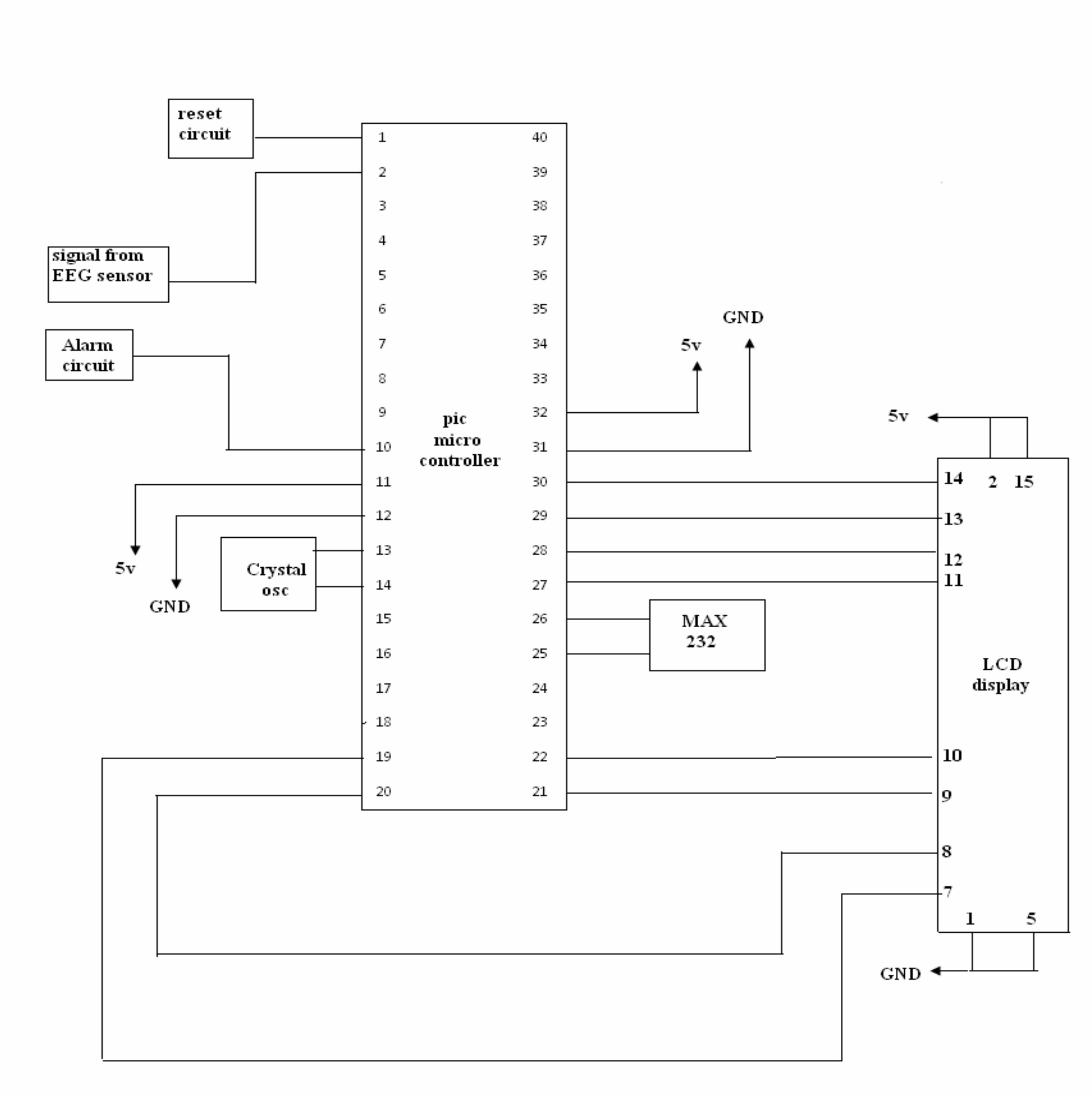
molecules are almost as mobile as they would be in a liquid, but are grouped together in an ordered form similar to a crystal.

An LCD consists of two glass panels, with the liquid crystal material sand witched in between them. The inner surface of the glass plates are coated with transparent electrodes which define the character, symbols or patterns to be displayed polymeric layers are present in between the electrodes and the liquid crystal, which makes the liquid crystal molecules to maintain a defined orientation angle.

3. Design Considerations



Interfacing Diagram

The microcontroller that has been used for this project is PIC16F877. Any device work with some voltage, we known that micro controller works with 5v which is connected to 12 & 31 pins and 11 & 32 pins are connected to ground. Crystal oscillator is important to run any micro controller here crystal oscillator is connected to 13 & 14 pins of micro controller.

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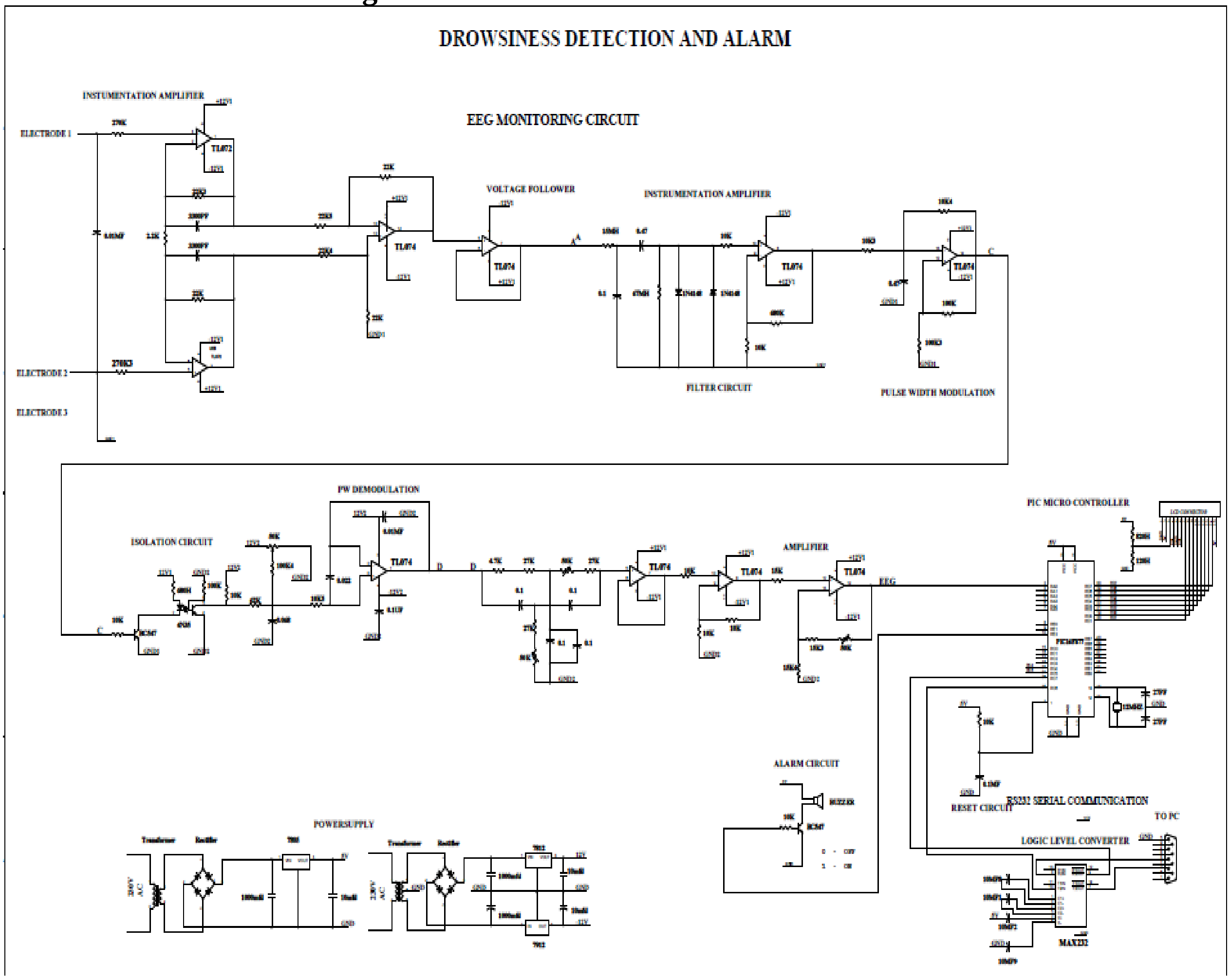
PIC16F877 has 5 ports. Port A & E contain analog input pins so, EEG signal which is analog in nature is connected to pin 2. Pin 1 is reset pin so; it is connected to reset circuit. Port D in PIC is parallel port so, LCD (liquid crystal display) which receives data in parallel is connected to port D (which is pin 19, 20, 21, 22, 27, 28, 29, 30).serial communication is done in PIC through the port C by the pins 25 & 26 pins.

4. Implementation

4.1 Over all circuit diagram :



Circuit Diagram of Drowsiness Detection

4.2 Power supply description:

The ac voltage, typically 120 V rms, is connected to a transformer, which steps that ac voltage down to the level for the desired dc output. A diode rectifier then 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. A regulator circuit can use this dc input to provide a dc voltage that not only has much less ripple voltage but also remains the same dc value even if the input dc voltage varies somewhat, or the load connected to the output dc voltage changes. This voltage regulation is usually obtained using one of a number of popular voltage regulator IC units.

Transformer

The potential transformer will step down the power supply voltage (0-230V) to (0-6V) level. Then the secondary of the potential transformer will be connected to the precision rectifier, which is

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constructed with the help of op–amp. The advantages of using precision rectifier are it will give peak voltage output as DC; rest of the circuits will give only RMS output.

Bridge rectifier

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.

Let us assume that the transformer is working properly and 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. this path is indicated by the solid arrows. Waveforms (1) and (2) can be observed across D1 and D3.

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. This path is indicated by the broken arrows. Waveforms (3) and (4) can be observed across D2 and D4. The current flow through RL is always in the same direction. In flowing through RL this current develops a voltage corresponding to that shown waveform (5). 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.

This may be shown by assigning values to some of the components shown in views A and B. assume that the same transformer is used in both circuits. The peak voltage developed between points X and y is 1000 volts in both circuits. In the conventional full-wave circuit shown—in view A, the peak voltage from the center tap to either X or Y is 500 volts. Since only one diode can conduct at any instant, the maximum voltage that can be rectified at any instant is 500 volts.

The maximum voltage that appears across the load resistor is nearly-but never exceeds-500 v0lts, as result of the small voltage drop across the diode. In the bridge rectifier shown in view B, the maximum voltage that can be rectified is the full secondary voltage, which is 1000 volts. Therefore, the peak output voltage across the load resistor is nearly 1000 volts. With both circuits using the same transformer, the bridge rectifier circuit produces a higher output voltage than the conventional full-wave rectifier circuit.

IC voltage regulators

Voltage regulators comprise a class of widely used ICs. 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 regulators can be selected for operation with load currents from hundreds of milli amperes to tens of amperes, corresponding to power ratings from milli watts to tens of watts.

Three - Terminal Voltage Regulators:

Fig shows the basic connection of a three-terminal voltage regulator IC to a load. The fixed voltage regulator has an unregulated dc input voltage, VI, applied to one input terminal, a regulated output dc voltage, VO, from a second terminal, with the third terminal connected to ground. For a selected regulator, IC device specifications list a voltage range over which the input voltage can vary to maintain a regulated output voltage over a range of load current. The specifications also list

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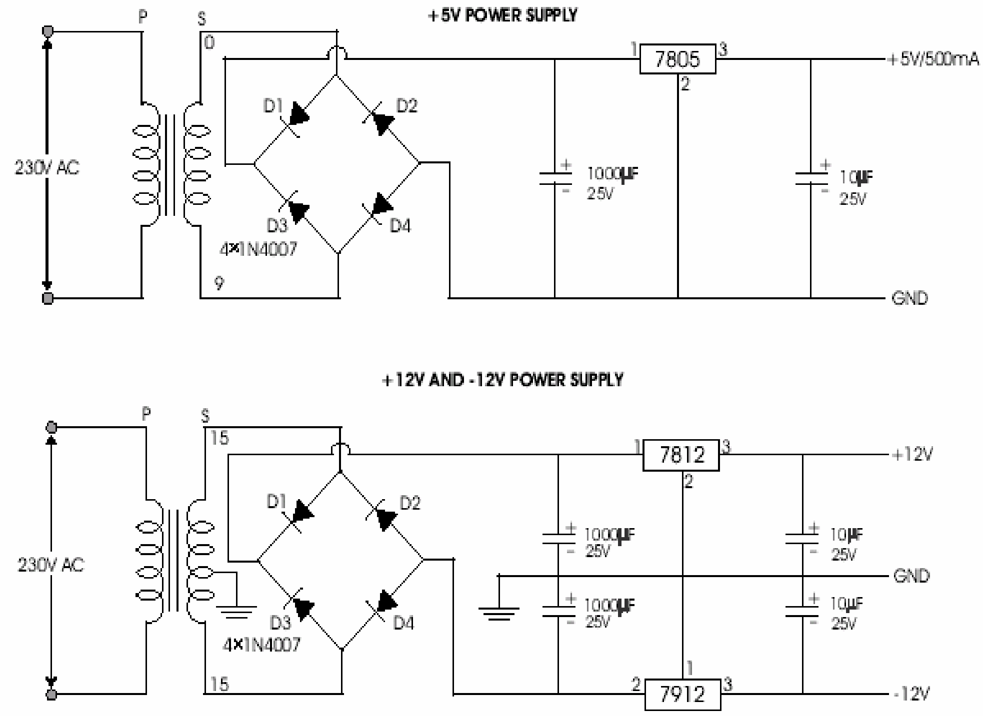
the amount of output voltage change resulting from a change in load current (load regulation) or in input voltage (line regulation).

The series 78 regulators provide fixed regulated voltages from 5 to 24 V. Figure 19.26 shows how one such IC, a 7812, is connected to provide voltage regulation with output from this unit of +12V dc. An unregulated input voltage VI is filtered by capacitor C1 and connected to the IC's IN terminal. The IC's OUT terminal provides a is which is filtered by capacitor C2 (mostly for any high-frequency noise). The third IC terminal is connected to ground (GND). While the input voltage may vary over some permissible voltage range, and the output load may vary over some acceptable range, the output voltage remains constant within specified voltage variation limit.



Power Supply Block

An unregulated input voltage VI is filtered by capacitor C1 and connected to the IC's IN terminal. The IC's OUT terminal provides a regulated + 12V which is filtered by capacitor C2 (mostly for any high-frequency noise). The third IC terminal is connected to ground (GND). While the input voltage may vary over some permissible voltage range, and the output load may vary over some acceptable range, the output voltage remains constant within specified voltage variation limits. These limitations are spelled out in the manufacturer's specification sheets. A table of positive voltage regulated ICs is provided in table.

IC Port	**Output Voltage (V)**	**Minimum Vi (V)**
7805	+5	7.3
7806	+6	8.3
7808	+8	10.5
7810	+10	12.5
7812	+12	14.6
7815	+15	17.7
7818	+18	21.0
7824	+24	27.1

Voltage Regulators in 7800 series

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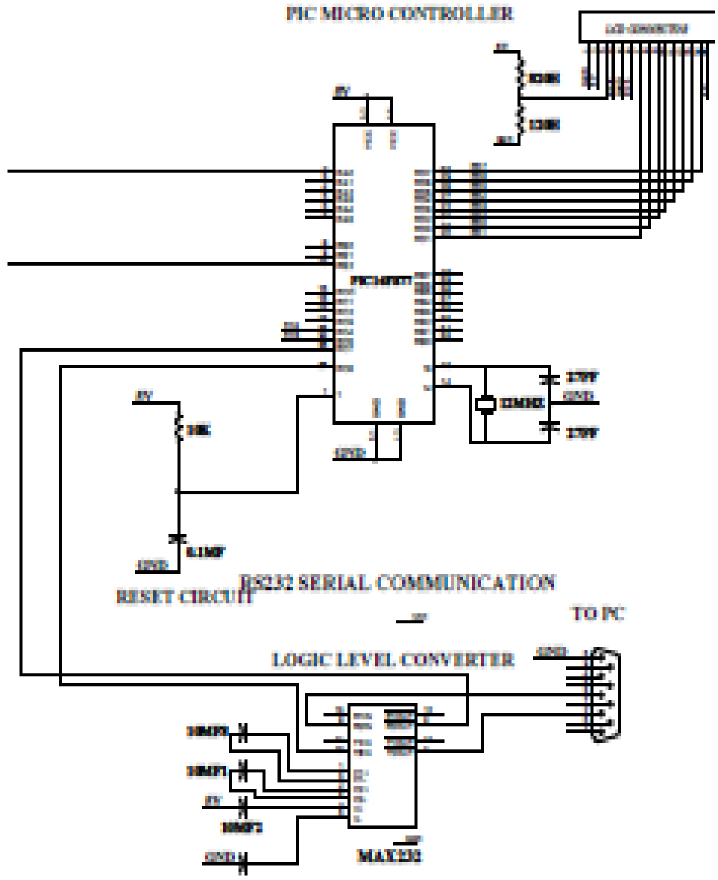
4.3 microcontroller circuit:



Micro Controller

The microcontroller circuit is connected with reset circuit, crystal oscillator circuit; LCD circuit the reset circuit is the one which is an external interrupt which is designed to reset the program. And the crystal oscillator circuit is the one used to generate the pulses to microcontroller and it also called as the heart of the microcontroller here we have used 12mhz crystal which generates pulses up to 12000000 frequency which is converted it machine cycle frequency when divided by 4 which is equal to 3000000hz to find the time we have to invert the frequency so that we get one micro second for each execution of the instruction.

The LCD that is liquid crystal display which is used to display the what we need the lcd has fourteen pins in which three pins for the command and eight pins for the data. If the data is given to LCD it is write command which is configured by the programmer otherwise it is read command in which data read to microcontroller the data pins are given to the port D and command pins are given to the port E .Other than these pin a one pin configured for the contrast of the LCD. Thus the microcontroller circuit works.

4.4 Processing of EEG signal:

In this circuit there are three electrodes are used to measure the EEG waves in which two electrodes are fixed with left and right side of the head another one electrode acts as reference ground electrode. Electrode 1 and Electrode 2 pick up the EEG waves from the both hands. Then the EEG waves are given to instrumentation amplifier section.

Instrumentation amplifier:

The instrumentation amplifier is constructed by the TL 072 operational amplifier. The TL072 are high speed J-FET input dual operational amplifier incorporating well matched, high voltage J-

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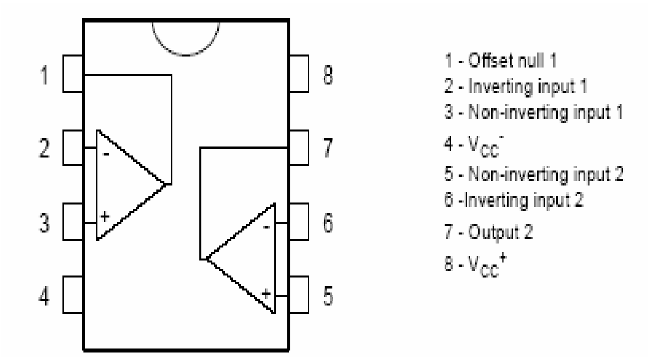
FET and bipolar transistors in a monolithic integrated circuit. The devices' feature high slew rates, low input bias and offset current and low offset voltage temperature coefficient.



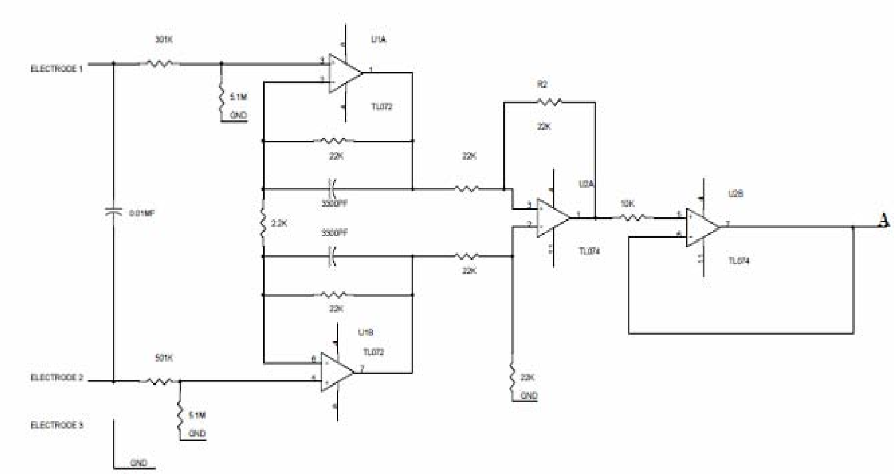
Pin diagram of instrumentation amplifier

The instrumentation amplifiers amplify the differential signal from the both electrode. This amplified EEG waves contains the line frequency, high frequency and low frequency noise signals. So the EEG wave is fed to filter section. The filter section consists of high pass filter and low pass filter which is used to remove the high frequency and low frequency noise signal. After the filtration the EEG wave is given to pulse width modulation unit. In this section the EEG wave converts to pulse format in order to perform the isolation. The isolation is constructing by the optic coupler. The isolation is necessary to isolate the human body and monitoring equipment such as CRO, PC etc.

Then the EEG pulse format wave is given to PWM demodulation unit in which the pulse format is reconstruct to original wave. Then the wave is fit to notch filter section in order to remove the line frequency noise signal.

A notch filter is a band-stop filter with a narrow stop band (high Q factor). Notch filters are used in live sound reproduction (Public Address systems, also known as PA systems) and in instrument amplifier (especially amplifiers or preamplifiers for acoustic instruments such as acoustic guitar, mandolin, bass instrument amplifier, etc.) to reduce or prevent feedback, while having little noticeable effect on the rest of the frequency spectrum. Other names include 'band limit filter', 'T-notch filter', 'band-elimination filter', and 'band-rejection filter'.

Typically, the width of the stop band is less than 1 to 2 decades (that is, the highest frequency attenuated is less than 10 to 100 times the lowest frequency attenuated). In the audio band, a notch filter uses high and low frequencies that may be only semitones apart. Here the notch filter is constructed by the operational amplifier TL074. Finally noise free EEG wave is given to amplifier. Then the amplified signal is given to monitored device such as CRO, PC etc.



Instrumentation amplifier circuit

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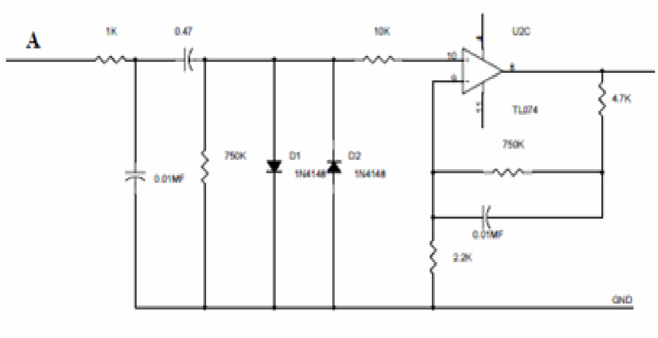
Filter Circuit:

Electronic filters a circuit which perform signal processing functions, specifically to remove unwanted frequency components from the signal, to enhance wanted ones, or both. A common need for filter circuits is in high-performance stereo systems, where certain ranges of audio frequencies need to be amplified or suppressed for best sound quality and power efficiency. You may be familiar with *equalizers*, which allow the amplitudes of several frequency ranges to be adjusted to suit the listener's taste and acoustic properties of the listening area. You may also be familiar with *crossover networks*, which block certain ranges of frequencies from reaching speakers. A tweeter (high-frequency speaker) is inefficient at reproducing low-frequency signals such as drum beats, so a crossover circuit is connected between the tweeter and the stereo's output terminals to block low-frequency signals, only passing high-frequency signals to the speaker's connection terminals. This gives better audio system efficiency and thus better performance. Both equalizers and crossover networks are examples of filters, designed to accomplish filtering of certain frequencies.



Filter

Pulse width modulator:

Pulse-width modulation (PWM), or pulse-duration modulation (PDM), is a commonly used technique for controlling power to inertial electrical devices, made practical by modern electronic power switches.

The average value of voltage (and current) fed to the load is controlled by turning the switch between supply and load on and off at a fast pace. The longer the switch is on compared to the off periods, the higher the power supplied to the load is.

The PWM switching frequency has to be much faster than what would affect the load, which is to say the device that uses the power. Typically switching's have to be done several times a minute in an electric stove, 120 Hz in a lamp dimmer, from few kilohertz (kHz) to tens of kHz for a motor drive and well into the tens or hundreds of kHz in audio amplifiers and computer power supplies.

The term *duty cycle* describes the proportion of 'on' time to the regular interval or 'period' of time; a low duty cycle corresponds to low power, because the power is off for most of the time. Duty cycle is expressed in percent, 100% being fully on.

The main advantage of PWM is that power loss in the switching devices is very low. When a switch is off there is practically no current, and when it is on, there is almost no voltage drop across the switch. Power loss, being the product of voltage and current, is thus in both cases close to zero. PWM also works well with digital controls, which, because of their on/off nature, can easily set the needed duty cycle.

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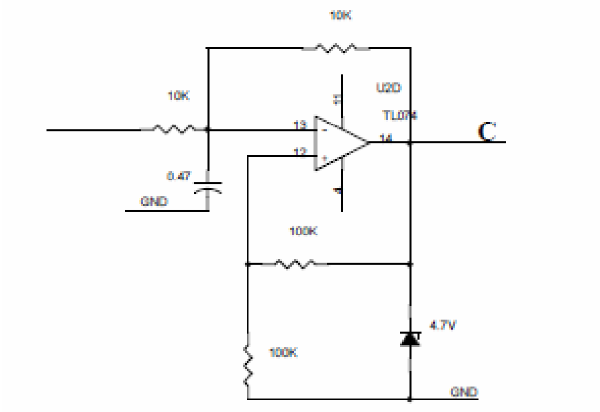
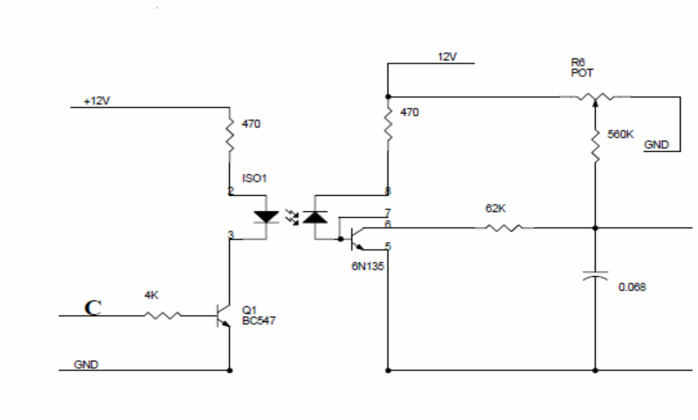


Pulse Width Modulator

Isolator:

The isolation circuit is coupled between a master circuit and a slave circuit for isolating or conducting an inter integrated circuit (I2C) signal. While the master circuit has electricity and the slave circuit does not, the isolation circuit isolates the master circuit Isolator switches have provisions for a padlock so that inadvertent operation is not possible. In high voltage or complex systems, these padlocks may be part of a trapped-key interlock system to ensure proper sequence of operation. In some designs the isolator switch has the additional ability to earth the isolated circuit thereby providing additional safety. Such an arrangement would apply to circuits which inter-connect power distribution systems where both end of the circuit need to be isolated.

The major difference between an isolator and a circuit breaker is that an isolator is an *off-load* device intended to be opened only after current has been interrupted by some other control device. Safety regulations of the utility must prevent any attempt to open the disconnected while it supplies a circuit. Standards in some countries for safety may require either local motor isolators or lockable overloads.



Isolator

PWM demodulator:

A demodulator for a pulse width modulated signal comprises a counter arranged to count in one direction when the PWM signal is "high" and in the opposite direction when the PWM signal is "low" to arrive at a count representative of a duty cycle. As a result, a value representative of the duty ratio of the PWM signal can be obtained from the up/down counter. In a further embodiment, the up/down counter is clocked by the output of a frequency multiplier, the output of the frequency multiplier having a frequency determined by the pulse width modulated signal frequency multiplied by a predetermined factor. The value of the duty ratio of the PWM signal can then be found regardless of the frequency of the PWM signal.

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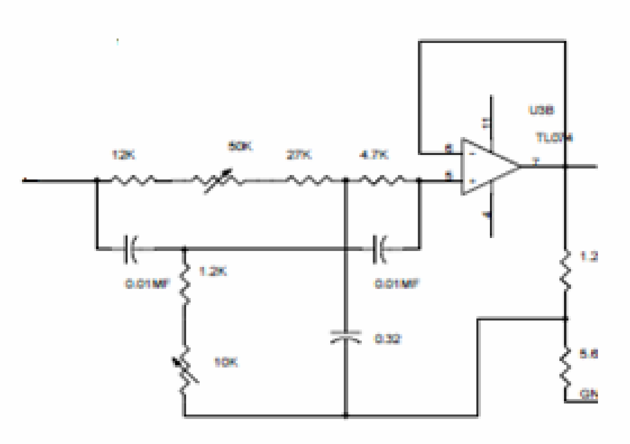
Notch filter:

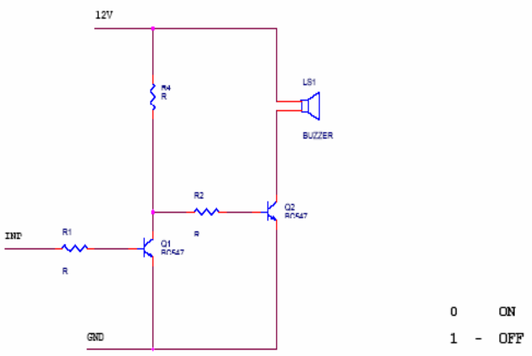
A notch filter is a band-stop filter with a narrow stop band (high Q factor). Narrow notch filters (optical) are used in Raman spectroscopy, live sound reproduction (Public Address systems, also known as PA systems) and in instrument amplifier (especially amplifiers or preamplifiers for acoustic instruments such as acoustic guitar, mandolin, bass instrument amplifier, etc.) to reduce or prevent feedback, while having little noticeable effect on the rest of the frequency spectrum (electronic or software filters).



Notch filter

4.5 Alarm:

A buzzer or beeper is a signaling 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 that determines if and which button was pushed or a preset time has lapsed, and usually illuminates a light on the appropriate button or control panel, 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).



Alarm

Often these units were anchored to a wall or ceiling and used the ceiling or wall as a sounding board. Another implementation with some AC-connected devices was to implement a circuit to make the AC current into a noise loud enough to drive a loudspeaker and hook this circuit up to a cheap 8-ohm speaker. Nowadays, it is more popular to use a ceramic-based piezoelectric sounder like a Son alert which makes a high-pitched tone. Usually these were hooked up to "driver" circuits which varied the pitch of the sound or pulsed the sound on and off.

Circuit description:

The circuit is designed to control the buzzer. The buzzer ON and OFF is controlled by the pair of switching transistors (BC 547). The buzzer is connected in the Q2 transistor collector terminal.

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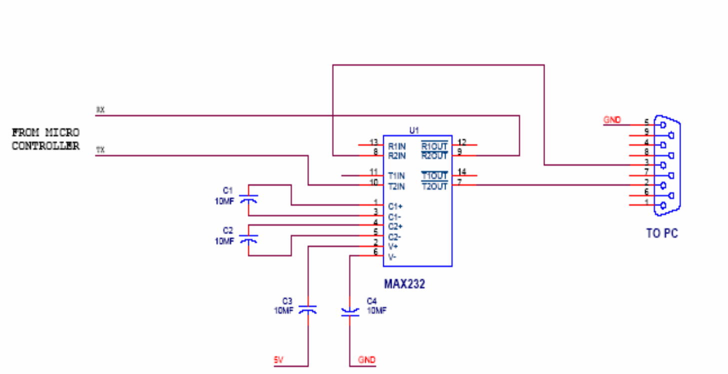
When high pulse signal is given to base of the Q1 transistors, the transistor is conducting and close the collector and emitter terminal so zero signals is given to base of the Q2 transistor. Hence Q2 transistor and buzzer is turned OFF state.

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 buzzer is energized and produces the sound signal.

4.6 Serial Communication:



Serial Communication

Serial data communication uses two methods, a synchronous and synchronous. The synchronous method transfers a block of data at a time while the synchronous transfers a single byte at a time. It is mean possible to write software to use either of these methods, but the programs can be tedious and long. For this reason, there are special IC chips made by many manufacturers for serial data communications. These chips are commonly referred to as UART (universal asynchronous receiver-transmitter) and USART (universal synchronous -asynchronous receiver-transmitter).

RS232 STANDARDS:

Two allow compatibility among the data communication equipment made by various manufacturers; an interfacing standard called RS232, was set by the electronics industries association (EIA) in 1960. RS 232 is the standard defined for the connection of "Data Terminal Equipment" (DTE) to "Data Communications Equipment" (DCE). DTE (Data Terminal Equipment) is a generic term for an item which forms part of the "information processing" portions of a system. Examples are: computer, printer, and terminal. DCE is a device, which provides an interface between a DTE and a communications link.

In RS 232, a 1 is represented by -3 to -25V which is called Mark, while a 0 bit is + 3 to + 25V which is called Space. To connect any RS 232 to a µc system, voltage converters such as Max 232are used. Max 232 IC chips are commonly referred to as line drivers.8.3. MAX 232. The RS 232 is not compatible with micro controllers, so a line driver converts the RS 232's signals to TTL voltage levels.

Circuit working Description:

In this circuit the MAX 232 IC used as level logic converter. The MAX232 is a dual driver/receiver that includes a capacitive voltage generator to supply EIA 232 voltage levels from a single 5v supply. Each receiver converts EIA-232 to 5v TTL/CMOS levels. Each driver converts TLL/CMOS input levels into EIA-232 levels.

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EACH DRIVER

INPUT TIN	OUTPUT TOUT
L	H
H	L

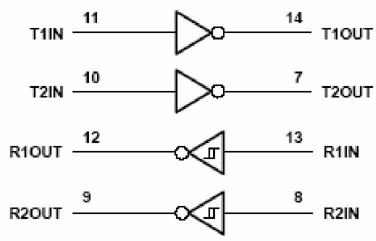
H = high level, L = low level

EACH RECEIVER

INPUT RIN	OUTPUT ROUT
L	H
H	L

H = high level, L = low level

Functional table of max232



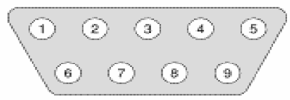
Logic diagram of MAX232

In this circuit the microcontroller transmitter pin is connected in the MAX232 T2IN pin which converts input 5v TTL/CMOS level to RS232 level. Then T2OUT pin is connected to reviver pin of 9 pin D type serial connector which is directly connected to PC.

In PC the transmitting data is given to R2IN of MAX232 through transmitting pin of 9 pin D type connector which converts the RS232 level to 5v TTL/CMOS level. The R2OUT pin is connected to receiver pin of the microcontroller. Likewise the data is transmitted and received between the microcontroller and PC or other device vice versa.

Flow Control and Hardware Handshaking:

RTS/CTS: These signals are often now used to throttle the rate at which data is delivered between a DTE and modem: the DTE "drops" RTS when its buffers are nearly full, and the modem does the same using the CTS signal. This is nowadays referred to as "hardware handshaking". It's worth noting that modern high-speed modems almost universally use the RTS/CTS pair for this purpose. In fact, without hardware handshaking, data compression in modems would not be possible.



DB-9 Connector Pin Out

Pin #	Signal Name	Signal Description
1	CD	Carrier Detect
2	RXD	Receive Data
3	TXD	Transmit Data
4	DTR	Data Terminal Ready
5	GND	Signal Ground / Common
6	DSR	Data Set Ready
7	RTS	Request To Send
8	CTS	Clear To Send
9	RI	Ring Indicator

SIGNAL DESCRIPTION OF MAX232

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4.7 LIQUID CRYSTAL DISPLAY [LCD]:

The LCD is used for the purpose of displaying the words which we are given in the program code. This code will be executed on microcontroller chip. By following the instructions in code the LCD display the related words. Fig.5.6 shows the LCD display.

Introduction

LCD Display

The LCD display consists of two lines, 20 characters per line that is interfaced with the PIC16F73.The protocol (handshaking) for the display is as shown in Fig. The display contains two internal byte-wide registers, one for commands (RS=0) and the second for characters to be displayed (RS=1). It also contains a user-programmed RAM area (the character RAM) that can be programmed to generate any desired character that can be formed using a dot matrix. To distinguish between these two data areas, the hex command byte 80 will be used to signify that the display RAM address 00h will be chosen Port1 is used to furnish the command or data type.

A liquid crystal is a material (normally organic for LCDs) that will flow like a liquid but whose molecular structure has some properties normally associated with solids. The Liquid Crystal Display (LCD) is a low power device. The power requirement is typically in the order of microwatts for the LCD. It is limited to a temperature range of about 0°C to 60°C and lifetime is an area of concern, because LCDs can chemically degrade.

There are two major types of LCDs which are:

- Dynamic-scattering LCDs and
- Field-effect LCDs

The turn-on and turn-off time is an important consideration in all displays. The response time of LCDs is in the range of 100 to 300ms.The lifetime of LCDs is steadily increasing beyond 10,000+hours limit. Since the color generated by LCD units is dependent on the source of illumination, there is a wide range of color choice.

LCD has 14 pins. The function of each pin is given shows the positions for various LCD.

VCC, VSS and VEE:

While VCC and VSS provide + 5 V and ground respectively, VEE is used for controlling LCD contrast.

RS, REGISTER SELECT:

There are two very important registers inside LCD. The RS pin is used for their selection as follows. Is RS= 0, the instruction command code register is selected, allowing the user to send a command such as clear display, Cursor at home, etc. if RS=1 the data register is selected, allowing the user to send data to be displayed on the LCD.

R/W, READ/WRITE:

R/W input allows the user to write information into the LCD or read information from it. R/W=1 when reading; R/W=0 when writing.

E, ENABLE:

The LCD to latch information presented to its data pins uses the enable pin. When data is supplied to data pins, a high to low pulse must be applied to this pin in order for the LCD to latch in the data present at the data pins. This pulse must be a minimum of 450 ns wide.

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D0-D7:

The 8-bit data pins, D0-D7, are used to send information to the LCD or read the contest of the LCD internal registers.

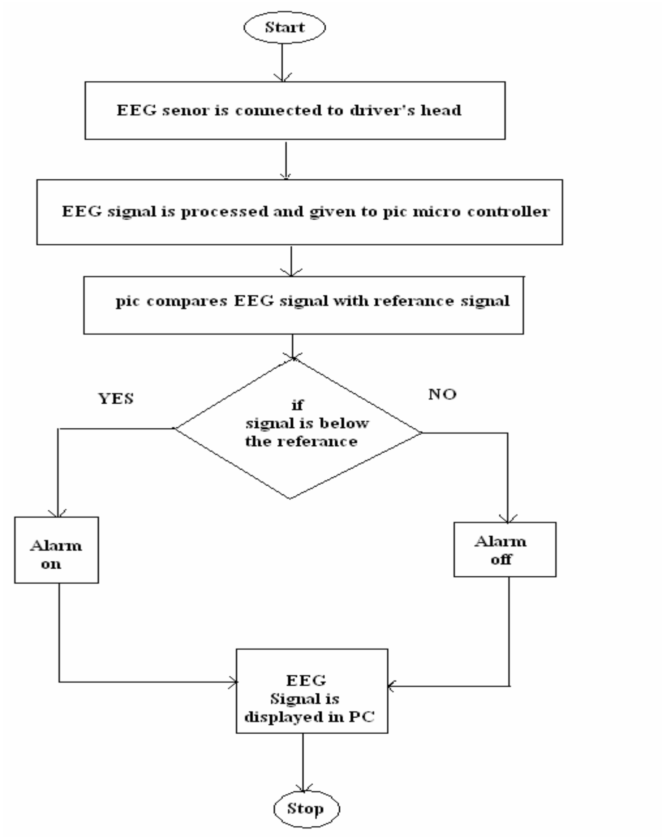
To display letters and numbers, we send ASCII codes for the letters A-Z, a-z, and numbers 0-9 to these pins while making RS=1. We also use RS= 0to check the busy flag bit to see if the LCD ready to receive. The busy flag isD7 and can be read when R/W=1 and RS= 0, as follows: if R/w=1 and RS = 0. When D7 =1, the LCD is busy taking care of internal operations and will not accept any new information. WhenD7=0, the LCD is ready to receive new information.

4.2 Software implementation

4.2.1 Algorithm:

Step1 : start
Step2 : EEG sensor is connected to drivers head
Step3 : EEG signal is processed and given to PIC microcontroller
Step4 : PIC compares the EEG signal with the reference signal
Step5 : If the signal is below the reference signal ALARAM is ON otherwise it will be in OFF state
Step6 : EEG signal is displayed on the PC
Step7 : stop

4.2.2 Flow chart:



5.1 Future Enhancement:

In this project we used wired transmission of EEG signals. But we can use wireless transmission by using zigbee, wi5, etc for EEG signal transmission. And also we can use micro electrodes instead of this surface electrode which will give more accurate values.

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5.2 Conclusion:

The primary object of this project is to provide a drowsiness detection system and a method there of that detects the driver's fatigability in time by a processing circuit that processes an EEG (electroencephalogram) signal. In order to achieve this object, the present invention includes an EEG detection circuit, a micro-control circuit and a processing circuit. The way to detect drowsiness of the driver is by the EEG detection circuit to get an EEG signal of a human brain. The micro-control circuit receives the EEG signal and generates a control signal that is sent to the processing circuit. In accordance with the control signal, the processes and analyzes the EEG signal so as to learn the fatigability of the person.

Moreover, the processing circuit includes a conversion unit, a processing unit and a recognition unit. The conversion unit receives and converts the EEG signal into a conversion signal while the processing unit receives and processes the conversion signal to generate a processing signal that is sent to the recognition unit for generating a detection result related to the drowsiness of the body. The detection result is sent back to the micro-control circuit for output of the detection result.

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