GALVANIC SKIN RESPONSE METER

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CERTIFICATE

This is to certify that the work entitled **Galvanic Skin Response Meter** submitted by Sahil Sanan, Nipun Rai Handa and Nitesh Panda in partial fulfillment for award of degree of Bachelor of Technology (Electronics And Communication Engineering) of Jaypee University of Information Technology has been carried out under my supervision.

This work has not been submitted partially or wholly to any other university or institution for award of this or any other degree programme.

Signature of Supervisor ....

Name of Supervisor Ms. Vanita Rana

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Date 24-05-2011

ACKNOWLEDGMENT

We take this opportunity to express our profound sense of gratitude and respect to all those who helped us throughout the duration of our project.

This report acknowledges the intense driving and technical competence of all the individuals who have contributed to it. It would have been almost impossible to produce fruitful results during the working of the project without the support of those people. We extend our thanks and gratitude to our Project Guide Ms. Vanita Rana who has helped us at every step. She spent her valuable time from her busy schedule to train us and provided her active and sincere support for our daily activities.

I would like to express my heartfelt thanks to Prof. Dr. Sunil Bhooshan, H.O.D., Electronics And Communication Department, Jaypee University of Information Technology, for his astute guidance, his constant encouragement and support throughout.

This report has been compiled by the sincere and active support from our guide who provided us proper guidance and direction regarding various problems. We have tried our best to summarize this report.

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SUMMARY

Skin conductance, also known as **Galvanic Skin Response** (GSR) is a method of measuring the electrical conductance of the skin, which varies with its moisture level. This is of interest because the sweat glands are controlled by the sympathetic nervous system-so skin conductance is used as an indication of psychological or physiological arousal.

The device measures the electrical conductance (which is the inverse of the electrical resistance between 2 points, and is essentially a type of ohmmeter. The two paths for current are along the surface of the skin and through the body. Active measuring involves sending a small amount of current through the body.

Due to the response of the skin and muscle tissue to external and internal stimuli, the conductance can vary by several microsiemens. When correctly calibrated, the skin conductance can measure these subtle differences. There is a relationship between sympathetic activity and emotional arousal, although one cannot identify which specific emotion is being elicited. The GSR is highly sensitive to emotions in some people.

By implementing this design on cars a safe car journey is possible decreasing the accident rate by indicating a person's body stress level.

LIST OF FIGURES

CHAPTER 1

1.1 INTRODUCTION

Skin conductance, also known as **galvanic skin response** (GSR), **or skin conductance response** (SCR) is a method of measuring the electrical conductance of the skin, which varies with its moisture level. This is of interest because the sweat glands are controlled by the sympathetic nervous system so skin conductance is used as an indication of psychological or physiological arousal. There has been a long history of electrodermal activity research, most of it dealing with spontaneous fluctuations or reactions to stimuli.

The device measures the electrical conductance (which is the inverse of the electrical resistance between 2 points, and is essentially a type of ohmmeter. The two paths for current are along the surface of the skin and through the body. Active measuring involves sending a small amount of current through the body.

Due to the response of the skin and muscle tissue to external and internal stimuli, the conductance can vary by several microsiemens. When correctly calibrated, the skin conductance can measure these subtle differences. There is a relationship between sympathetic activity and emotional arousal, although one cannot identify which specific emotion is being elicited. The SCR is highly sensitive to emotions in some people. Fear, anger, startle response, orienting response and sexual feelings are all among the reactions which may produce similar skin conductance responses. These reactions are utilized as part of the polygraph or lie detector.

1.2 BACKGROUND

The scientific study of GSR began in the early 1900s. One of the first references to the use of GSR instruments in Psychoanalysis is the book by C. G. Jung entitled *Studies in Word Analysis*, published in 1906.Wilhelm Reich also studied GSR in his experiments at the Psychological Institute at the University of Oslo in 1935-6 to confirm the existence of a bio-electrical charge behind his concept of vegetative, pleasurable 'streamings. GSR was used for a variety of types of research in the 1960s through the late 1970s, with a decline in use as more sophisticated techniques (such as EEG and MRI) replaced it in many areas of psychological research. As of 2010, skin conductance monitoring equipment is still in use because it is inexpensive.

CHAPTER 2

2.1 AIM AND OBJECTIVE

The aim is to design and fabricate a skin response meter and using it to check the stress level of a person's body. The stress level is displayed on L.C.D screen and simultaneously a message will be generated on a mobile-phone. By implementing this design on the steering of the car a safe car journey is possible decreasing the accident rate by knowing the stress level of the person driving.

2.2 LITERATURE REVIEW

Skin conductance measurement is one component of polygraph devices and is used in scientific research of emotional or physiological arousal. Skin conductance measurement is also becoming more popular in hypnotherapy and physiological practice where it can be used as a method of detecting depth of hypnotic hypnotherapy trance prior to suggestion therapy commencing. When traumatic material is experienced by the client (for example, during hypnoanalysis), immediate changes in sweat rate can indicate that the client is experiencing emotional arousal. It is also used in behavior therapy to measure physiological reactions such as fear.

2.3 DESIGN CONCEPT :

Our **DEVICE** is an interfacing of a **Galvanic skin response sensor**, **8051 microcontroller** , **16x2 LCD** and a **GSM Modem.**

In the Galvanic Skin Response Sensor we have used an operational amplifier LM358. The microcontroller that is interfaced with the sensor is the AT89C51 which belongs to the 8051 family and is manufactured by Atmel.The GSM Modem used is a product of the SIMCOM .

The designing of the sensor and the various interfacing will be discussed in detail in the following chapters.

CHAPTER 3

3.1 SKIN RESPONSE METER

3.1.1 Designing the Skin Response Meter

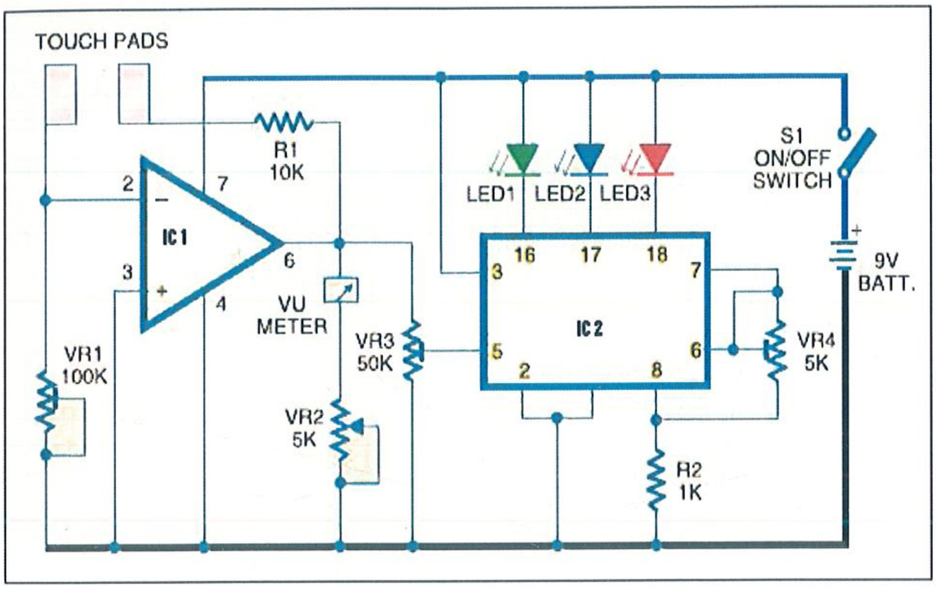


FIG 3.1 ***CIRCUIT DIAGRAM OF GALVANIC SKIN RESPONSE METER***

This circuit is useful to monitor the skin's response to relaxation techniques. It is very sensitive and shows response during a sudden moment of stress. Even a deep sigh will give response in the circuit. The circuit uses a sensitive amplifier to sense variations in the skin resistance.

IC LM358 (IC1) is designed as a resistance-to-voltage converter that outputs varying voltage based on the skin's conductivity. It is wired as an inverting amplifier to generate constant current to skin in order to measure the skin resistance.

IC LM358 is a 4.5MHz BiMOS operational amplifier with MOSFET inputs and bipolar output. The gate-protected inputs have high impedance and can sense current as low as 10 pA. This device is ideal to sense small currents in low-input-current applications.

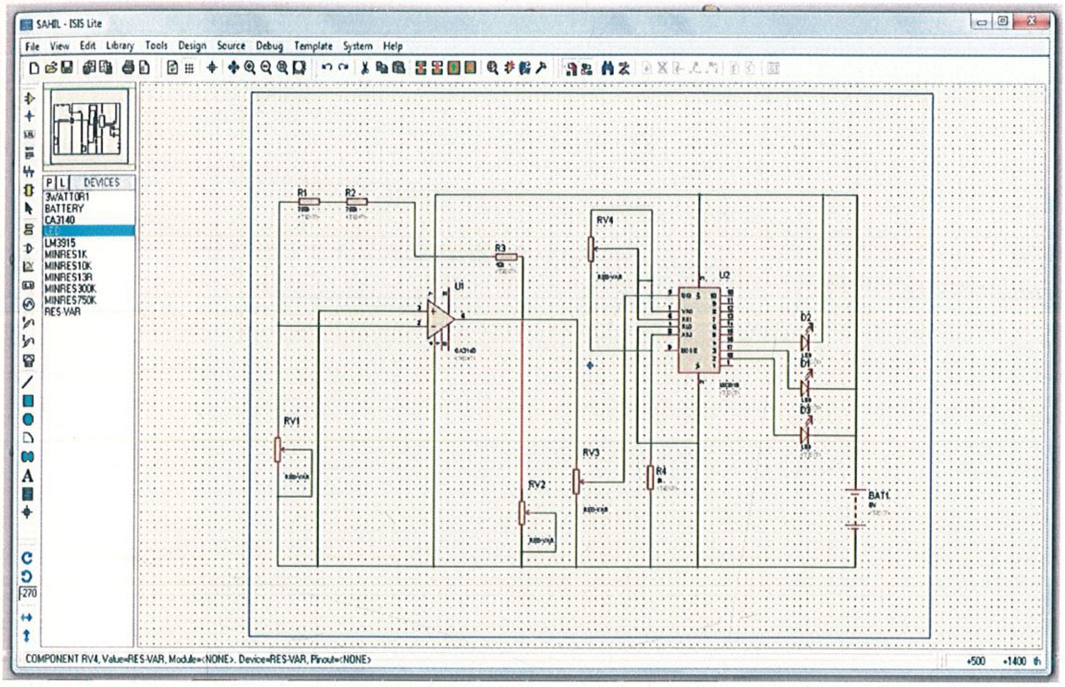


FIG 3.2 ***CIRCUIT IMPLEMENTATION ON PROTEUS***

The inverting input (pin 2) of IC1 is connected to ground (through preset VR1) and one of the touch plates, while the non-inverting input (pin 3) is grounded directly. The output from IC1 passes through current-limiting resistor R1 to the second touch plate. R1 act as a feedback resistor along with the skin when the touch plates make contact with the skin. So the gain of IC1 depends on the feedback provided by R1 and the skin.

In the inverting mode of IC1, a positive input voltage to its pin 2 through the feedback network makes its output low. If the skin offers very high resistance in the relaxed state, input voltage to pin

2 reduces and the output remains high. Thus the gain of IC1 varies depending on the current passing through the skin, which, in turn, depends on the skin response and emotional state.

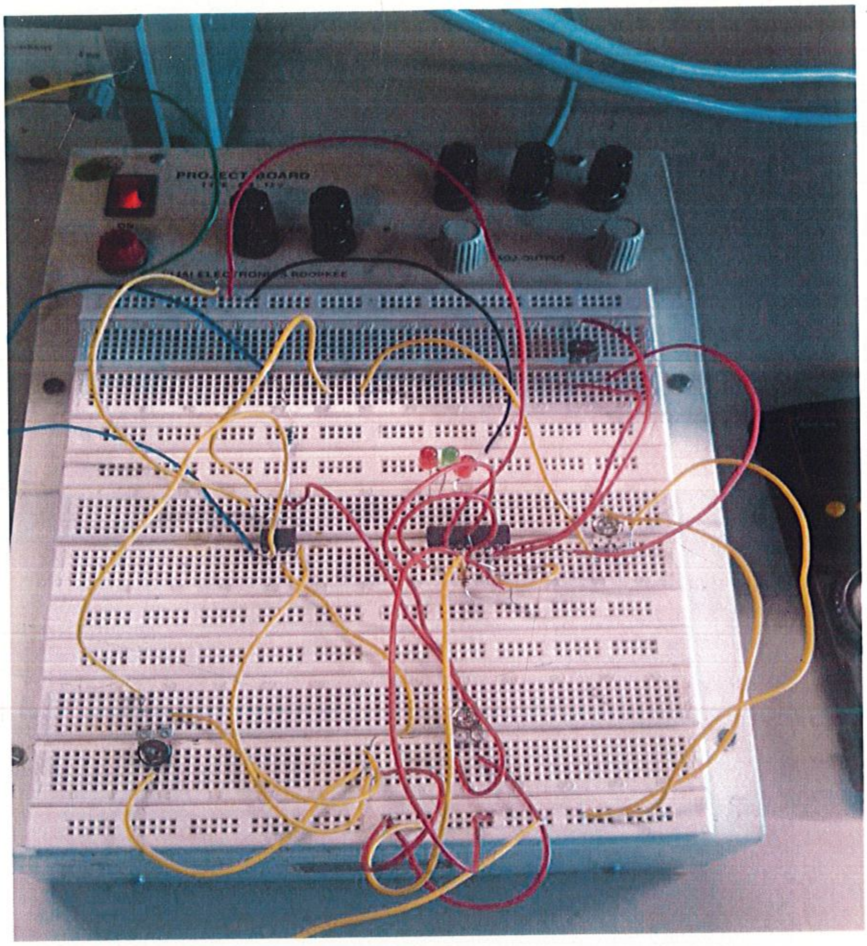


FIG 3.3 CIRCUIT IMPLEMENTATION ON BREADBOARD

In the standby state, touch plates are free. As there is no feedback to IC1,it gives a high output (around 6 volts),which is indicated by shifting of the meter to right side.

When the touch plates are shorted by the skin,the feedback circuit completes and the output voltage reduces to 4 volts or less depending on the resistance of the skin. Since the feedback network has a fixed resistor (R1) and VR1 is set to a fixed resistance value, the current flowing through it depends only on the resistance of the skin. The output from IC1 is displayed on a sensitive moving coil meter (VU meter). By varying preset VR2, you can adjust the sensitivity of the meter. For easy visual observation, an LED display is also included. IC LM3915 (IC2) is used to give a logarithmic display through LED indications. It can sink current from pin 18 to pin 10 with each increment of 125 millivolts at its input pin 5. Using VR3 you can adjust the input voltage of IC2, while using VR4 you can control the brightness of the LEDs.

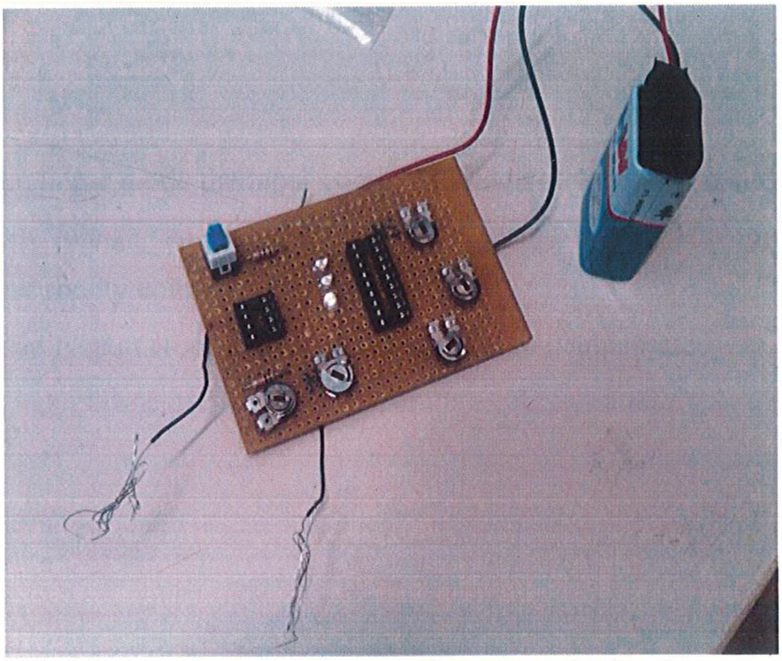


FIG 3.4 ***SOLDERED GALVANIC SKIN RESPONSE SENSOR***

3.1.2 GENERAL DESCRIPTION OF LM358

The LM358 consists 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 voltages. 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 amplifiers, dc gain blocks and all the conventional op amp circuits which now can be more easily implemented in single power supply systems. For example, the LM358 can be directly operated off of the standard +5V power supply voltage which is used in digital systems and will easily provide the required interface electronics without requiring the additional ±15V power supplies. The LM358 and LM2904 are available in a chip sized package (8-Bump micro SMD) using National's micro SMD package technology.

UNIQUE CHARECTERISTICS

- In the linear mode the input common-mode voltage range includes ground and the output voltage can alsoswing to ground, even though operated from only a single power supply voltage.
- The unity gain cross frequency is temperature compensated.
- The input bias current is also temperature compensated.

ADVANTAGES

1. Two internally compensated op amps
2. Eliminates need for dual supplies
3. Allows direct sensing near GND and VOUT also goes to GND
4. Compatible with all forms of logic
5. Power drain suitable for battery operation

FEATURES

- Available in 8-Bump micro SMD chip sized package
- Internally frequency compensated for unity gain
- Large dc voltage gain: 100 dB
- Wide bandwidth (unity gain): 1 MHz
- Wide power supply range:
  - Single supply: 3V to 32V
  - or dual supplies: ±1.5V to ±16V
- Very low supply current drain (500 μA)—essentially independent of supply voltage.
- Low input offset voltage: 2 mV.
- Input common-mode voltage range includes ground.
- Differential input voltage range equal to the power supply voltage
- Large output voltage swing

OBSERVATION TABLE

(USING 100Kilo-ohms Variac)

Sr.no	Variac Range(in k-ohms)	LED	VOLTMETER READING(IN VOLTS)
1	35-100	NONE	6.5V
2	33-35	LED1	1.5V
3	28-33	LED1+LED2	1.1V
4	26-28	LED 2	0.9V
5	20-25	LED 2+LED 3	0.6V
6	17-20	LED 3	0.5V
7	11-17	LED1+LED2+LED3	0.3V

TABLE 3.1 ***SKIN RESPONSE METER READING***

In practise, the circuit provides both meter reading andLED indications. If the LED display is not needed, IC2 can be omitted. After assembling the circuit, adjust the presets such that IC1 outputs around 6 volts. None of the LEDs (LED1 through LED3) glows in this position with the touch plates open. Now gently touch the touch plates with your middle finger. Maintain the finger still allowing one minute to bond with the pads and keep your body relaxed. Adjust VR3 until the green LED (LED1) lights up and the meter shows full deflection. Adjust VR2 to get maximum deflection of the meter. This indicates normal resistance of the skin, provided the body is fully relaxed .If you are stressed or have ill feeling, skin resistance decreases and the blue LED lights up followed by the red LED along with a deflection of the meter towards the lower side. In short, the red LED and zero meter reading indicate you are stressed, and the green LED and high meter reading indicate you are relaxed.

3.2 8051 BASED PROCESSING MODULE

3.2.1 INTERFACING SKIN RESPONSE METER WITH AT89C51

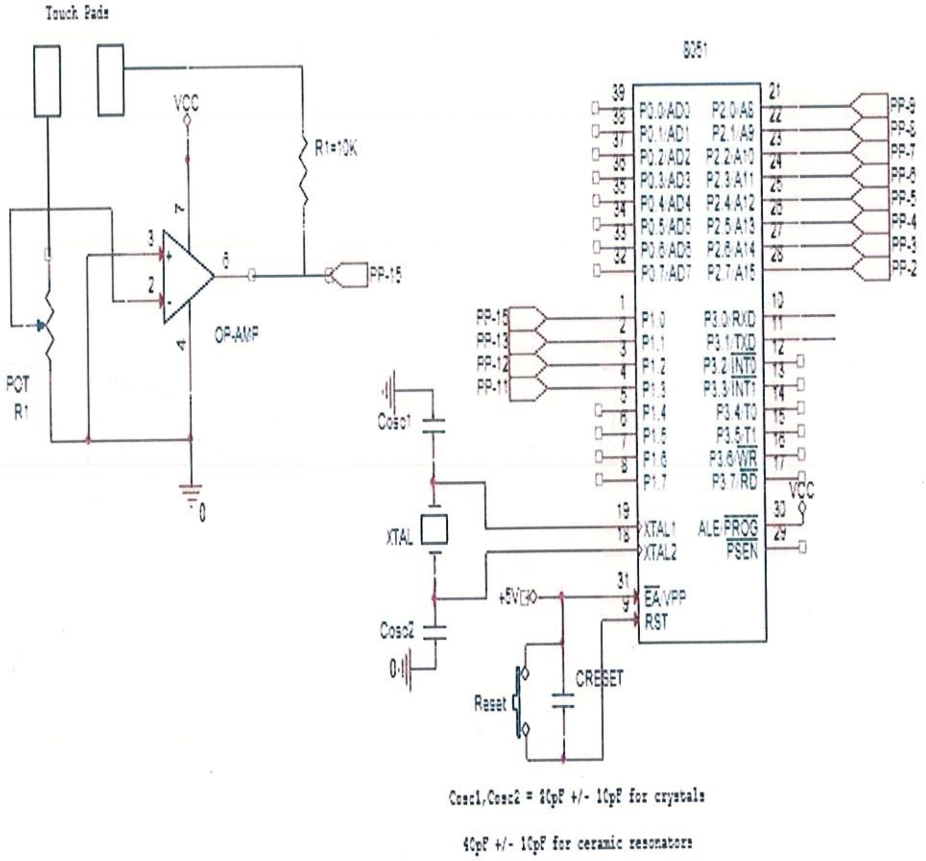


FIG 3.5 ***GALVANIC SKIN RESPONSE METER INTERFACED WITH AT89C51***

In the stand by state when the touch-plates are free, there is no feedback to the OP-AMP (IC LM358).

Hence it gives a high output of nearly 6volts.When the touch-plates are shorted by the skin the feedback circuit completes which reduces the output voltage to 4volts or less depending upon the resistance of the skin (Galvanic Skin Response). The feedback network has a fixed resistance R1 and therefore VR1 is used to change the sensitivity of the meter. The current flowing through it depends only upon the resistance of the skin.

The output voltage from the skin response meter that is from IC1 (OP-AMP) is sent to P1.0 of the microcontroller- Atmel AT89C51 which is further interfaced with GSM Modem- SIMCOM 300 and a 16X2 LCD.

3.2.1 THE 8051 FAMILY

In 1981, Intel Corporation introduced an 8-bit microcontroller called the 8051. This microcontroller had 128 bytes of RAM, 4K bytes of on-chip ROM, two timers, one serial port, and four ports (each 8-bits wide) all on a single chip. The 8051 is an 8-bit processor, meaning that the CPU can work on only 8 bits of data at a time. Data larger than 8 bits has to broken into 8-bit pieces to be processed by the CPU. The 8051 has a total of four I/O ports, each 8 bits wide. Although the 8051 can have a maximum of 64K bytes of on-chip ROM, many manufacturers have put only 4K bytes on the chip. There are different flavors of the 8051 in terms of speed and amount of on-chip ROM, but they are all compatible with the original 8051 as far as the instructions are concerned. The various members of the 8051 family are 8051 microcontroller, 8052 microcontroller and 8031 microcontroller.

8051 MICROCONTROLLER

The 8051 is the original member of the 8051 family. Figure 2.1 shows the block diagram of the 8051 microcontroller. The AT89C51 is a low-power, high-performance CMOS 8-bit microcomputer with 4K bytes of Flash programmable and erasable read only memory (PEROM). The device is manufactured using Atmel's high-density nonvolatile memory technology and is compatible with the industry-standard MCS-51 instruction set and pin out. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional nonvolatile memory programmer. By combining a versatile 8-bit CPU with Flash on a monolithic chip, the Atmel AT89C51 is a powerful microcomputer which provides a highly-flexible and cost-effective solution to many embedded control applications. The AT89C51 provides the following standard features: 4Kbytes of Flash, 128 bytes of RAM, 32 I/O lines, two 16-bittimer/counters, five vector two-level interrupt architecture, a full duplex serial port, and on-chip oscillator and clock circuitry. In addition, the AT89C51 is designed with static logic for operation down to zero frequency and supports two software selectable power saving modes. The Idle Mode stops the CPU while allowing the RAM, timer/counters, serial port and interrupt system to continue functioning. The Power-down Mode saves the RAM contents but freezes the oscillator disabling all other chip functions until the next hardware reset.

BLOCK DIAGRAM

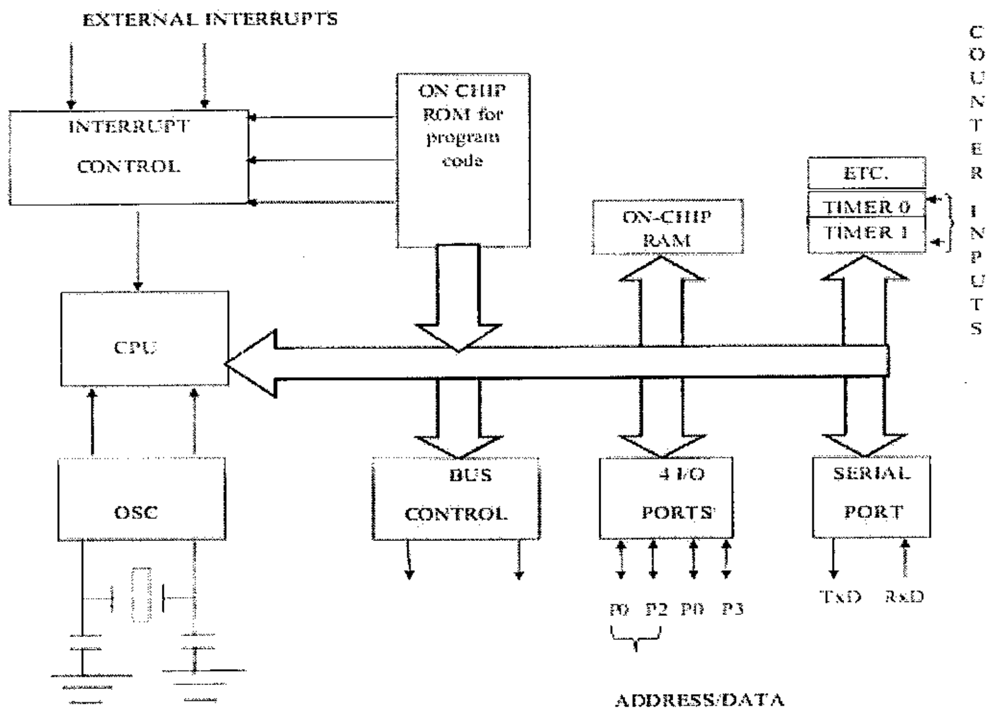


Figure 3.6 ***Block diagram of inside the microcontroller 8051***

3.2.2 PIN DESCRIPTION OF THE 8051 MICROCONTROLLER

VCC

Supply voltage.

GND

Ground.

Port 0

Port 0 is an 8-bit open-drain bi-directional I/O port. As an output port, each pin can sink eight TTL inputs. When 1s are written to port 0 pins, the pins can be used as high-impedance inputs. Port 0 may also be configured to be the multiplexed low- order address/data bus during accesses to external program and data memory. In this mode P0 has internal pull-ups. Port 0 also receives the code bytes during Flash programming, and outputs the code bytes during program verification. External pull-ups are required during program verification.

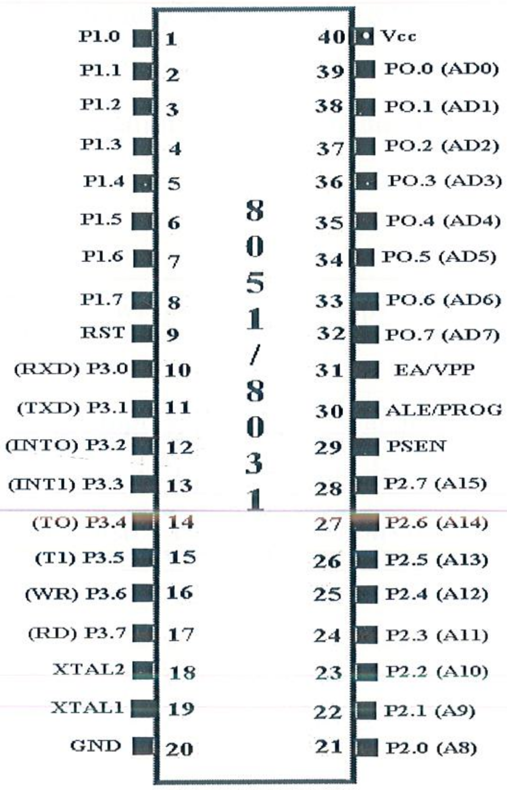


Figure 3.7 *Pin diagram for microcontroller 8051*

Port 1

Port 1 is an 8-bit bi-directional I/O port with internal pull-ups. The Port 1 output buffers can sink/source four TTL inputs. When 1s are written to Port 1 pins they are pulled high by the internal pull-ups and can be used as inputs. As inputs, Port 1 pins that are externally being pulled low will source current (IIL) because of the internal pull-ups. Port 1 also receives the low-order address bytes during Flash programming and verification.

Port 2

Port 2 is an 8-bit bi-directional I/O port with internal pull-ups. The Port 2 output buffers can sink/source four TTL inputs. When 1s are written to Port 2 pins they are pulled high by the internal pull-ups and can be used as inputs. As inputs, Port 2 pins that are externally being pulled low will source current (IIL) because of the internal pull-ups. Port 2 emits the high-order address byte during fetches from external program memory and during accesses to external data memory that uses 16-bit addresses (MOVX @DPTR). In this application, it uses strong internal pull-ups when emitting 1s. During accesses to external data memory that uses 8-bit addresses (MOVX @ RI), Port 2 emits the contents of the P2 Special Function Register. Port 2 also receives the high-order address bits and some control signals during Flash programming and verification.

Port 3

Port 3 is an 8-bit bi-directional I/O port with internal pull-ups. The Port 3 output buffer scan sink/source four TTL inputs. When 1s are written to Port 3 pins they are pulled high by the internal pull-ups and can be used as inputs. As inputs, Port 3 pins that are externally being pulled low will source current (IIL) because of the pull-ups. Port 3 also receives some control signals for Flash programming and verification. Port 3 also serves the functions of various special features of the AT89C51 as listed below:

Port Pin	Alternate Functions
P3.0	RXD (serial input port)
P3.1	TXD (serial output port)
P3.2	$\overline{INT0}$ (external interrupt 0)
P3.3	$\overline{INT1}$ (external interrupt 1)
P3.4	T0 (timer 0 external input)
P3.5	T1 (timer 1 external input)
P3.6	$\overline{WR}$ (external data memory write strobe)
P3.7	$\overline{RD}$ (external data memory read strobe)

Table 3.2 ***Function of Port-3***

RST

Reset input. A high on this pin for two machine cycles while the oscillator is running resets the device.

ALE/PROG

Address Latch Enable output pulse for latching the low byte of the address during accesses to external memory. This pin is also the program pulse input (PROG) during Flash programming. In normal operation ALE is emitted at a constant rate of 1/6 the oscillator frequency, and may be used for external timing or clocking purposes. Note, however, that one ALE pulse is skipped during each access to external Data Memory. If desired, ALE operation can be disabled by setting bit 0 of SFR location 8EH. With the bit set, ALE is active only during a MOVX or MOVC instruction. Otherwise, the pin is weakly pulled high. Setting the ALE-disable bit has no effect if the microcontroller is in external execution mode.

PSEN

Program Store Enable is the read strobe to external program memory. When the AT89C51 is executing code from external program memory, PSEN is activated twice each machine cycle, except that two PSEN activations are skipped during each access to external data memory.

EA/VPP

External Access Enable. EA must be strapped to GND in order to enable the device to fetch code from external program memory locations starting at 0000H up to FFFFH. Note, however, that if lock bit 1 is programmed, EA will be internally latched on reset. EA should be strapped to VCC for internal program executions. This pin also receives the 12-volt programming enable voltage (VPP) during Flash programming, for parts that require 12-volt VPP.

XTAL1

Input to the inverting oscillator amplifier and input to the internal clock operating circuit.

XTAL2

Output from the inverting oscillator amplifier. Oscillator Characteristics XTAL1 and XTAL2 are the input and output, respectively, of an inverting amplifier which can be configured for use as an on-chip oscillator, as shown in Figure 1. Either a quartz crystal or ceramic resonator may be used. To drive the device from an external clock source, XTAL2 should be left unconnected while XTAL1 is driven as shown.

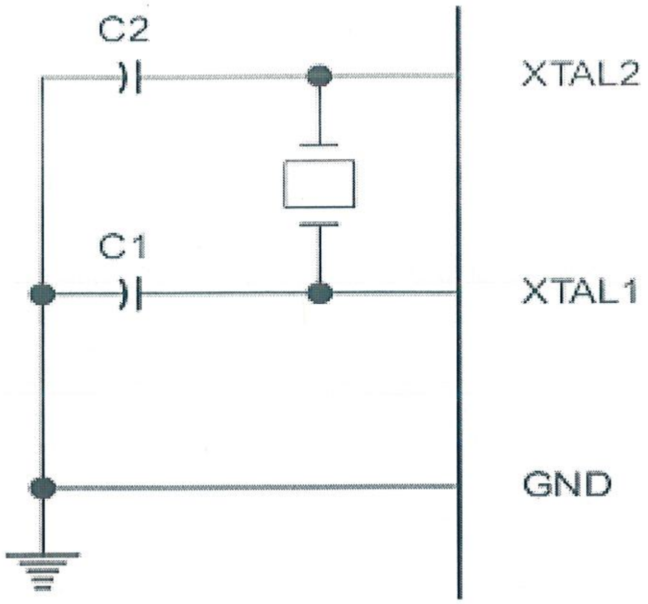


Figure 3.8 ***CRYSTAL OSCILLATOR CONNECTIONS***

There are no requirements on the duty cycle of the external clock signal, since the input to the internal clocking circuitry is through a divide-by-two flip-flop, but minimum and maximum voltage high and low time specifications must be observed.

3.2.3 PROGRAMMING OF 8051 MICROCONTROLLER

We are using embedded C programming language to program the central unit i.e. microcontroller 8051, so that it performs the specific task according to the requirement.

NEED OF C :

Compiler produces hex file that we download into ROM of microcontroller. The size of hex file produced by compiler is one of the main concerns of microcontroller programmers for two reasons:

1. Microcontroller has limited on -chip ROM
2. The code space for 8051 is limited to 64 KB

Programming in assembly language is tedious and time consuming. C is a high level programming language that is portable across many hardware architectures.

So for following reasons we use C:

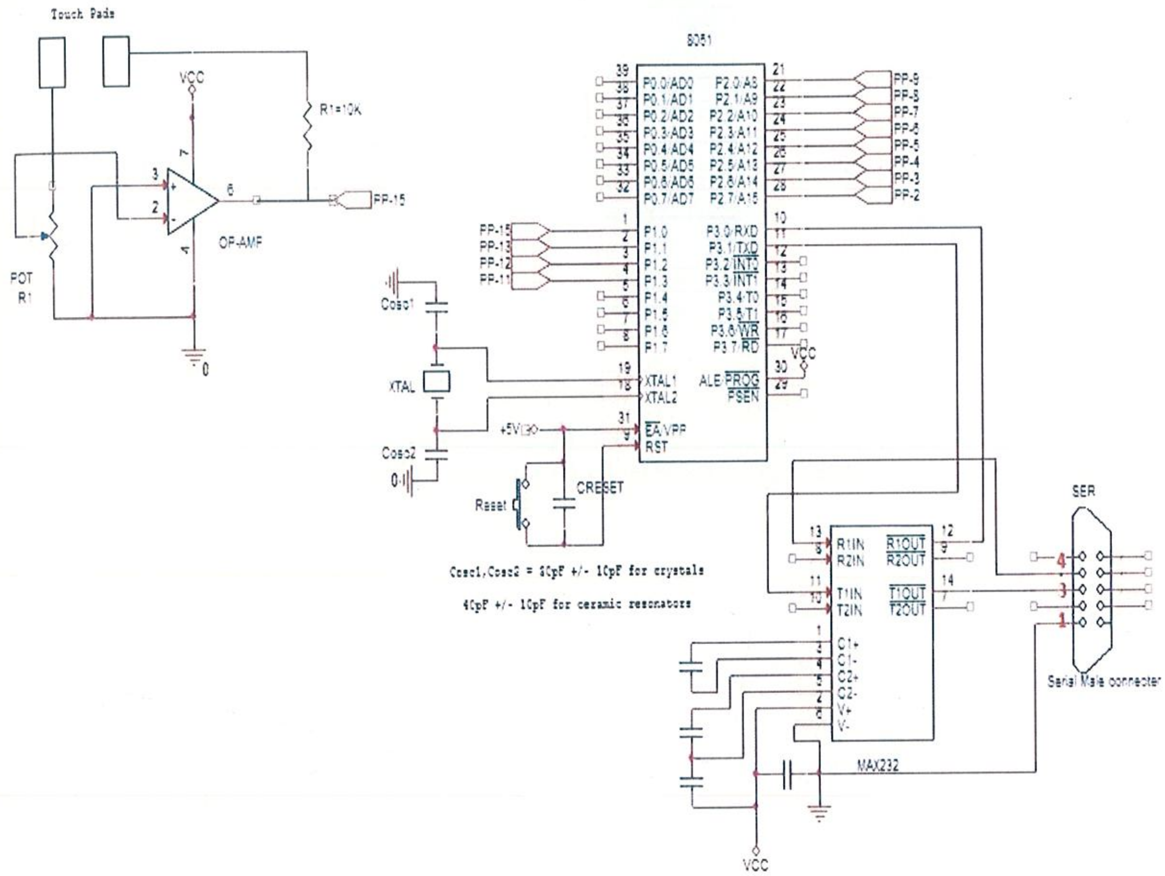
1. It is easier and less time consuming to write in C than assembly.
2. C is easier to modify and update.
3. You can use code available in function libraries.
4. C code is portable to other microcontrollers with little or no modification.

We use reg51.h as a header file as "#include <reg51.h>". These files contain all the definitions of the 80C51 registers. This file is included in our project and will be assembled together with the compiled output of our C program.

C data types for 8051:

1. Unsigned char is 8-bit data type ranging 0-255 (0-FFH)
2. Signed char is 8-bit data type that uses most significant bit to represent the – or + value. We have only 7-bits for the magnitude of the signed numbers giving us values from -128 to +127.
3. Unsigned int is 16-bit data type ranging 0-65535(0-FFFFH).
4. Signed int is 16-bit data type that uses most significant bit to represent the – or + value. We have only 15-bits for the magnitude of the signed numbers giving us values from -32768 to +32767.

3.3 SERIAL COMMUNICATION BASED MODULE



Interfacing of GSM modem with microcontroller

3.3.1 BASICS OF SERIAL COMMUNICATION

Computer transfers data in two ways :

1. **Parallel:** Often 8 or more lines (wire conductors) are used to transfer data to a device that is only few feet away.
2. **Serial:** To transfer to a device located many meters away, the serial method is used. The data is sent one bit at a time.

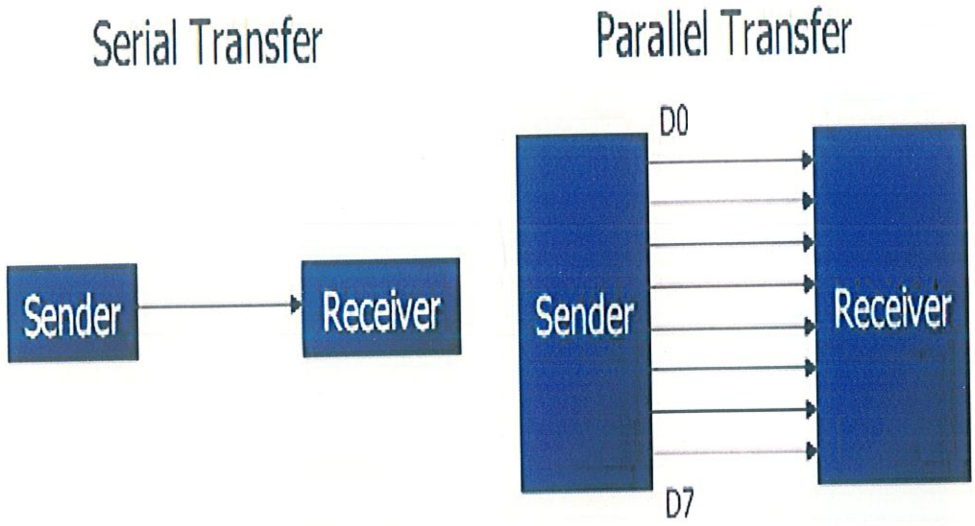


Figure 3.9 ***MODE OF COMMUNICATION***

At the transmitting end, the byte of data must be converted to serial bits using parallel-in-serial-out shift register. At the receiving end, there is a serial-in-parallel-out shift register to receive the serial data and pack them into byte. When the distance is short, the digital signal can be transferred as it is on a simple wire and requires no modulation. If data is to be transferred on the telephone line, it must be converted from 0s and 1s to audio tones. This conversion is performed by a device called a modem, "Modulator/demodulator".

Serial data communication uses two methods. First are synchronous method transfers a block of data at a time. Second is an asynchronous method transfer a single byte at a time.

It is possible to write software to use either of these methods, but the programs can be tedious and long. There are special IC chips made by many manufacturers for serial communications namely UART (universal asynchronous Receiver-transmitter) & USART (universal synchronous-asynchronous Receiver-transmitter).

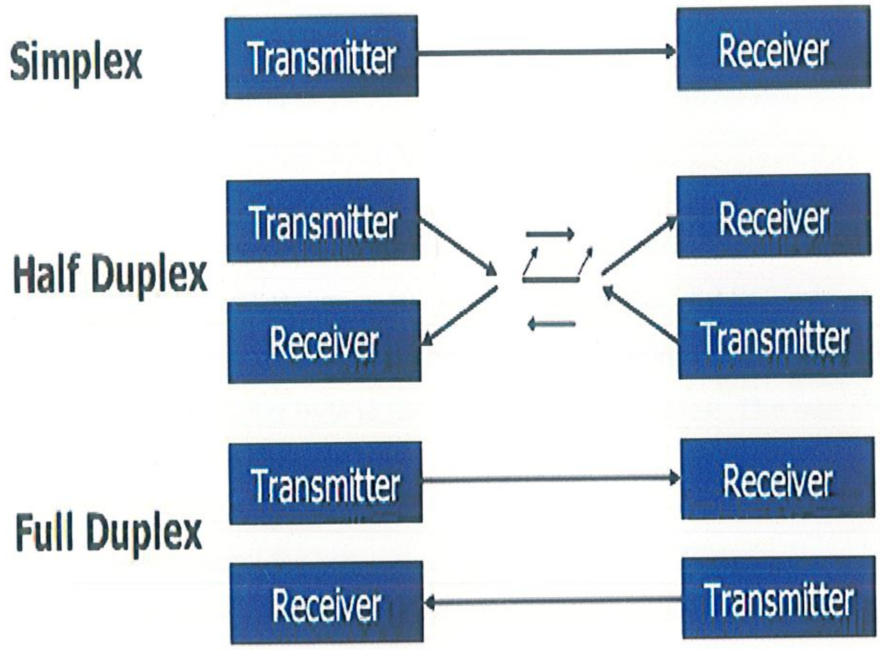


Figure 3.10 *DIAGRAMMATIC SIMPLEX AND DUPLEX TRANSMISSION*

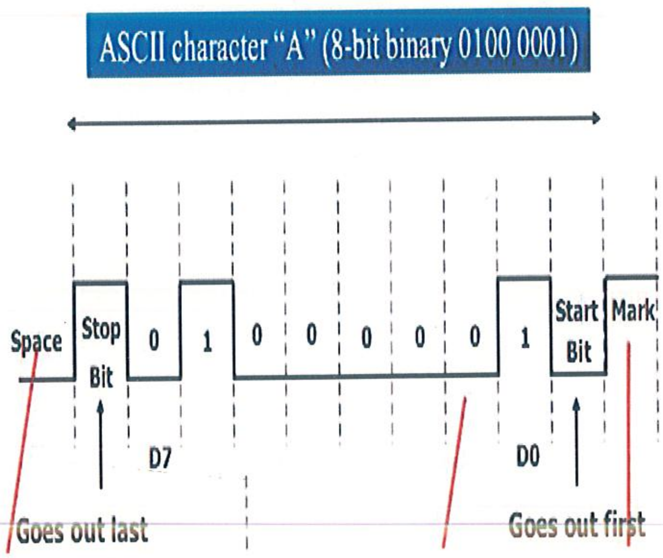


Figure 3.11 *TRANSMISSION OF DATA*

A protocol is a set of rules agreed by both the sender and receiver. Asynchronous serial data communication is widely used for character-oriented transmissions where each character is placed in between start and stop bits, this is called framing and block-oriented data transfers use the synchronous method. The start bit is always one bit, but the stop bit can be one or two bits the start bit is always a 0 (low) and the stop bit(s) is 1 (high).

Due to the extended ASCII characters, 8-bit ASCII data is common in modern PCs the use of one stop bit is standard. Assuming that we are transferring a text file of ASCII characters using 1 stop bit, we have a total of 10 bits for each character. In some systems in order to maintain data integrity, the parity bit of the character byte is included in the data frame. The rate of data transfer in serial data communication is stated in bps (bits per second).

Another widely used terminology for bps is baud rate. As far as the conductor wire is concerned, the baud rate and bps are the same, and we use the terms interchangeably. The data transfer rate of given computer system depends on communication ports incorporated into that system.

An interfacing standard RS232 was set by the Electronics Industries Association (EIA) in 1960. The standard was set long before the advent of the TTL logic family, its input and output voltage levels is not TTL compatible where a 1 is represented by -3 ~ -25 V, while a 0 bit is +3 ~ +25 V, making -3 to +3 undefined.

3.3.2 MAX232

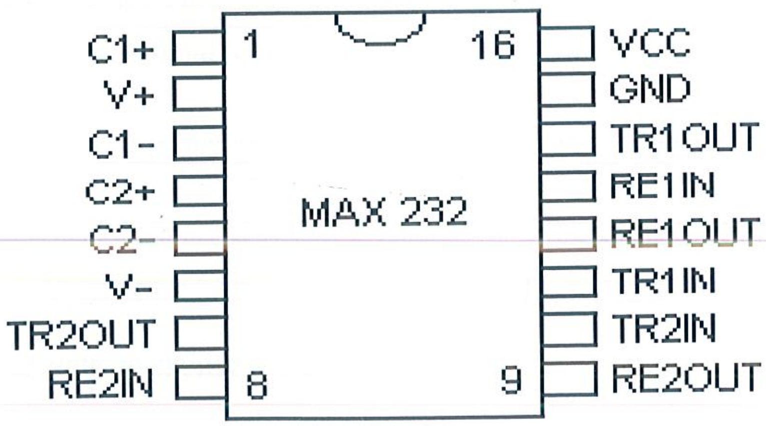


FIG 3.12 ***PIN DIAGRAM OF MAX232***

A line driver required to convert RS232 voltage levels to TTL levels, and vice versa. It includes a capacitive voltage generator to supply TIA/EIA-232-F voltage levels from a single 5-V supply. Each receiver converts TIA/EIA-232-F inputs to 5-V TTL/CMOS levels. These receivers have a typical threshold of 1.3 V, a typical hysteresis of 0.5 V, and can accept ±30-V inputs. Each driver converts TTL/CMOS input levels into TIA/EIA-232-F levels.

RS-232 WAVEFORM

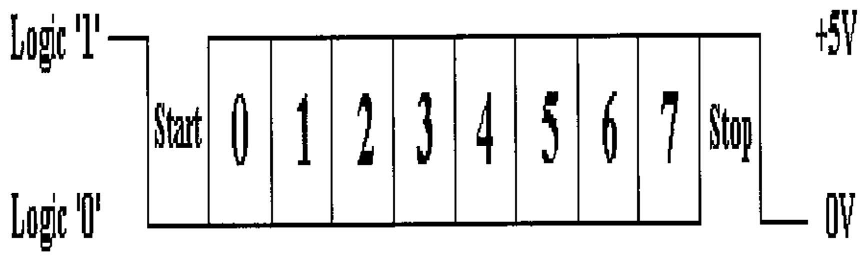


FIG 3.13 TTL/CMOS SERIAL LOGIC WAVEFORM

The diagram above, shows the expected waveform from the UART when using the common 8N1 format. 8N1 signifies 8 Data bits, No Parity and 1 Stop Bit. The RS-232 line, when idle is in the Mark State (Logic 1). A transmission starts with a start bit which is (Logic 0). Then each bit is sent down the line, one at a time. The LSB (Least Significant Bit) is sent first. A Stop Bit (Logic 1) is then appended to the signal to make up the transmission.

The data sent using this method, is said to be *framed.* That is the data is *framed* between a Start and Stop Bit .

RS-232 Voltage levels

1. +3 to +25 volts to signify a "Space"
(logic0)
2. -3 to -25 volts for a "Mark" (logic 1).
3. Any voltage in between these regions (i.e. between +3 and -3 Volts) is undefined.

The data byte is always transmitted *least-significant-bit first.*

The bits are transmitted at specific time intervals determined by the **baud rate** of the serial signal.

This is the signal present on the RS-232 Port of your computer, shown below.

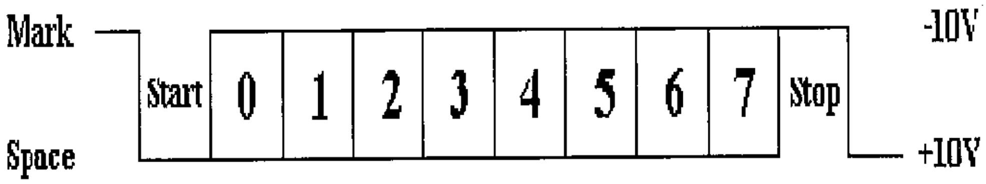


FIG 3.14 ***RS-232 LOGIC WAVEFORM***

RS-232 LEVEL CONVERTER

Standard serial interfacing of microcontroller (TTL) with PC or any RS232C Standard device , requires TTL to RS232 Level converter . A MAX232 is used for this purpose. It provides 2-channel RS232C port and requires external 10uF capacitors.

The driver requires a single supply of +5V .

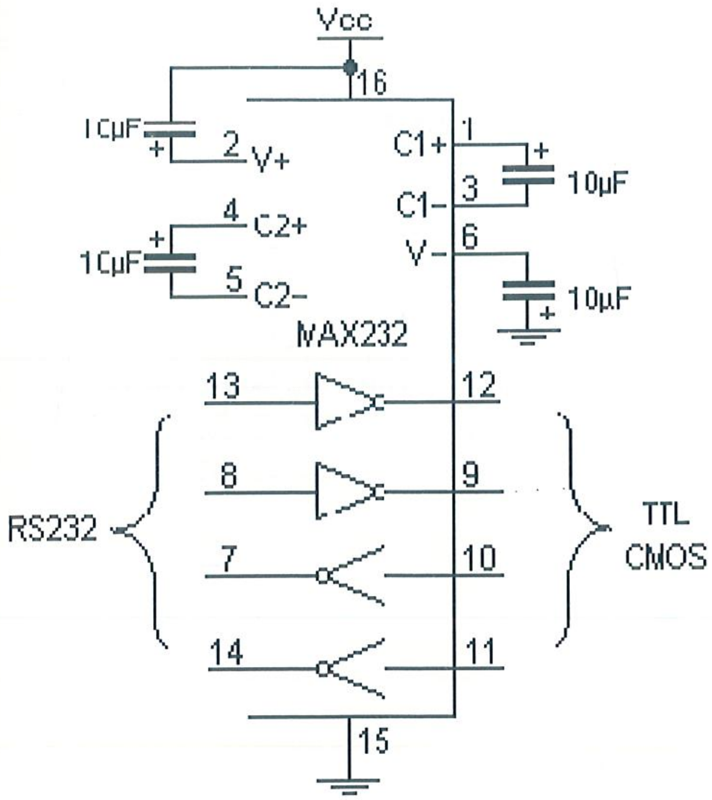


FIG 3.15 ***WORKING OF MAX232***

MAX-232 includes a Charge Pump, which generates +10V and -10V from a single 5v supply.

3.3.3 MICROCONTROLLER INTERFACING WITH RS-232 STANDARD DEVICES

- MAX232 (+5V -> +-12V converter)
- Serial port male 9 pin connector (SER)

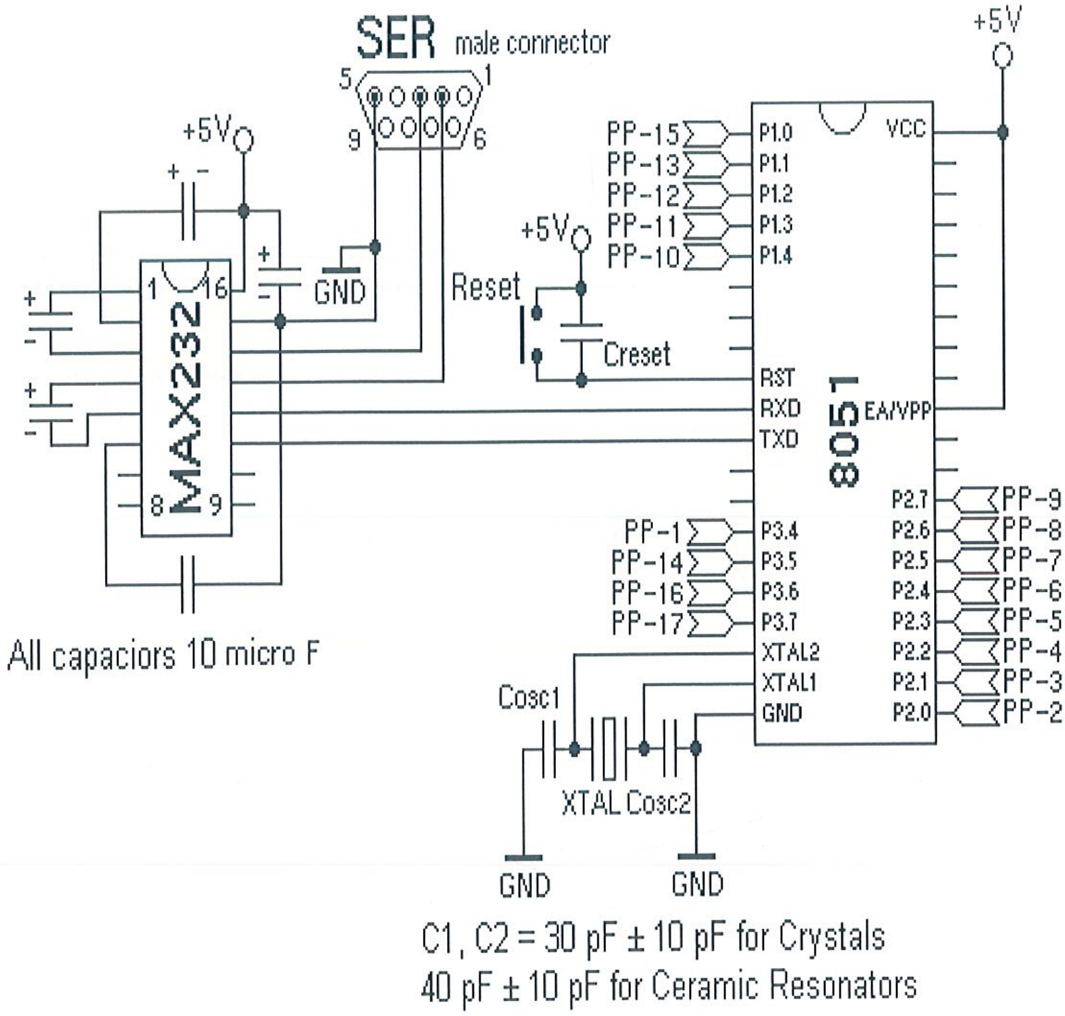


FIGURE 3.16 ***INTERFACING OF 8051 MICROCONTROLLER WITH MAX 232***

8051 has two pins that are used specifically for transferring and receiving data serially. These two pins are called TxD and RxD and are part of the port 3 group (P3.0 and P3.1).These pins are TTL compatible; therefore, they require a line driver to make them RS232 compatible. To allow data transfer between the PC and an 8051 system without any error, we must make sure that the baud rate of 8051 system matches the baud rate of the PC's COM port.

SETTING SERIAL PORT.

SCON

8 bit UART ,RN enabled , TI & RI operated by program. - 50hex

Timer 1 Count

TH1 = 256 - ((Crystal / 384) / Baud) -PCON.7 is clear.

TH1 = 256 - ((Crystal / 192) / Baud)-PCON.7 is set.

so with PCON.7 is clear we get timer value = FDhex

3.3.4 REGISTER STRUCTURE

SBUF Register: This is an 8-bit register used solely for serial communication. For a byte data to be transferred via the TxD line, it must be placed in the SBUF register. The moment a byte is written into SBUF, it is framed with the start and stop bits and transferred serially via the TxD line. SBUF holds the byte of data when it is received by 8051 RxD line. When the bits are received serially via RxD, the 8051 defames it by eliminating the stop and start bits, making a byte out of the data received, and then placing it in SBUF.

SCON Register: SCON is an 8-bit register used to program the start bit, stop bit, and data bits of data framing, among other things.

SM0	SM1	SM2	REN	TB8	RB8	TI	RI

SM0	SCON.7	Serial port mode specifier
SM1	SCON.6	Serial port mode specifier
SM2	SCON.5	Used for multiprocessor communication
REN	SCON.4	Set/cleared by software to enable/disable reception
TB8	SCON.3	Not widely used
RB8	SCON.2	Not widely used
TI	SCON.1	Transmit interrupt flag. Set by HW at the begin of the stop bit mode 1. And cleared by SW
RI	SCON.0	Receive interrupt flag. Set by HW at the begin of the stop bit mode 1. And cleared by SW

Note: *Make SM2, TB8, and RB8 =0*

Table 3.3 ***Functions of various bits in SCON register***

SM0, SM1: They determine the framing of data by specifying the number of bits per character and the start and stop bits.

SM0	SM1	
0	0	Serial Mode 0
0	1	Serial Mode 1, 8-bit data, 1 stop bit, 1 start bit
1	0	Serial Mode 2
1	1	Serial Mode 3

Only mode 1 is of interest to us

Table 3.4 ***Mode selection using SM0 & SM1***

SM2: This enables the multiprocessing capability of the 8051.

REN (receive enable): It is a bit-addressable register. When it is high, it allows 8051 to receive data on RxD pin. If low, the receiver is disables (transmit interrupt). When 8051 finishes the transfer of 8-bit character. It raises TI flag to indicate that it is ready to transfer another byte. TI bit is raised at the beginning of the stop bit RI (receive interrupt). When 8051 receives data serially via RxD, it gets rid of the start and stop bits and places the byte in SBUF register. It raises the RI flag bit to indicate that a byte has been received and should be picked up before it is lost. RI is raised halfway through the stop bit.

3.4 INTERFACING OF LCD WITH 8051 MICROCONTROLLER

The 44780 standard requires 3 control lines as well as either 4 or 8 I/O lines for the data bus. The user may select whether the LCD is to operate with a 4-bit data bus or an 8-bit data bus.
If a 4-bit data bus is used, the LCD will require a total of 7 data lines.
If an 8-bit data bus is used, the LCD will require a total of 11 data lines.
The three control lines are EN, RS, and RW.

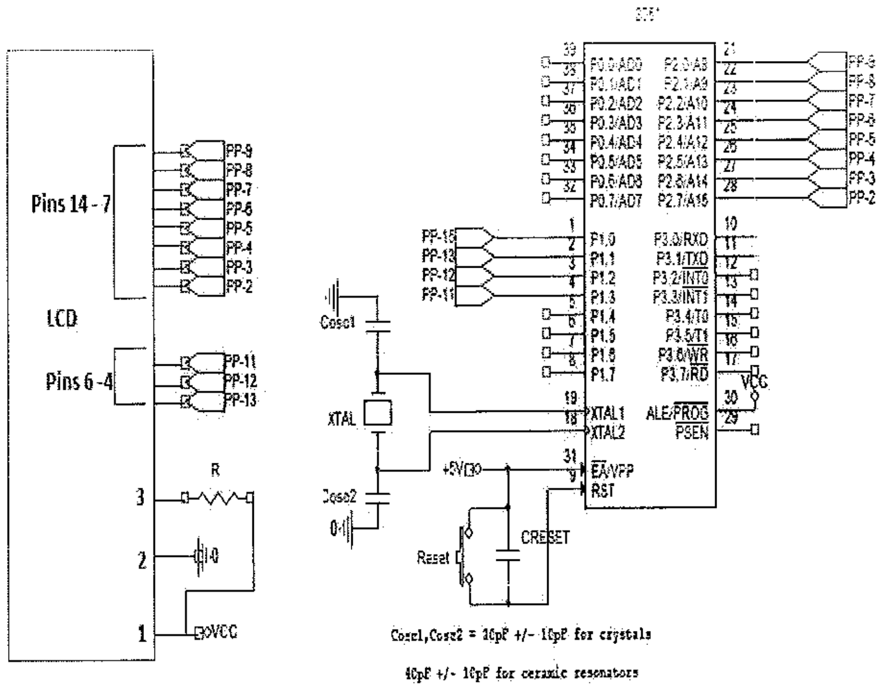


FIG 3.17 ***INTERFACING OF LCD WITH MICROCONTROLLER AT89C51***

3.4.1 LCD PINOUT

• 8 data pins D7:D0

Bi-directional data/command pins.

Alphanumeric characters are sent in ASCII format.

• RS: Register Select

RS = 0 -> Command Register is selected

RS = 1 -> Data Register is selected

• R/W: Read or Write

0 -> Write, 1 -> Read

• E: Enable (Latch data)

Used to latch the data present on the data pins.

A high-to-low edge is needed to latch the data.

• VEE: contrast control

NOTE: When writing to the display, data is transferred only on the high to low transition of this signal. However, when reading from the display, data will become available shortly after the low to high transition and remain available until the signal falls low again.

3.4.2 DISPLAY DATA RAM (DDRAM)

Display data RAM (DDRAM) is where you send the characters (ASCII code) you want to see on the LCD screen. It stores display data represented in 8-bit character codes. Its capacity is 80 characters (bytes). Below you see DD RAM address layout of a 2*16 LCD.

In the above memory map, the area shaded in black is the visible display (For 16×2 display) .

For first line addresses for first 15 characters is from 00h to 0Fh. But for second line address of first character is 40h and so on up to 4Fh for the 16th character.

So if you want to display the text at specific positions of LCD , we require to manipulate address and then to set cursor position accordingly .

Character Generator RAM (CGRAM)-User defined character RAM

In the character generator RAM, we can define our own character patterns by program. CG RAM is 64 bytes, allowing for eight 5*8 pixel, character patterns to be defined. However how to define this and use it is out of scope of this tutorial. So I will not talk any more about CGRAM

Registers

The HD44780 has two 8-bit registers, an instruction register (IR) and a data register (DR). The IR stores instruction codes. The DR temporarily stores data to be written into DDRAM or CGRAM and temporarily stores data to be read from DDRAM or CGRAM. Data written into the DR is automatically written into DDRAM or CGRAM by an internal operation. . These two registers can be selected by the register selector (RS) signal. See the table below:

Register Selection

RS	R/W	Operation
0	0	IR write as an nternal operation (display clear, etc.)
0	1	Read busy flag (DB7) and address counter (DB0 to DB6)
1	0	DR write as an internal operation (DR to DDRAM or CGRAM)
1	1	DR read as an internal operation (DDRAM or CGRAM to DR)

TABLE 3.5 ***REGISTER SELECTION***

Busy Flag (BF)

When the busy flag is 1, the LCD is in the internal operation mode, and the next instruction will not be accepted. When RS = 0 and R/W = 1 (see the table above), the busy flag is output to DB7 (MSB of LCD data bus). The next instruction must be written after ensuring that the busy flag is 0.

3.4.3 LCD COMMANDS

The LCD's internal controller accept several commands and modify the display accordingly. These commands would be things like:

– Clear screen

– Return home

– Shift display right/left

Instruction	Decimal	HEX
Function set (8-bit interface, 2 lines, 5*7 Pixels)	56	38
Function set (8-bit interface, 1 line, 5*7 Pixels)	48	30
Function set (4-bit interface, 2 lines, 5*7 Pixels)	40	28
Function set (4-bit interface, 1 line, 5*7 Pixels)	32	20
Entry mode set	See Below	See Below
Scroll display one character right (all lines)	28	1E
Scroll display one character left (all lines)	24	18
Home (move cursor to top/left character position)	2	2
Move cursor one character left	16	10
Move cursor one character right	20	14
Turn on visible underline cursor	14	0E
Turn on visible blinking-block cursor	15	0F
Make cursor invisible	12	0C
Blank the display (without clearing)	8	08
Restore the display (with cursor hidden)	12	0C
Clear Screen	1	01
Set cursor position (DDRAM address)	128 + addr	80+ addr
Set pointer in character-generator RAM (CG RAM address)	64 + addr	40+ addr

TABLE 3.6 ***LCD INSTRUCTIONS***

Entry Mode Set

This command sets cursor move direction and display shift ON/OFF. There are 4 possible function set commands; 04, 05, 06, and 07. This command changes the direction the cursor moves by setting the address counter to increment or decrement. This command is very important. If you do not understand it you may not see anything or what you actually wanted to see on LCD screen. We have created 4 animated gifs to demonstrate what the function set command is all about.

Set cursor position (DDRAM address)

As said earlier if we want to display the text at specific positions of LCD , we need to manipulate address and then to set cursor position accordingly.

We want to display "MAHESH" in message "Hi MAHESH" at the right corner of first line then we should start from 10th character.

So referring to table 80h+0Ah= 8Ah.

Checking the Busy Flag

You can use subroutine for checking busy flag or just a big (and safe) delay.

1. Set R/W Pin of the LCD HIGH(read from the LCD)
2. Select the instruction register by setting RS pin LOW
3. Enable the LCD by Setting the enable pin HIGH
4. The most significant bit of the LCD data bus is the state of the busy flag(1=Busy,0=ready to accept instructions/data). The other bits hold the current value of the address counter.

If the LCD never come out from "busy" status because of some problems ,The program will "hang," waiting for DB7 to go low. So in a real applications it would be wise to put some kind of time limit on the delay--for example, a maximum of 100 attempts to wait for the busy signal to go low. This would guarantee that even if the LCD hardware fails, the program would not lock up.

3.4.4 16 x 2 LCD FEATURES

• 5 x 8 dots with cursor

• Built-in controller (KS 0066 or Equivalent)

• + 5V power supply (Also available for + 3V)

• 1/16 duty cycle

• B/L to be driven by pin 1, pin 2 or pin 15, pin 16 or A.K (LED)

• N.V. optional for + 3V power supply

MECHANICAL DATA		
ITEM	STANDARD VALUE	UNIT
Module Dimension	80.0 x 36.0	mm
Viewing Area	66.0 x 16.0	mm
Dot Size	0.56 x 0.66	mm
Character Size	2.96 x 5.56	mm

TABLE 3.7 ***MECHANICAL DATA***

ABSOLUTE MAXIMUM RATING					
ITEM	SYMBOL	STANDARD VALUE			UNIT
		MIN.	TYP.	MAX.	
Power Supply	VDD-VSS	-0.3	-	7.0	V
Input Voltage	VI	-0.3	-	VDD	V

NOTE: VSS = 0 Volt, VDD = 5.0 Volt

TABLE 3.8 ***ABSOLUTE MAXIMUM RATING***

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

TABLE 3.9 ***PIN FUNCTIONS OF 16x2 LCD***

CHAPTER 4

4.1 RESULTS AND DISCUSSIONS

We have designed a **GALVANIC SKIN RESPONCE sensor** which calculates the stress level of a person's body. The sensor is then interfaced with the **microcontroller**. The microcontroller is further **interfaced** with a **LCD** and a **GSM Modem**. The microcontroller is programmed in the manner that a message is displayed onto the **LCD Screen** and a **SMS** is generated onto the persons mobile with the help of GSM Modem.

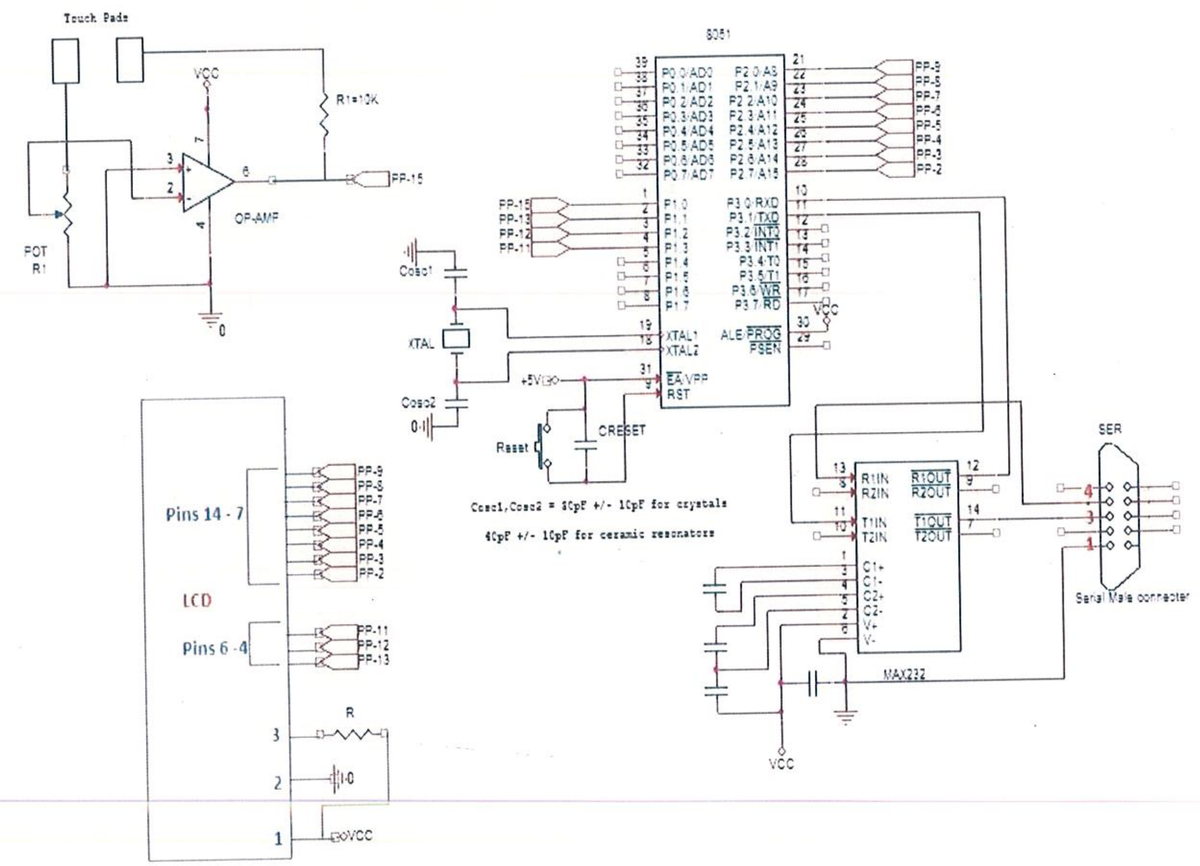


FIG 4.1 ***FINAL DESIGN OF THE DEVICE***

OBSERVATION TABLE

(USING 100Kilo-ohms Variac)

Sr.no	Variac Range(in k-ohms)	LED	VOLTMETER READING(IN VOLTS)
1	35-100	NONE	6.5V
2	33-35	LED1	1.5V
3	28-33	LED1+LED2	1.1V
4	26-28	LED 2	0.9V
5	20-25	LED 2+LED 3	0.6V
6	17-20	LED 3	0.5V
7	11-17	LED1+LED2+LED3	0.3V

TABLE 4.1 ***SKIN RESPONSE METER READINGS***

The readings of the GSR sensor concludes that the **stress level of a person is inversely proportional to the skin resistance of the person's body.**

CHAPTER 5

5.1 CONCLUSION

Based on the results and discussions presented in the report, the following major conclusions are drawn from the present study:

1. The stress level of an individual is inversely proportional to the skin resistance of his body as observed in Table 3.1.
2. When an individual is under stress a message is displayed on the LCD screen. A message is also flashed on the individual's mobile through the GSM Modem.
3. The device that we have developed can be attached to the steering of a car and the stress level of the driver can be monitored.

5.2 SCOPE FOR FURTHER WORK:

Skin conductance measurement is a major component of polygraph devices . With more advancements in this field the stress measurement can be enhanced and it can be added as a vital component in the Lie-Detector tests.

Improvements in these areas can further increase the number of applications of the device.

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APPENDIX A

CODE FOR GSM MODEM:

```
#include<reg51.H> // header file
#include<string.h>
sbit device1=P1^0;
 void init (void); // prototype declaration
 void Uart_gsm (void);
 void delay(unsigned char);
 void Recievedata();
 void gsminit(void);
 void gsmcmdsend(unsigned char *);
 unsigned char Rx_data(void);
 unsigned char message[11];
 unsigned char count;
 unsigned char code password1[10]="stress measured";
 void main()
 {
```

```
// port initialization

init();

Uart_gsm(); // serial port initialization

gsminit();

Recievedata(); // for recieving the data from modem

}

void init(void)

{

P0=0x01; // all device off


}

void Uart_gsm(void)

{

TMOD = 0x20;//timer1 mode 2

 TH1 = -3; //9600 baud rate

 SCON = 0X50;

 TR1 = 1;

 }

 void Recievedata()

 {

 while(1)

 {


 while(Rx_data()!='+'); // chacking message format
```

```
while(Rx_data()!='C');

while(Rx_data()!='M');

while(Rx_data()!='T');

while(Rx_data()!=':');

while(Rx_data()!='"');

while(Rx_data()!='\n');

for(count=0;count<11;count++) // storing msg in a buffer

{

message[count]=Rx_data();

 if(message[count]=='\r')

 break;

 }

  message[count]='\0';

  if(strncmp(message,password1,10)==0) // comapring message with passward  to make a action on device

  {


device1=1;




  }


 if(strncmp(message,password2,11)==0)

 {
```

```
device1=0;

}
```

// **TO RECIEVE SERAIL DATA**

```
unsigned char Rx_data(void)
{ RI=0;
while(RI==0);
return(SBUF);
}

void delay(unsigned char x)
{ unsigned int i,j;
for(i=0;i<x;i++)
for(j=0;j<2000;j++);
}
void gsminit(void)
{
unsigned char gsm_cmd1[]="AT";
unsigned char gsm_cmd2[]="ATE0";
```

```
unsigned char gsm_cmd3[]="AT&W";

unsigned char gsm_cmd4[]="AT+CMGF=1";

unsigned char gsm_cmd5[]="AT+CNMI=2,2,0,0,0 ";

gsmcmdsend(gsm_cmd1);

gsmcmdsend(gsm_cmd2);

gsmcmdsend(gsm_cmd3);

gsmcmdsend(gsm_cmd4);

gsmcmdsend(gsm_cmd5);

}


void gsmcmdsend(unsigned char *cmd)
```

// **FUCNTON TO INITILIZE AT COMMANDS FOR MSG**

```
{

 unsigned char i;

 for(i=0;*cmd!='\0';i++)

 {

 SBUF=*cmd;

 while(TI==0);

  TI=0;

  cmd++;

  }
```

```
delay(2);

SBUF=0x0A;// new line

 while(TI==0);

         TI=0;

         SBUF=0x0D; //enter

         while(TI==0);

          TI=0;

          while(RI==0);

          RI=0;

          }
```

APPENDIX B

CODING OF LCD

```
mov p2,#00h
mov p3,#00h
mov p1,#01h

chk:
chk0:
jnb p1.0,enter0

mov r0,p1
cjne r0,#01h,chk
ljmp enterN
ljmp chk
ret

enter0:
mov 26,#01h
```

```
mov 28,#10h
lcall lcd
sjmp chk1
ret

enterN:
mov 26,#03h
mov 28,#50h
lcall lcd
ljmp chk
ret
lcd:
mov r7,#01h
mov r2,#8fh
mov r3,#01h
mov r5,#00
        mov a,#38h
        acall comn
        acall delay
        mov a,#0eh
        acall comn
        acall delay
        mov a,#01
        acall comn
```

```
acall delay
mov a, #06h
acall comn
acall delay
next:
;mov dptr,#100h
mov dph,26
mov dpl,28
next1:
mov a,r7
mov r6,a
mov a,r3
mov r4,a
mov a,r2
acall comn
;acall delay
loop:
clr a

movc a,@a+dptr
acall datawrt
inc dptr
djnz r4,loop
;acall delay
```

```
dec r2

inc r3

inc r5

cjne r2,#7fh,next

inc r2

;mov dptr,#200h

mov dph,26

mov dpl,28
```

dptrinc:

```
inc dptr

djnz r6,dptrinc

inc r7

cjne r5,#30,next1

ret

comn: mov p2,a

clr p3.0

clr p3.1

setb p3.2

acall delay

clr p3.2

ret

datawrt: mov p2,a

setb p3.0

clr p3.1
```

```
setb p3.2

acall delay

clr p3.2

ret

delay: mov r0,#50

here2: mov r1,#255

here: djnz r1,here

djnz r0,here2

ret

org 110h

DB ' stress measured'

org 350h

DB 'skin response meter using GSR'

End
```

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