Secure Health Monitoring System

A PROJECT REPORT

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Under the Supervision of
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CERTIFICATE

Certified that **VISHWADEV GUPTA (200029014005821), ASIF (200029014005718), PRIYANKA RAGHUVANSHI (200029014005776)** have carried out the project work having “**Secure Health Monitoring System”** for Master of Computer Applications from Dr. A.P.J. Abdul Kalam Technical University (AKTU) (formerly UPTU), Technical University, Lucknow under my supervision. The project report embodies original work, and studies are carried out by the student himself / herself and the contents of the project report do not form the basis for the award of any other degree to the candidate or to anybody else from this or any other University/Institution.

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ABSTRACT

In spite of the improvement of communication link and despite all progress in advanced communication technologies, there are still very few functioning commercial wireless monitoring systems, which are most off-line, and there are still a number of issues to deal with.

Therefore, there is a strong need for investigating the possibility of design and implementation of an interactive real-time wireless communication system. In our project, a generic real-time wireless communication system was designed and developed for short- and long-term remote patient-monitoring applying wireless protocol. The primary function of this system is to monitor the temperature and Heartbeat of the Patient and the Data collected by the sensors are sent to the Microcontroller. The Microcontroller transmits the data over the air. Here we are using the GSM modem in order to transmit the information.

From the transmitter the recordings are sent as an SMS to the care taker or the expert which have been given as the recipient. Not only we send the information through GSM module as SMS we also display the readings in the PC where we can record them and also keep a track on his/her previous history. And when the conditions go abnormal then we sense those values and then alarm the people around by blowing the alarm and also sending by sending as urgency SMS.

ACKNOWLEDGEMENTS

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LIST OF CHAPTERS

1.Introduction

COVID-19 was one of the most pressing worldwide health concerns. Acc to survey on 19 November persons worldwide who have been verified to have been purulent with SARS COV 2 is greater than 56.3 million, with more than 1.35 million deaths from the coronavirus, demonstrating that COVID-19 cases are on the rise . As of November 21, 2020, there were total 445,281 active COVID 19 cases in Bangladesh, with 6350 deaths from the corona virus [2].breath shortness ,fever low oxygen saturation ,vomiting, diarrhea, throat probelom, head ache, dry cough, loss of smell and taste, body pain, and irregular rate of pulse are all signs of COVID-19 [3]. High fever, and low oxygen saturation, an irregular rate of are all considered dangerous symptoms. Hypoxemia and hypoxia are caused by shortness of breath . Patients with hypoxemia and pulse rate issues have a lower likelihood of survival and patients may fail to notice hypoxemia and an increasedpulse rate, and as a result, they die without receiving necessary treatment. The patients of COVID-19 should be known about their health problems on a frequent basis, particularly their body temperature, heart rate, and SpO2 . As the person becomes older, it becomes increasingly important for them have regular medical checkup exams. Because getting frequent health checkup visits can be time consuming and can be difficult for most of the people, IoT arrangements can be advantageous for individuals h a v e routine health exams . IoT has evolved into a critical innovation having countless use. Any system of physical equipment that obtains and exchanges data via wireless networks is referred to as a wireless network.

2.Block Diagram

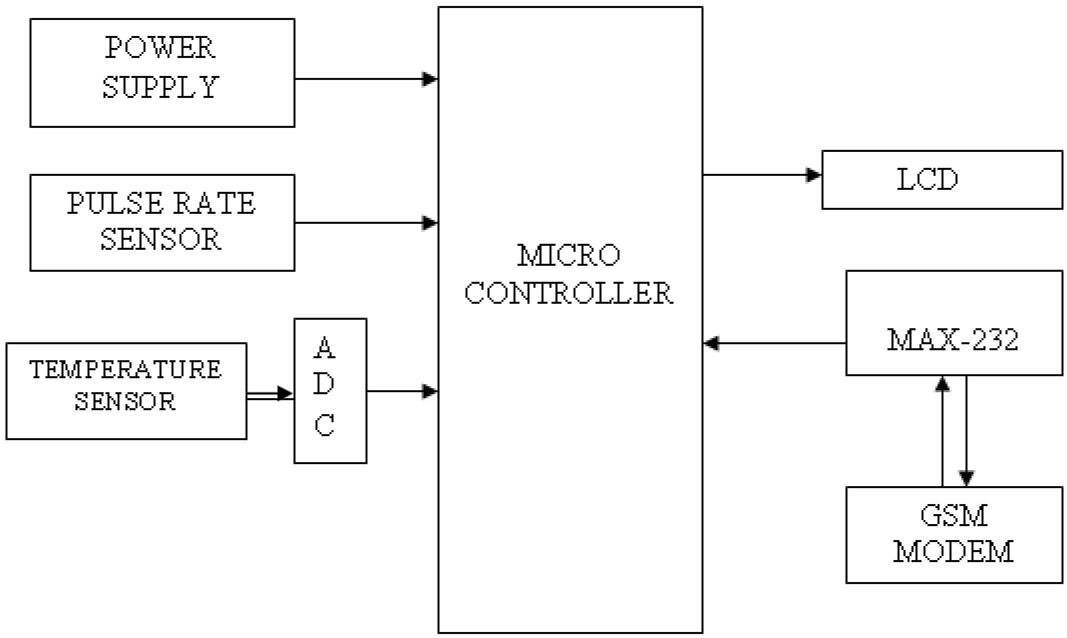


Figure 1 Block Diagram

2.1 Block Diagram Description

In this block diagram, there is a micro controller, a heart beat sensor (Electrodes) circuitry, a GSM MODEM and a LCD Display.

The heart beat circuitry consists of a Quad Op-amp IC and three electrodes. These electrodes are placed to the patient who is suffering with high B.P as well as heart problems. The output of this circuitry is considered into logic levels and this output is given to one of the pin of the micro controller.

The GSM Modem is used for sending and receiving messages from the patient to a doctor and vice versa. Whenever the heart beat rate or the B.P. exceeds the threshold value. The micro controller will automatically send the signals to the GSM Modem. Through the GSM Modem, the message will gives to the concerned person or a doctor.

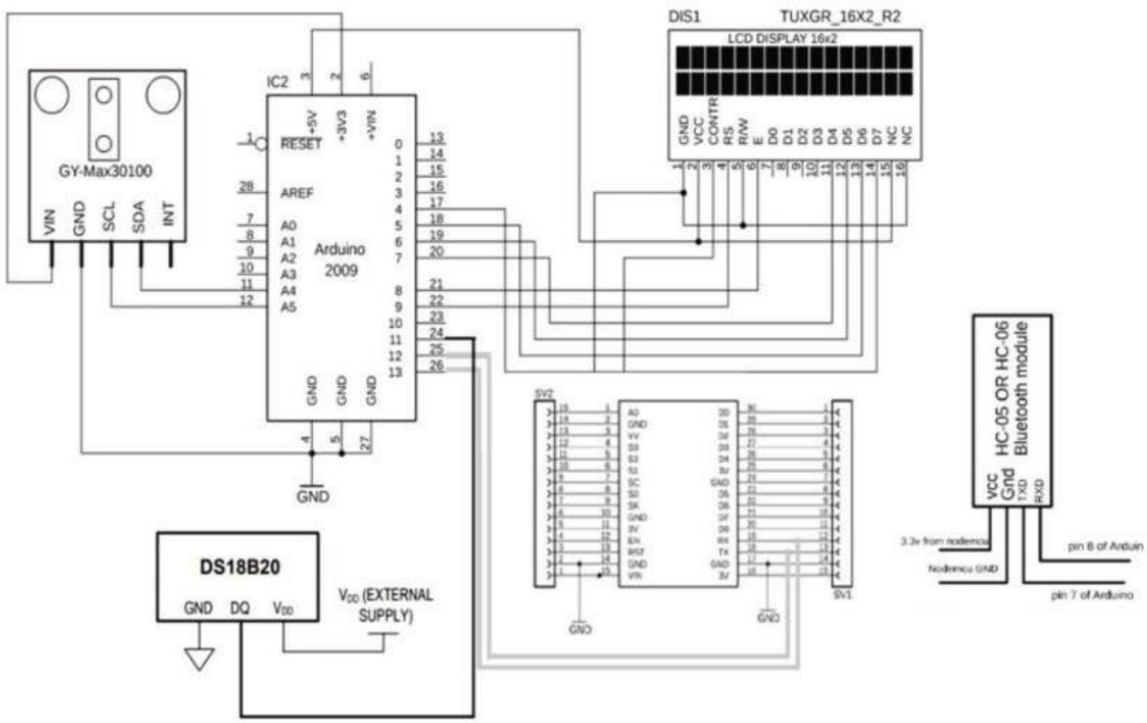


Figure 1: The system's block diagram.

The LCD display is used to display the status of the GSM modem and as well as the heart beat rate continuously.

For the circuitry operation, it requires the +5V DC power supply.

2.2 Schematic Diagram

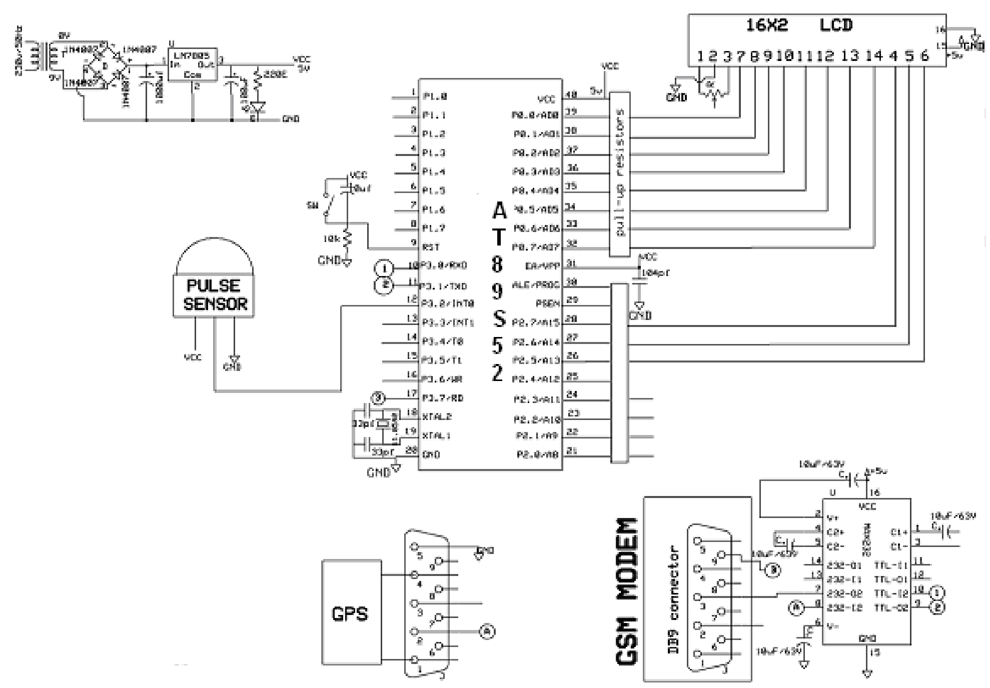


Figure 2 Schematic

2.3 Schematic Description

2.3.1 Latch Connections to Micro controller

Pins	**Connections**
9, 16	P3.0

2, 13	P3.1
19	P3.6
1	P3.7
10	GND
20	VCC

2.3.2 MAX-232 connections to microcontroller

Pins	**connections**
11	This pin is connected to P3.1 (TXD) of the Micro controller
12	This pin is connected to P3.0 (RXD) of the Micro controller
13	This pin is connected to 3rd pin (TXD) of DB-9 connector
14	This pin is connected to 2nd pin (RXD) of DB-9 connector
15	Ground
16	Vcc (+5v)

2.3.3 LCD connections to Micro controller

Pins	**Connections**
1	VSS (ground)
2	VCC (+5V)
3	10k pot
4	RS, this pin is connected to P2.7 of the micro controller
5	R/w, this pin is connected to P2.6 of the micro controller
6	EN, this pin is connected to P2.5 of the micro controller
7-14	(D0-D7) these pins are connected to the port (P0) of the micro controller

The heart beat sensor (Electrodes) circuitry is connected to the P3.2 of the micro controller.

3. Hardware Components

3.1 Micro Controller 89S52

3.1.1 Introduction

A Micro controller consists of a powerful CPU tightly coupled with memory, various I/O interfaces such as serial port, parallel port timer or counter, interrupt controller, data acquisition interfaces-Analog to Digital converter, Digital to Analog converter, integrated on to a single silicon chip

.

If a system is developed with a microprocessor, the designer has to go for external memory such as RAM, ROM, EPROM and peripherals. But controller is provided all these facilities on a single chip. Development of a Micro controller reduces PCB size and cost of design.

One of the major differences between a Microprocessor and a Micro controller is that a controller often deals with bits not bytes as in the real world application.

Intel has introduced a family of Micro controllers called the MCS-51.

3.1.2 The Major Features

- Compatible with MCS-51 products
- 4k Bytes of in-system Reprogrammable flash memory
- Fully static operation: 0HZ to 24MHZ
- Three level programmable clock
- 128 * 8 –bit timer/counters
- Six interrupt sources
- Programmable serial channel
- Low power idle power-down modes

AT89C52 is 8-bit micro controller, which has 4 KB on chip flash memory, which is just sufficient for our application. The on-chip Flash ROM allows the program memory to be reprogrammed in system or by conventional non-volatile memory Programmer. Moreover ATMEL is the leader in flash technology in today’s market place and hence using AT 89C52 is the optimal solution.

Table 1: A list of the hardware components that are necessary, as well as their amount and price..

Item description	Unit price	Quantity	Total price (BDTK)
Arduino Uno	420	1	420
Temperature	450	1	450
SpO2 Pulse	1400	1	1400
Node MCU WirelessModule	525	1	525
Bluetooth	280	1	280
16 × 2 LCD display	285	1	285
Buck converter	82	1	82
3.7 lithium battery	60	2	120
3.7 lithium batteryprotector	45	2	90
2 s lithium battery	1850	1	1850
2 s lithium battery protector	250	1	250
9 V 2A battery adapter	100	1	100
Wire set	120	2	240
Switch	10	1	10
Buzzer	18	1	18
Total			

Figure 4: Arduino Uno [25]

Figure 5: Pulse Sensor (MAX30100) [27].

The Hardware Materials That Were Used The system is made up of two components: the equipments and a mobile application. Both components are essential to the system's operation. The system of health monitoring can detect saturation of oxygen , heart rate, and temperature of body in humans. The implementation of this multifunction system necessitates the use of various components. Implementation is accomplished by carrying out the tasks outlined in a work plan. The implementation of the design is critical to the system's success. The components needed to run this system are listed below in brief. Table 1 shows the hardware components that are necessary, as well as their quantities and prices.

Arduino Uno. The Arduino Uno, Arduino Mega, Arduino Due, and Arduino Leonardo are examples of commerciallyaccessible Arduino boards. 14 digital I/O pins 20 I/O pins, and six analogue I/O pins make up Arduino Uno. There are 54digital I/O pins, 12 analogue pins of input , and two analogue pins of output on Arduino Due. There are 54 pins of digital I/O ,16 analogue inputs, and 0 output pins on Arduino Mega.There are 20 pins of digital I/O , 12 analogue inputs, and 0 output pins on the Arduino Leonardo

Figure 7: Node MCU ESP8266

Figure 8: Buck converter

Figure 9: 16×2 Liquid crystal display.

Figure 10 : DS18B20 Sensor .

Pulse Detection (MAX30100). The MAX30100 is sensor used to determine saturation of blood oxygen and rate of pulse. Prototype of SpO2 sensor of pulse is shown in Figure 5. (MAX30100). The amount of oxygenated haemoglobin in the circulation is measured by peripheral oxygen saturation , which is the measurement of blood vessel saturation of oxygen. SpO2 levels in human body typically vary from 90 to 100 percent. A MAX 30100 pulse oximeter is suitable for this setup. It's combination of a oximeter used for measuring beat and a sensor for heart rate that gives precise results. This sensor is suited for this system because it combines a photo detector, two LEDs, low-noise analogue and improved optics flag processing to recognise heart rate signals and beat oximetry . Bluetooth Module 1.1.3 Commercially accessible Bluetooth modules come in a variety of shapes and sizes. Because it is user friendly, we chose HC05 module of bluetooth for our system. The Bluetooth HC05 module is a Bluetooth serial port protocol module that enables for both wireless and serial communication with Bluetooth-enabled devices with micro-controllers. The 2.45-GHz frequency band is used by the HCO5 Bluetooth module, which has range of 10 m. It has a rate of data transfer about 1 megabit per second. It can work with a 4–6 V power supply. There are two working modes for the HC05 Bluetooth module: data mode and command mode

SpO2, pulse rate, and temperature were all measured in Figure 17.

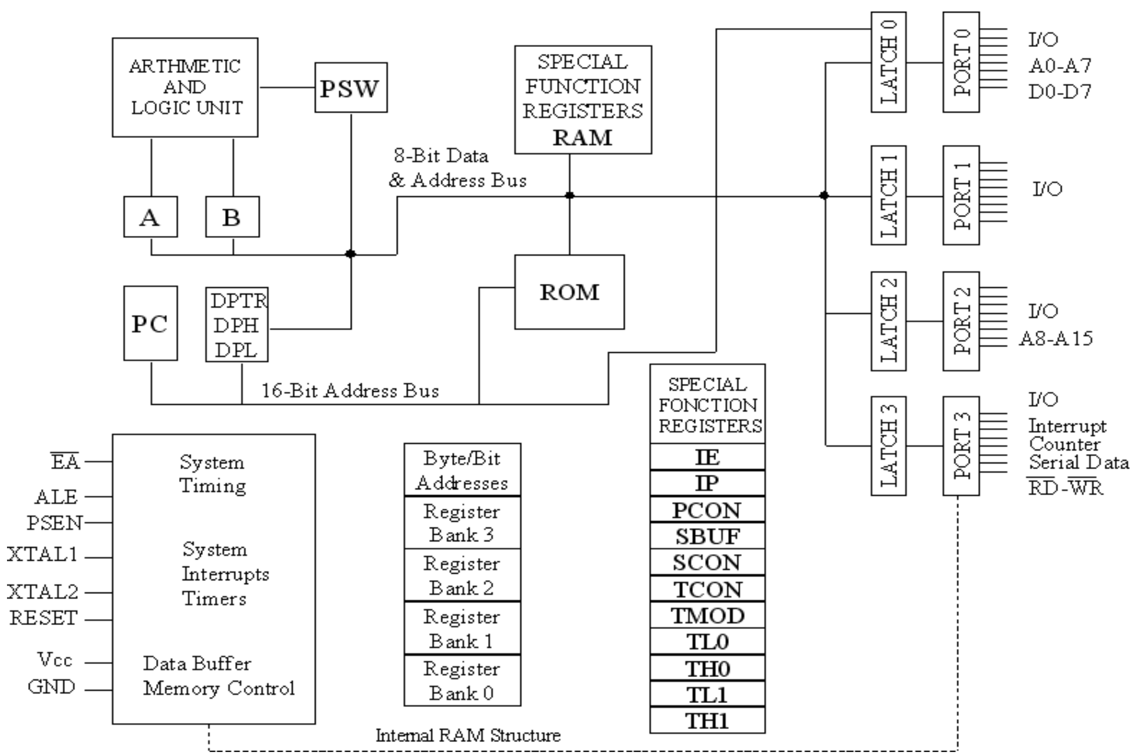
Figure 19 : Sytem's Prototype

The button that controls the server. Using the server button, the mobile application will be connected to the device and display patient's measured saturation of oxygen, rate of pulse and temperature. Figure 15 depicts saturation of oxygen, rate of pulse, and temperature interaction (b). The doctor portal interface is shown in figure 16(a). This screen will show if the doctor hits the doctor's portal button. By clicking on COVID patient and normal patient buttons, clinicians may compare the temperatures, SpO2, and pulse rates of normal and COVID-19 patients. A typical patient portfolio is shown in Figure 16(b). This interface will appear when user hits standard patient button. This interface will display a list of normal patients who are unaffected by COVID-19.

3.1.3 AT89S52 Microcontroller Architecture

The 89C52 architecture consists of these specific features:

- Eight –bit CPU with registers A (the accumulator) and B
- Sixteen-bit program counter (PC) and data pointer (DPTR)
- Eight- bit stack pointer (PSW)
- Eight-bit stack pointer (Sp)
- Internal ROM or EPROM (8751) of 0(8031) to 4K (89C51)
- Internal RAM of 128 bytes:
- Thirty –two input/output pins arranged as four 8-bit ports:p0-p3
- Two 16-bit timer/counters: T0 and T1
- Full duplex serial data receiver/transmitter: SBUF
- Control registers: TCON, TMOD, SCON, PCON, IP, and IE
- Two external and three internal interrupts sources.
- Oscillator and clock circuits.



Functional block diagram of Microcontroller

3.1.4 Types of memory

The 89C51 have three general types of memory. They are on-chip memory, external Code memory and external Ram. On-Chip memory refers to physically existing memory on the micro controller itself. External code memory is the code memory that resides off chip. This is often in the form of an external EPROM. External RAM is the Ram that resides off chip. This often is in the form of standard static RAM or flash RAM.

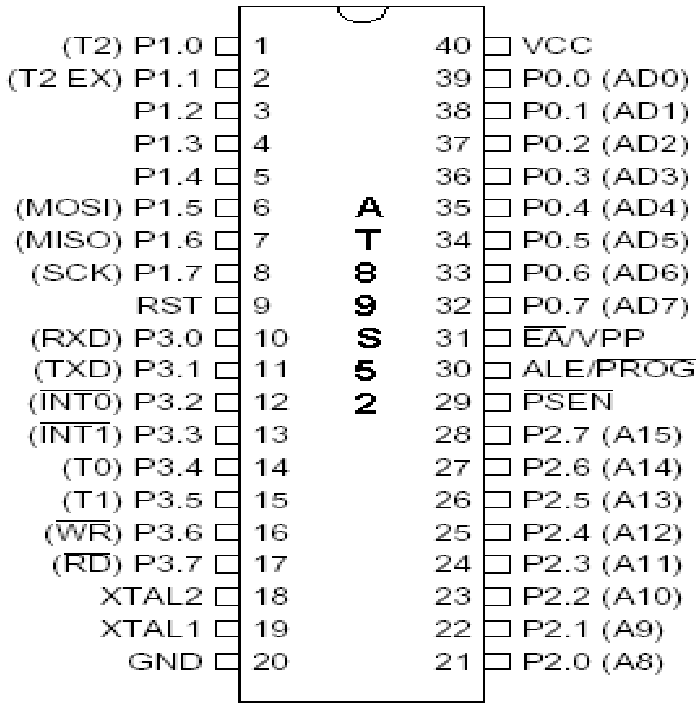
Code memory

Code memory is the memory that holds the actual 89C51 programs that is to be run. This memory is limited to 64K. Code memory may be found on-chip or off-chip. It is possible to have 4K of code memory on-chip and 60K off chip memory simultaneously. If only off-chip memory is available then there can be 64K of off chip ROM. This is controlled by pin provided as EA.

Internal RAM

The 89C51 have a bank of 128 of internal RAM. The internal RAM is found on-chip. So it is the fastest Ram available. And also it is most flexible in terms of reading and writing. Internal Ram is volatile, so when 89C51 is reset, this memory is cleared. 128 bytes of internal memory are subdivided. The first 32 bytes are divided into 4 register banks. Each bank contains 8 registers. Internal RAM also contains 128 bits, which are addressed from 20h to 2Fh. These bits are bit addressed i.e. each individual bit of a byte can be addressed by the user. They are numbered 00h to 7Fh. The user may make use of these variables with commands such as SETB and CLR.

Flash memory is a nonvolatile memory using NOR technology, which allows the user to electrically program and erase information. Flash memory is used in digital cellular phones, digital cameras, LAN switches, PC Cards for notebook computers, digital set-up boxes, embedded controllers, and other devices.



Pin Diagram of AT89s52

3.1.5 Pin Description

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 1sare 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.

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 3

Port 3 is an 8-bit bi-directional I/O port with internal pull-ups. The Port 3 output buffers can 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 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	$\overline{\text{INT0}}$ (external interrupt 0)
P3.3	$\overline{\text{INT1}}$ (external interrupt 1)
P3.4	T0 (timer 0 external input)
P3.5	T1 (timer 1 external input)
P3.6	$\overline{\text{WR}}$ (external data memory write strobe)
P3.7	$\overline{\text{RD}}$ (external data memory read strobe)

Table 1Port pins and their alternate functions

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 1/6the 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 micro controller 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.

3.1.6 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 Figs 6.1 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 in Figure 6.2. 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.

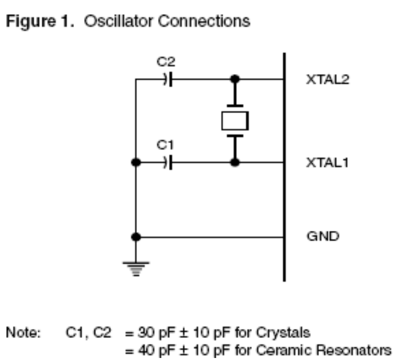


Figure 5Oscillator Connections

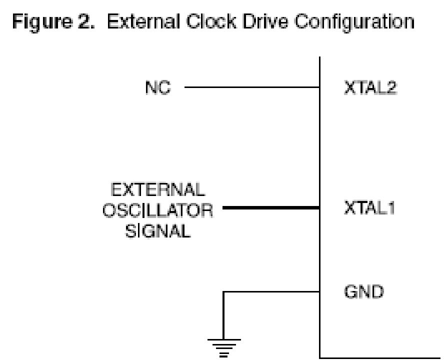


Figure 3.1External Clock Drive Configuration

3.1.7 REGISTERS

In the CPU, registers are used to store information temporarily. That information could be a byte of data to be processed, or an address pointing to the data to be fetched. The vast majority of 8051 registers are 8–bit registers.

D7	D6	D5	D4	D3	D2	D1	D0

The most widely used registers of the 8051 are A(accumulator), B, R0, R1, R2, R3, R4, R5, R6, R7, DPTR(data pointer), and PC(program counter). All of the above registers are 8-bits, except DPTR and the program counter. The accumulator, register A, is used for all arithmetic and logic instructions.

3.1.8 SFRs (Special Function Registers)

In the 8051, registers A, B, PSW and DPTR are part of the group of registers commonly referred to as SFR (special function registers). The SFR can be accessed by the names (which is much easier) or by their addresses. For example, register A has address E0h, and register B has been ignited the address F0H, as shown in table.

The following two points should note about the SFR addresses.

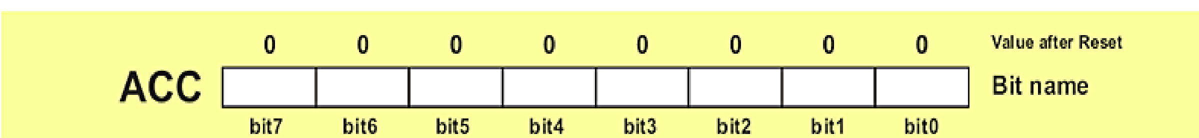
1. The Special function registers have addresses between 80H and FFH. These addresses are above 80H, since the addresses 00 to 7FH are addresses of RAM memory inside the 8051.
2. Not all the address space of 80H to FFH is used by the SFR. The unused locations 80H to FFH are reserved and must not be used by the 8051 programmers.

Symbol	**Name**	**Address**
ACC	Accumulator	0E0H
B	B register	0F0H
PSW	Program status word	0D0H
SP	Stack pointer	81H
DPTR	Data pointer 2 bytes	
DPL	Low byte	82H
DPH	High byte	83H
P0	Port0	80H
P1	Port1	90H
P2	Port2	0A0H
P3	Port3	0B0H

IP	Interrupt priority control	0B8H
IE	Interrupt enable control	0A8H
TMOD	Timer/counter mode control	89H
TCON	Timer/counter control	88H
T2CON	Timer/counter 2 control	0C8H
T2MOD	Timer/counter mode2 control	0C9H
TH0	Timer/counter 0high byte	8CH
TL0	Timer/counter 0 low byte	8AH
TH1	Timer/counter 1 high byte	8DH
TL1	Timer/counter 1 low byte	8BH
TH2	Timer/counter 2 high byte	0CDH
TL2	Timer/counter 2 low byte	0CCH
RCAP2H	T/C 2 capture register high byte	0CBH
RCAP2L	T/C 2 capture register low byte	0CAH
SCON	Serial control	98H
SBUF	Serial data buffer	99H
PCON	Power control	87H

Table 3.2: 8051 Special function register Address

A Register (Accumulator)



This is a general-purpose register, which serves for storing intermediate results during operating. A number (an operand) should be added to the accumulator prior to execute an instruction upon it. Once an arithmetical operation is preformed by the ALU, the result is placed into the accumulator

B Register

B register is used during multiply and divide operations which can be performed only upon numbers stored in the A and B registers. All other instructions in the program can use this register as a spare accumulator (A).

Registers (R0-R7)

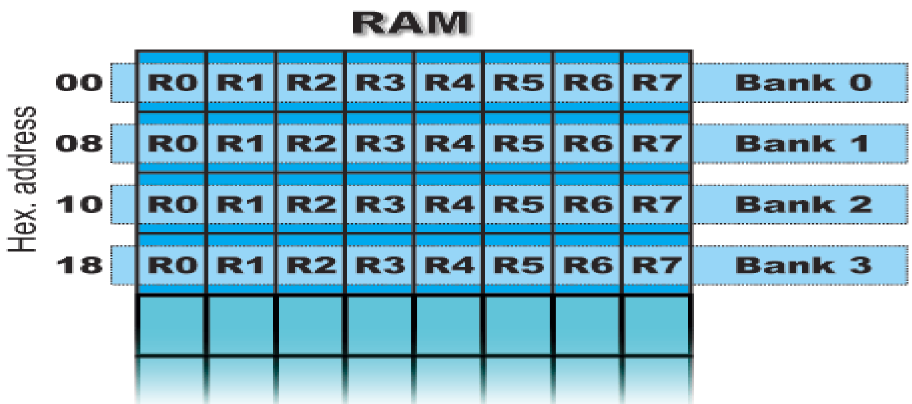


Figure 4Memory Organization of RAM

This is a common name for the total 8 general purpose registers (R0, R1, R2 ...R7). Even they are not true SFRs, they deserve to be discussed here because of their purpose. The bank is active when the R registers it includes are in use. Similar to the accumulator, they are used for temporary storing variables and intermediate results. Which of the banks will be active depends on two bits included in the PSW Register. These registers are stored in four banks in the scope of RAM.

3.1.9 8051 Register Banks and Stack

RAM memory space allocation in the 8051

There are 128 bytes of RAM in the 8051. The 128 bytes of RAM inside the 8051 are assigned addresses 00 to7FH. These 128 bytes are divided into three different groups as follows:

1. A total of 32 bytes from locations 00 to 1FH hex are set aside for register banks and the stack.
2. A total of 16 bytes from locations 20 to 2FH hex are set aside for bit-addressable read/write memory.

3. A total of 80 bytes from locations 30H to 7FH are used for read and write storage, or what is normally called Scratch pad. These 80 locations of RAM are widely used for the purpose of storing data and parameters nu 8051 programmers.

Default register bank

Register bank 0; that is, RAM locations 0, 1,2,3,4,5,6, and 7 are accessed with the names R0, R1, R2, R3, R4, R5, R6, and R7 when programming the 8051.

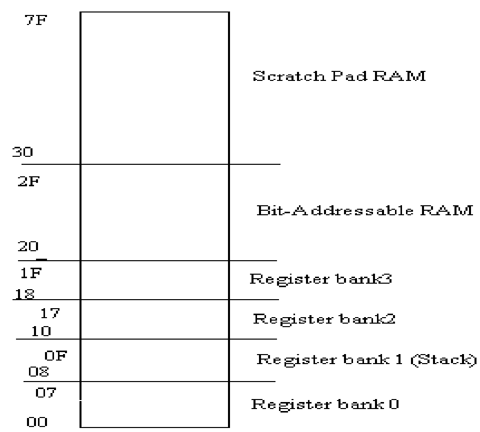
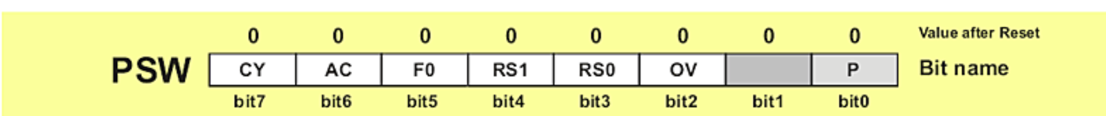


FIG 3.6 RAM Allocation in the 8051

PSW Register (Program Status Word)



This is one of the most important SFRs. The Program Status Word (PSW) contains several status bits that reflect the current state of the CPU. This register contains: Carry bit, Auxiliary Carry, two register bank select bits, Overflow flag, parity bit, and user-definable status flag. The ALU automatically changes some of register’s bits, which is usually used in regulation of the program performing.

P - Parity bit. If a number in accumulator is even then this bit will be automatically set (1), otherwise it will be cleared (0). It is mainly used during data transmission and receiving via serial communication.

OV Overflow occurs when the result of arithmetical operation is greater than 255 (decimal), so that it cannot be stored in one register. In that case, this bit will be set (1). If there is no overflow, this bit will be cleared (0).

RS0, RS1 - Register bank select bits. These two bits are used to select one of the four register banks in RAM. By writing zeroes and ones to these bits, a group of registers R0-R7 is stored in one of four banks in RAM. This is a general-purpose bit available to the user.

RS1	**RS2**	**Space in RAM**
0	0	Bank0 00h-07h
0	1	Bank1 08h-0Fh
1	0	Bank2 10h-17h
1	1	Bank3 18h-1Fh

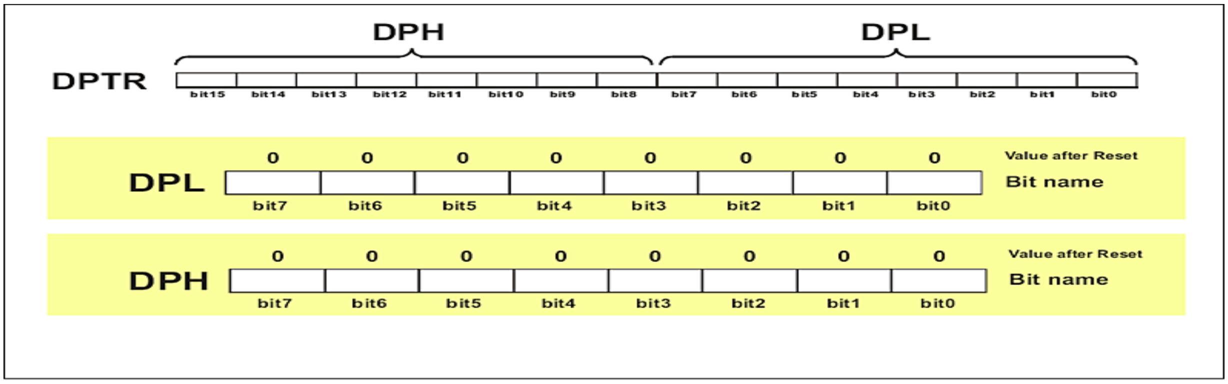
Table 3.3: Register bank select

AC - Auxiliary Carry Flag is used for BCD operations only.

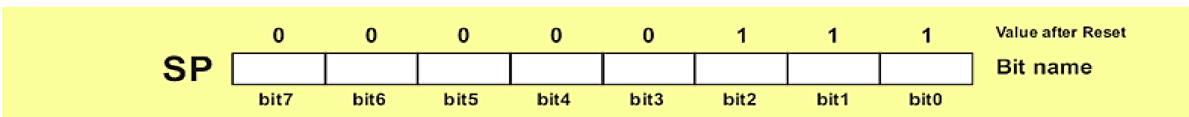
CY - Carry Flag is the (ninth) auxiliary bit used for all arithmetical operations and shift instructions.

DPTR Register (Data Pointer)

These registers are not true ones because they do not physically exist. They consist of two separate registers: DPH (Data Pointer High) and (Data Pointer Low). Their 16 bits are used for external memory addressing. They may be handled as a 16-bit register or as two independent 8-bit registers. Besides, the DPTR Register is usually used for storing data and intermediate results, which have nothing to do with memory locations.



SP Register (Stack Pointer)



The stack is a section of RAM used by the CPU to store information temporily. This information could be data or an address. The CPU needs this storage area since there are only a limited number of registers.

How stacks are accessed in the 8051

If the stack is a section of RAM, there must be registers inside the CPU to point to it. The register used to access the stack is called the SP (Stack point) Register. The stack pointer in the 8051 is only 8 bits wide; which means that it can take values of 00 to FFH. When the 8051 is powered up, the SP register contains value 07. This means that RAM location 08 is the first location used for the stack by the 8051. The storing of a CPU register in the stack is called a PUSH, and pulling the contents off the stack back into a CPU register is called a POP. In other words, a register is pushed onto the stack to save it and popped off the stack to retrieve it. The job of the SP is very critical when push and pop actions are performed.

3.1.10 Program counter

The important register in the 8051 is the PC (Program counter). The program counter points to the address of the next instruction to be executed. As the CPU fetches the opcode from the program ROM, the program counter is incremented to point to the next instruction. The program counter in the 8051 is 16bits wide. This means that the 8051 can access program addresses 0000 to FFFFH, a total of 64k bytes of code. However, not all members of the 8051 have the entire 64K bytes of on-chip ROM installed, as we will see soon.

3.1.11 TIMERS

On-chip timing/counting facility has proved the capabilities of the micro controller for implementing the real time application. These includes pulse counting, frequency measurement, pulse width measurement, baud rate generation, etc,. Having sufficient number of timer/counters may be a need in a certain design application. The 8051 has two timers/counters. They can be used either as timers to generate a time delay or as counters to count events happening outside the micro controller.

3.1.12 Serial Communication

Serial data communication uses two methods, asynchronous and synchronous. The synchronous method transfers a block of data at a time, while the asynchronous method transfers a single byte at a time.

In data transmission if the data can be transmitted and received, it is a duplex transmission. This is in contrast to simplex transmissions such as with printers, in which the computer only sends data. Duplex transmissions can be half or full duplex, depending on whether or not the data transfer can be simultaneous. If data is transmitted one way at a time, it is referred to as half duplex. If the data can go both ways at the same time, it is full duplex. Of course, full duplex requires two wire conductors for the data lines, one for transmission and one for reception, in order to transfer and receive data simultaneously.

Asynchronous serial communication and data framing

The data coming in at the receiving end of the data line in a serial data transfer is all 0s and 1s; it is difficult to make sense of the data unless the sender and receiver agree on a set of rules, a protocol, on how the data is packed, how many bits constitute a character, and when the data begins and ends.

Start and stop bits

Asynchronous serial data communication is widely used for character-oriented transmissions, while block-oriented data transfers use the synchronous method. In the asynchronous method, each character is placed between start and stop bits. This is called framing. In the data framing for asynchronous communications, the data, such as ASCII characters, are packed between a start bit and a stop bit. 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).

Data transfer rate

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. However, the baud and bps rates are not necessarily equal. This is due to the fact that baud rate is the modem terminology and is defined as the number of signal changes per second. In modems a single change of signal, sometimes transfers several bits of data. As far as the conductor wire is concerned, the baud rate and bps are the same, and for this reason we use the bps and baud interchangeably.

3.1.13 RS232 Standards

To allow compatibility among data communication equipment made by various manufacturers, an interfacing standard called RS232 was set by the Electronics Industries Association (EIA) in 1960. In 1963 it was modified and called RS232A. RS232B AND RS232C were issued in 1965 and 1969, respectively. Today, RS232 is the most widely used serial I/O interfacing standard. This standard is used in PCs and numerous types of equipment. However, since the standard was set long before the advert of the TTL logic family, its input and output voltage levels are not TTL compatible. In RS232, a 1 is represented by -3 to -25V, while a 0 bit is +3 to +25V, making -3 to +3 undefined. For this reason, to connect any RS232 to a micro controller system we must use voltage converters such as MAX232 to convert the TTL logic levels to the RS232 voltage levels, and vice versa. MAX232 IC chips are commonly referred to as line drivers.

RS232 pins

RS232 cable, commonly referred to as the DB-25 connector. In labeling, DB-25P refers to the plug connector (male) and DB-25S is for the socket connector (female). Since not all the pins are used in PC cables, IBM introduced the DB-9 Version of the serial I/O standard, which uses 9 pins only, as shown in table.

DB-9 pin connector

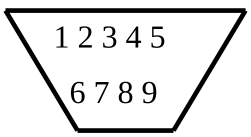


Fig3.7 DB-9 pin connector

Pin Functions

Pin	Description
1	Data carrier detect (DCD)
2	Received data (RXD)
3	Transmitted data (TXD)
4	Data terminal ready(DTR)
5	Signal ground (GND)
6	Data set ready (DSR)
7	Request to send (RTS)
8	Clear to send (CTS)
9	Ring indicator (RI)

Table 3.5 : DB9 Pin Functions

Note: DCD, DSR, RTS and CTS are active low pins.

The method used by RS-232 for communication allows for a simple connection of three lines: Tx, Rx, and Ground. The three essential signals for 2-way RS-232

Communications are these

TXD: carries data from DTE to the DCE.

RXD: carries data from DCE to the DTE

SG: signal ground

3.1.14 8051 connection to RS232

The RS232 standard is not TTL compatible; therefore, it requires a line driver such as the MAX232 chip to convert RS232 voltage levels to TTL levels, and vice versa. The interfacing of 8051 with RS232 connectors via the MAX232 chip is the main topic.

The 8051 has two pins that are used specifically for transferring and receiving data serially. These two pins are called TXD and RXD and a part of the port 3 group (P3.0 and P3.1). pin 11 of the 8051 is assigned to TXD and pin 10 is designated as RXD. These pins are TTL compatible; therefore, they require a line driver to make them RS232 compatible. One such line driver is the MAX232 chip.

Since the RS232 is not compatible with today's microprocessors and microcontrollers, we need a line driver (voltage converter) to convert the RS232's signals to TTL voltage levels that will be acceptable to the 8051's TXD and RXD pins. One example of such a converter is MAX232 from Maxim Corp. The MAX232 converts from RS232 voltage levels to TTL voltage levels, and vice versa.

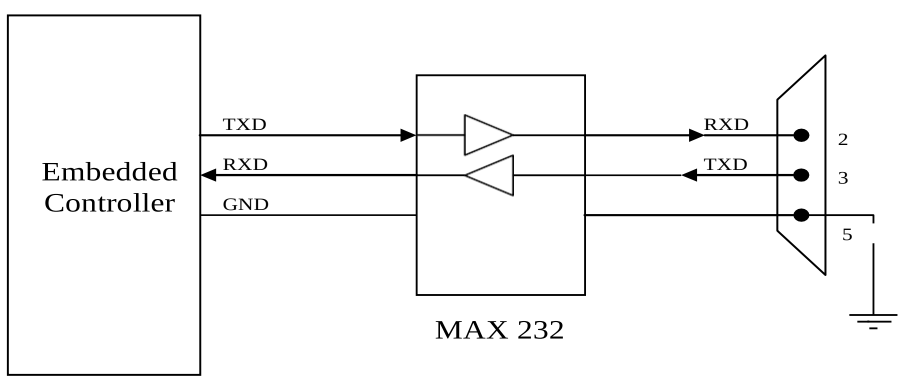


Figure 5Interfacing of MAX-232 to Controller

3.1.15 INTERRUPTS

A single micro controller can serve several devices. There are two ways to do that: INTERRUPTS or POLLING.

INTERRUPTS vs POLLING

The advantage of interrupts is that the micro controller can serve many devices (not all the same time, of course); each device can get the attention of the micro controller based on the priority assigned to it. The polling method cannot assign priority since it checks all devices in round-robin fashion. More importantly, in the interrupt method the micro controller can also ignore (mask) a device request for service. This is again not possible with the polling method. The most important reason that the interrupt method is preferable is that the polling method wastes much of the micro controller's time by polling devices that do not need service. So, in order to avoid tying down the micro controller, interrupts are used.

INTERRUPT SERVICE ROUTINE

For every interrupt, there must be an interrupt service routine (ISR), or interrupt handler. When an interrupt is invoked, the micro controller runs the interrupts service routine. For every interrupt, there is a fixed location in memory that holds the address of its ISR. The group of memory location set aside to hold the addresses of ISRs is called the interrupt vector table. Shown below:

Interrupt Vector Table for the 8051

INTERRUPT	ROM LOCATION (HEX)	PIN	FLAG CLEARING
Reset	0000	9	Auto
External hardware Interrupt 0	0003	P3.2 (12)	Auto
Timers 0 interrupt (TF0)	000B		Auto
External hardware Interrupt 1(INT1)	0013	P3.3 (13)	Auto
Timers 1 interrupt (TF1)	001B		Auto
Serial COM (RI and TI)	0023		Programmer Clears it

Six Interrupts in the 8051

In reality, only five interrupts are available to the user in the 8051, but many manufacturers' data sheets state that there are six interrupts since they include reset .the six interrupts in the 8051 are allocated as above.

1. Reset. When the reset pin is activated, the 8051 jumps to address location 0000.this is the power-up reset.
2. Two interrupts are set aside for the timers: one for Timer 0 and one for Timer 1.Memory location 000BH and 001BH in the interrupt vector table belong to Timer 0 and Timer 1, respectively.
3. Two interrupts are set aside for hardware external harder interrupts. Pin number 12(P3.2) and 13(P3.3) in port 3 is for the external hardware interrupts INT0 and INT1, respectively. These external interrupts are also referred to as EX1 and EX2.Memory location 0003H and 0013H in the interrupt vector table are assigned to INT0 and INT1, respectively.
4. Serial communication has a single interrupt that belongs to both receive and transmit. The interrupt vector table location 0023H belongs to this interrupt.

Interrupt Enable Register

D7	D6	D5	D4	D3	D2	D1	D0
EA	--	ET2	ES	ET1	EX1	ET0	EX0

EA IE.7 disables all interrupts. If EA=0, no interrupts is acknowledged.
If EA=1, each interrupt source is individually enabled disabled
By setting or clearing its enable bit.

-- IE.6 Not implemented, reserved for future use.*

ET2 IE.5 Enables or disables Timer 2 overflow or capture interrupt (8052 Only).

ES IE.4 Enables or disables the serial ports interrupt.

ET1 IE.3 Enables or disables Timers 1 overflow interrupt

EX1 IE.2 Enables or disables external interrupt 1.

ET0 IE.1 Enables or disables Timer 0 overflow interrupt.

EX0 IE.0 Enables or disables external interrupt 0.

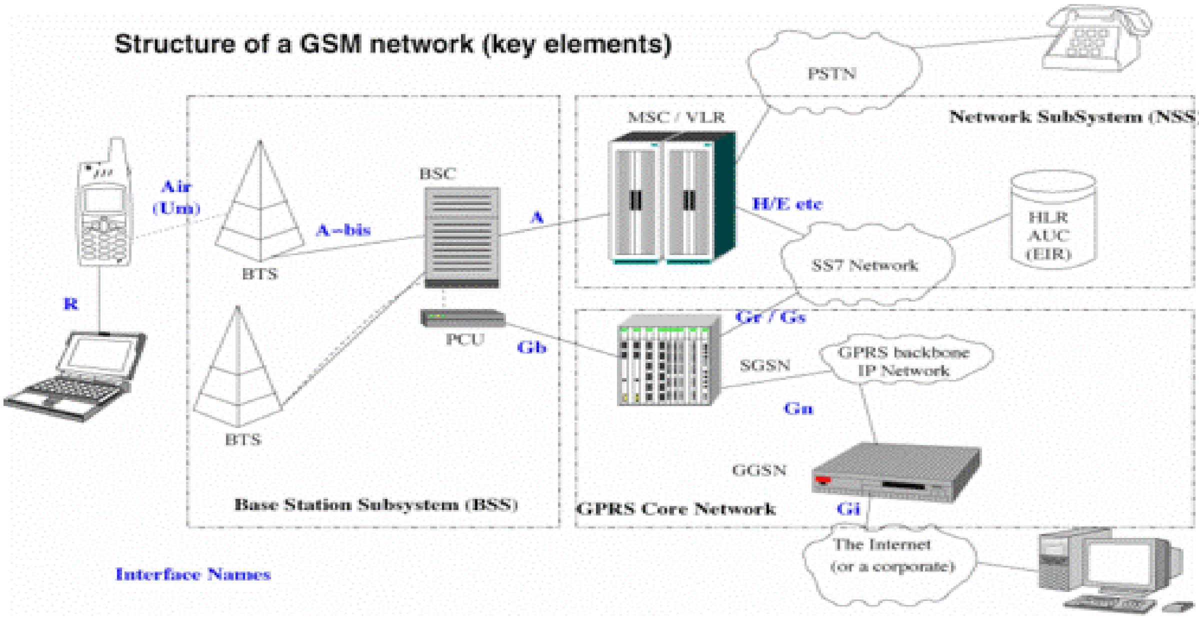
3.2 GLOBAL SYSTEM FOR MOBILE COMMUNICATIONS

3.2.1 Definition

Global system for mobile communication (GSM) is a globally accepted standard for digital cellular communication. GSM is the name of a standardization group established in 1982 to create a common European mobile telephone standard that would formulate specifications for a pan-European mobile cellular radio system operating at 900 MHz. It is estimated that many countries outside of Europe will join the GSM partnership.

3.2.2 Description

GSM, the Global System for Mobile communications, is a digital cellular communications system, which has rapidly gained acceptance and market share worldwide, although it was initially developed in a European context. In addition to digital transmission, GSM incorporates many advanced services and features, including ISDN compatibility and worldwide roaming in other GSM networks. The advanced services and architecture of GSM have made it a model for future third-generation cellular systems, such as UMTS. This paper will give an overview of the services offered by GSM, the system architecture, the radio transmission



Structure Of a GSM Network

3.3 PULSE SENSOR(LM358)

Unique Characteristics

- In the linear mode the input common-mode voltage range includes ground and the output voltage can also swing to ground, even though operated from only a single power supply voltage.

- The unity gain cross frequency is temperature compensated.

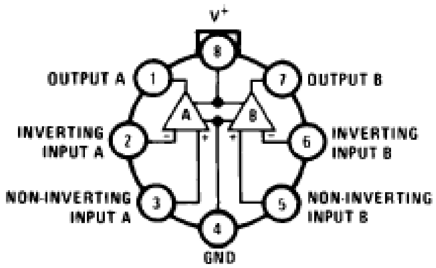
- The input bias current is also temperature compensated.

Advantages

- Two internally compensated op amps in a single package
- Eliminates need for dual supplies
- Allows directly sensing near GND and VOUT also goes to GND
- Compatible with all forms of logic
- Power drain suitable for battery operation
- Pin-out same as LM1558/LM1458 dual operational

Connection Diagrams (Top Views)

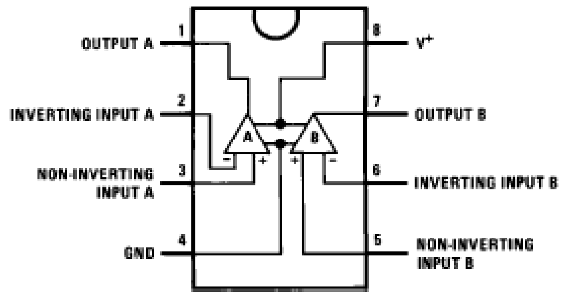
Metal Can Package



TL/H/7787–1

Order Number LM158AH, LM158AH/883*, LM158H, LM158H/883*, LM258H or LM358H
See NS Package Number H08C

DIP/SO Package



TL/H/7787–2

Order Number LM158J, LM158J/883*, LM158AJ or LM158AJ/883*
See NS Package Number J08A
Order Number LM358M, LM358AM or LM2904M
See NS Package Number M08A
Order Number LM358AN, LM358N or LM2904N
See NS Package Number N08E

Features

- Internally frequency compensated for unity gain
- Large dc voltage gain 100 dB
- Wide bandwidth (unity gain) 1 MHz
  (temperature compensated)
- Wide power supply range:
- Single supply 3V to 32V
  or dual supplies g1.5V to g16V
- Very low supply current drain (500 mA)Ðessentially 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 0V to Va b 1.5V

CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the

device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

Absolute Maximum Ratings

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications. (Note 9)

	LM158/LM258/LM358 LM158A/LM258A/LM358A	LM2904
Supply Voltage, V^+	32V	26V
Differential Input Voltage	32V	26V
Input Voltage	−0.3V to +32V	−0.3V to +26V
Power Dissipation (Note 1)		
Molded DIP	830 mW	830 mW
Metal Can	550 mW	
Small Outline Package (M)	530 mW	530 mW
Output Short-Circuit to GND (One Amplifier) (Note 2)		
$V^+ \le 15V$ and $T_A = 25°C$	Continuous	Continuous
Input Current ($V_{IN} < -0.3V$) (Note 3)	50 mA	50 mA

	LM158/LM258/LM358 LM158A/LM258A/LM358A	LM2904
Operating Temperature Range		
LM358	0°C to +70°C	−40°C to +85°C
LM258	−25°C to +85°C	
LM158	−55°C to +125°C	
Storage Temperature Range	−65°C to +150°C	−65°C to +150°C
Lead Temperature, DIP (Soldering, 10 seconds)	260°C	260°C
Lead Temperature, Metal Can (Soldering, 10 seconds)	300°C	300°C
Soldering Information		
Dual-In-Line Package		
Soldering (10 seconds)	260°C	260°C
Small Outline Package		
Vapor Phase (60 seconds)	215°C	215°C
Infrared (15 seconds)	220°C	220°C

See AN-450 "Surface Mounting Methods and Their Effect on Product Reliability" for other methods of soldering surface mount devices.

ESD Tolerance (Note 10)	250V	250V

Electrical Characteristics $V^+ = +5.0V$, unless otherwise stated

Parameter	Conditions	LM158A			LM358A			LM158/LM258			LM358			LM2904			Units
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
Input Offset Voltage	(Note 5), $T_A = 25°C$		1	2		2	3		2	5		2	7		2	7	mV
Input Bias Current	$I_{IN(+)}$ or $I_{IN(-)}$, $T_A = 25°C$, $V_{CM} = 0V$, (Note 6)		20	50		45	100		45	150		45	250		45	250	nA
Input Offset Current	$I_{IN(+)} - I_{IN(-)}$, $V_{CM} = 0V$, $T_A = 25°C$		2	10		5	30		3	30		5	50		5	50	nA
Input Common-Mode Voltage Range	$V^+ = 30V$, (Note 7) (LM2904, $V^+ = 26V$), $T_A = 25°C$	0		$V^+-1.5$	0		$V^+-1.5$	0		$V^+-1.5$	0		$V^+-1.5$	0		$V^+-1.5$	V
Supply Current	Over Full Temperature Range $R_L = \infty$ on All Op Amps																
	$V^+ = 30V$ (LM2904 $V^+ = 26V$)		1	2		1	2		1	2		1	2		1	2	mA
	$V^+ = 5V$		0.5	1.2		0.5	1.2		0.5	1.2		0.5	1.2		0.5	1.2	mA

Electrical Characteristics (Continued) $V^+ = +5.0V$, Note 4, unless otherwise stated

Parameter		Conditions	LM158A			LM358A			LM158/LM258			LM358			LM2904			Units
			Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
Large Signal Voltage Gain		$V^+ = 15V$, $T_A = 25°C$, $R_L \geq 2\ k\Omega$, (For $V_O = 1V$ to 11V)	50	100		25	100		50	100		25	100		25	100		V/mV
Common-Mode Rejection Ratio		$T_A = 25°C$, $V_{CM} = 0V$ to $V^+ -1.5V$	70	85		65	85		70	85		65	85		50	70		dB
Power Supply Rejection Ratio		$V^+ = 5V$ to 30V (LM2904, $V^+ = 5V$ to 26V), $T_A = 25°C$	65	100		65	100		65	100		65	100		50	100		dB
Amplifier-to-Amplifier Coupling		f = 1 kHz to 20 kHz, $T_A = 25°C$ (Input Referred), (Note 8)		−120			−120			−120			−120			−120		dB
Output Current	Source	$V_{IN}^+ = 1V$, $V_{IN}^- = 0V$, $V^+ = 15V$, $V_O = 2V$, $T_A = 25°C$	20	40		20	40		20	40		20	40		20	40		mA
	Sink	$V_{IN}^- = 1V$, $V_{IN}^+ = 0V$ $V^+ = 15V$, $T_A = 25°C$, $V_O = 2V$	10	20		10	20		10	20		10	20		10	20		mA
		$V_{IN}^- = 1V$, $V_{IN}^+ = 0V$ $T_A = 25°C$, $V_O = 200\ mV$, $V^+ = 15V$	12	50		12	50		12	50		12	50		12	50		μA
Short Circuit to Ground		$T_A = 25°C$, (Note 2), $V^+ = 15V$		40	60		40	60		40	60		40	60		40	60	mA
Input Offset Voltage		(Note 5)			4			5			7			9			10	mV
Input Offset Voltage Drift		$R_S = 0\Omega$		7	15		7	20		7			7			7		μV/°C
Input Offset Current		$I_{IN(+)} - I_{IN(-)}$			30			75			100			150		45	200	nA
Input Offset Current Drift		$R_S = 0\Omega$		10	200		10	300		10			10			10		pA/°C
Input Bias Current		$I_{IN(+)}$ or $I_{IN(-)}$		40	100		40	200		40	300		40	500		40	500	nA

Electrical Characteristics (Continued) $V^+ = +5.0V$, Note 4, unless otherwise stated

Parameter		Conditions		LM158A			LM358A			LM158/LM258			LM358			LM2904			Units
				Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
Input Common-Mode Voltage Range		$V^+ = 30V$, (Note 7) (LM2904, $V^+ = 26V$)		0		$V^+ - 2$	0		$V^+ - 2$	0		$V^+ - 2$	0		$V^+ - 2$	0		$V^+ - 2$	V
Large Signal Voltage Gain		$V^+ = +15V$ ($V_O = 1V$ to $11V$) $R_L \geq 2 k\Omega$		25			15			25			15			15			V/mV
Output Voltage Swing	V_{OH}	$V^+ = +30V$ (LM2904, $V^+ = 26V$)	$R_L = 2 k\Omega$	26			26			26			26			22			V
			$R_L = 10 k\Omega$	27	28		27	28		27	28		27	28		23	24		V
	V_{OL}	$V^+ = 5V$, $R_L = 10 k\Omega$			5	20		5	20		5	20		5	20		5	100	mV
Output Current	Source	$V_{IN}^+ = +1V$, $V_{IN}^- = 0V$, $V^+ = 15V$, $V_O = 2V$		10	20		10	20		10	20		10	20		10	20		mA
	Sink	$V_{IN}^- = +1V$, $V_{IN}^+ = 0V$, $V^+ = 15V$, $V_O = 2V$		10	15		5	8		5	8		5	8		5	8		mA

Note 1: For operating at high temperatures, the LM358/LM358A, LM2904 must be derated based on a +125°C maximum junction temperature and a thermal resistance of 120°C/W which applies for the device soldered in a printed circuit board, operating in a still air ambient. The LM258/LM258A and LM158/LM158A can be derated based on a +150°C maximum junction temperature. The dissipation is the total of both amplifiers—use external resistors, where possible, to allow the amplifier to saturate or to reduce the power which is dissipated in the integrated circuit.

Note 2: Short circuits from the output to V+ can cause excessive heating and eventual destruction. When considering short circuits to ground, the maximum output current is approximately 40 mA independent of the magnitude of V^+. At values of supply voltage in excess of +15V, continuous short-circuits can exceed the power dissipation ratings and cause eventual destruction. Destructive dissipation can result from simultaneous shorts on all amplifiers.

Note 3: This input current will only exist when the voltage at any of the input leads is driven negative. It is due to the collector-base junction of the input PNP transistors becoming forward biased and thereby acting as input diode clamps. In addition to this diode action, there is also lateral NPN parasitic transistor action on the IC chip. This transistor action can cause the output voltages of the op amps to go to the V+ voltage level (or to ground for a large overdrive) for the time duration that an input is driven negative. This is not destructive and normal output states will re-establish when the input voltage, which was negative, again returns to a value greater than −0.3V (at 25°C).

Note 4: These specifications are limited to $-55°C \leq T_A \leq +125°C$ for the LM158/LM158A. With the LM258/LM258A, all temperature specifications are limited to $-25°C \leq T_A \leq +85°C$, the LM358/LM358A temperature specifications are limited to $0°C \leq T_A \leq +70°C$, and the LM2904 specifications are limited to $-40°C \leq T_A \leq +85°C$.

Note 5: $V_O = 1.4V$, $R_S = 0\Omega$ with V^+ from 5V to 30V; and over the full input common-mode range (0V to $V^+ - 1.5V$) at 25°C. For LM2904, V^+ from 5V to 26V.

Note 6: The direction of the input current is out of the IC due to the PNP input stage. This current is essentially constant, independent of the state of the output so no loading change exists on the input lines.

Note 7: The input common-mode voltage of either input signal voltage should not be allowed to go negative by more than 0.3V (at 25°C). The upper end of the common-mode voltage range is $V^+ - 1.5V$ (at 25°C), but either or both inputs can go to +32V without damage (+26V for LM2904), independent of the magnitude of V^+.

Note 8: Due to proximity of external components, insure that coupling is not originating via stray capacitance between these external parts. This typically can be detected as this type of capacitance increases at higher frequencies.

Note 9: Refer to RETS158AX for LM158A military specifications and to RETS158X for LM158 military specifications.

Note 10: Human body model, 1.5 kΩ in series with 100 pF.

3.4 Temperature Sensor

3.4.1 The LM35

The LM35 is an integrated circuit sensor that can be used to measure temperature with an electrical output proportional to the temperature (in ºC)

The LM35 - An Integrated Circuit Temperature Sensor

- You can measure temperature more accurately than a using a thermistor.
- The sensor circuitry is sealed and not subject to oxidation, etc.
- The LM35 generates a higher output voltage than thermocouples and may not require that the output voltage be amplified.

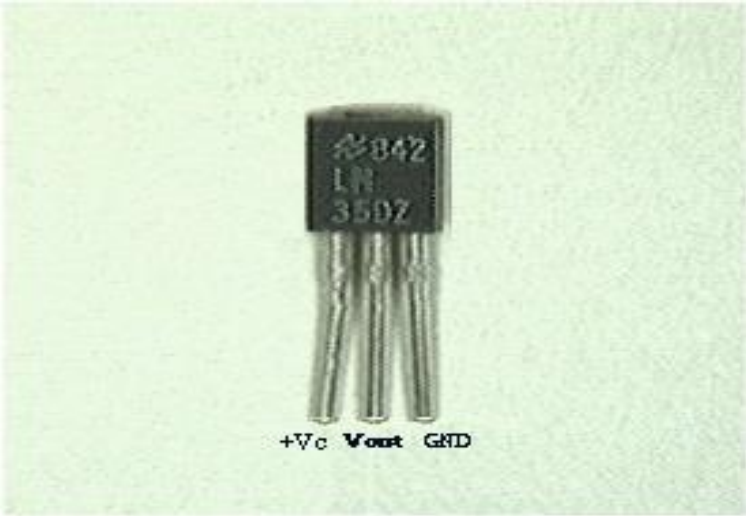


Fig 3.22 Temperature Sensor

Working of LM35

- It has an output voltage that is proportional to the Celsius temperature.
- The scale factor is .01V/ºC
- The LM35 does not require any external calibration or trimming and maintains an accuracy of +/-0.4 ºC at room temperature and +/- 0.8 ºC over a range of 0 ºC to +100 ºC.
- Another important characteristic of the LM35DZ is that it draws only 60 micro amps from its supply and possesses a low self-heating capability. The sensor self-heating causes less than 0.1 ^{o}C temperature rise in still air.

The LM35 comes in many different packages, including the following.

- TO-92 plastic transistor-like package,
- T0-46 metal can transistor-like package
- 8-lead surface mount SO-8 small outline package
- TO-202 package. (Shown in the picture above)

CIRCUIT CONNECTION

Here is a commonly used circuit. For connections refer to the picture above.

- In this circuit, parameter values commonly used are:
  - V_c = 4 to 30v

- 5v or 12 v are typical values used.
- $R_a = V_c / 10^{-6}$
- Actually, it can range from 80 K□ to 600 K□ , but most just use 80 K□.

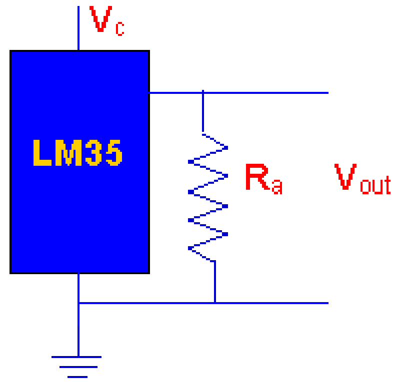


Figure 6 Circuit diagram of LM35

- Here is a photo of the LM 35 wired on a circuit board.
  - The white wire in the photo goes to the power supply.
  - Both the resistor and the black wire go to ground.
  - The output voltage is measured from the middle pin to ground.l

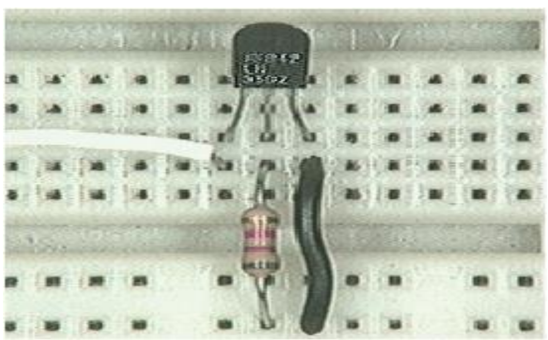


Figure 7 LM 35 wired on a circuit board

3.5 Power supply

The power supply are designed to convert high voltage AC mains electricity to a suitable low voltage supply for electronics circuits and other devices. A power supply can by broken down into a series of blocks, each of which performs a particular function. A d.c power supply which maintains the output voltage constant irrespective of a.c mains fluctuations or load variations is known as “Regulated D.C Power Supply”

For example a 5V regulated power supply system as shown below:

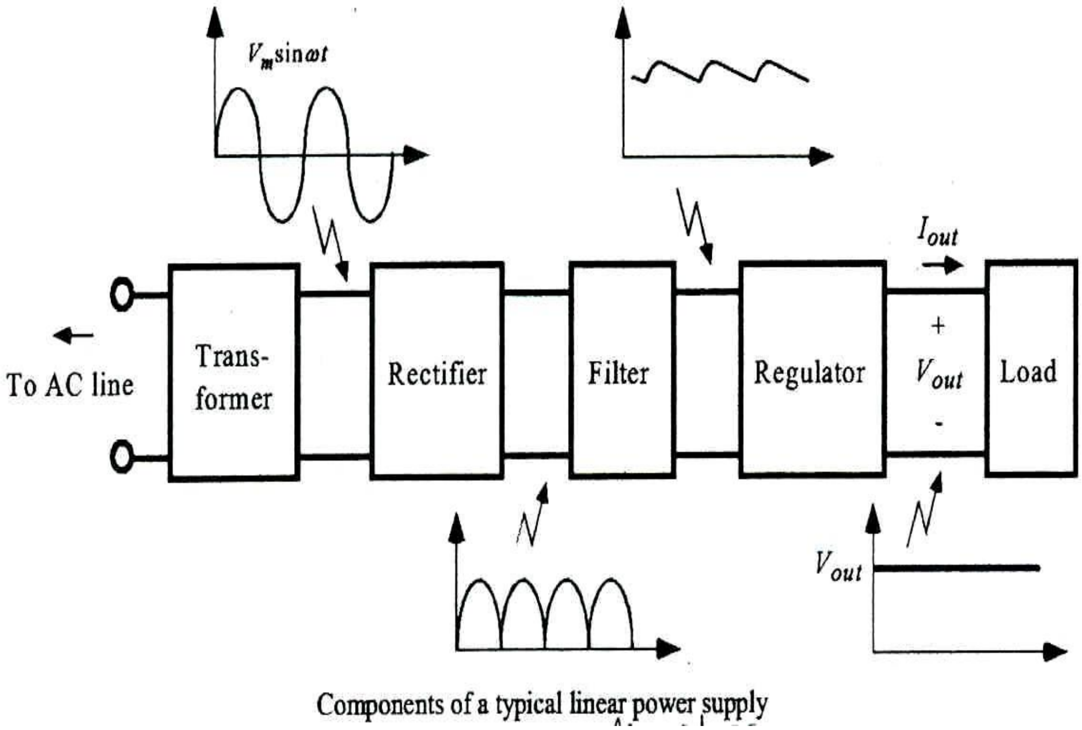


Figure 8 Functional Block Diagram of Power supply

3.6 LCD

The most commonly used LCDs found in the market today are 1 Line, 2 Line or 4 Line LCDs which have only one controller and support at most 80 characters, whereas LCDs supporting more than 80 characters make use of 2 HD44780 controllers. Apart from displaying some simple static characters you can create animated text scripts and a lot more! Most LCDs with 1 controller has 14 Pins and 16 Pins (two extra pins are for back-light LED connections). Pin description is shown in the table below. (We may also have 16 pins in 2 controllers, refer to the datasheet for exact details).

Figure 9 LCD

Pin No.	Name	Description
1	VSS	GND
2	VCC	+5V
3	VEE	Contrast adjust
4	RS	0 = Command register 1 = Data register
5	R/W	0 = Write to LCD module 1 = Read from LCD module
6	EN	Enable
7	D0	Data bus line 0 (LSB)
8	D1	Data bus line 1
9	D2	Data bus line 2
10	D3	Data bus line 3
11	D4	Data bus line 4
12	D5	Data bus line 5
13	D6	Data bus line 6
14	D7	Data bus line 7 (MSB)

Figure 10 LCD Pin Description

3.7 ADC

Normally analogue-to-digital con-verter (ADC) needs interfacing through a microprocessor to convert analogue data into digital format. This requires hardware and necessary software, resulting in increased complexity and hence the total cost.

The circuit of A-to-D converter shown here is configured around ADC 0808, avoiding the use of a microprocessor. The ADC 0808 is an 8-bit A-to-D converter, having data lines D0-D7. It works on the principle of successive approximation. It has a total of eight analogue input channels, out of which any one can be selected using address lines A, B and C. Here, in this case, input channel IN0 is selected by grounding A, B and C address lines.

Usually the control signals EOC (end of conversion), SC (start conversion), ALE (address latch enable) and OE (output enable) are interfaced by means of a microprocessor. However, the circuit shown here is built to operate in its continuous mode without using any microprocessor. Therefore the input control signals ALE and OE, being active-high, are tied to Vcc (+5 volts). The input control signal SC, being active-low, initiates start of conversion at falling edge of the pulse, whereas the output signal EOC becomes high after completion of digitisation. This EOC output is coupled to SC input, where falling edge of EOC output acts as SC input to direct the ADC to start the conversion.

As the conversion starts, EOC signal goes high. At next clock pulse EOC output again goes low, and hence SC is enabled to start the next conversion. Thus, it provides continuous 8-bit digital output corresponding to instantaneous value of analogue input. The maximum level of analogue input voltage should be appropriately scaled down below positive reference (+5V) level.

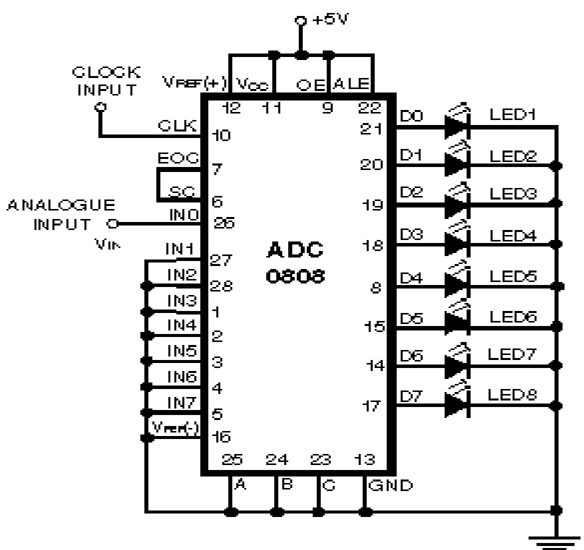


Figure 11 ADC

4 Circuit Description

In this project, the GSM and GPS are connected to the micro controller. The GSM is used for sending, receiving and reading the messages. The GPS is used for getting the location of the vehicle which sends the location name in the form of coordinates ie., latitudes, longitudes and altitudes. These GSM and GPS are both meant for serial communication. Both the GSM and GPS are RS voltage level compatible but the Micro controller is TTL compatible. To match the voltage levels we using the MAX-232 line driver to convert the RS voltage level to TTL voltage levels and vice versa.

The controller is having one serial port. It is impossible to interface to two serial communication devices and access both at a time. So that, through Latch these devices are connected to the MAX. The latch is acts to store the information temporarily. For accessing these devices, one is kept in sleep mode and the other activated and vice versa.

The Heart beat circuitry consists of electrodes and a 4-quad op-amp IC. There are three electrodes are present. These electrodes are placed to patient at the heart and patient pulse. The signals are given to the LM 324 IC, which quad op-amp IC. In that IC, the two signal frequencies are mixed up to generate a particular frequency there you can given to the input of the third op-amp. The reference signal is generated at the fourth op-amp with the help of the RC circuit. These signals such as reference signal and the output of the third op-amp signal is compares then given output through the transistor. The transistor converts the analog frequencies into our corresponding logic levels. These output digital values are given to the one of the pin of the micro controller.

The LCD display will acts as an output source in this project that will be helpful to display the location name on this display. The RS, R/W. and EN pins are the control pins which are used for controlling purpose. The RS pin is used to select either data mode or command mode. The R/W is used to indicate that the LCD will acts as a either read or write mode. The EN pin is used to enable the data. D0-D7 are data pins used to get the data from the micro controller. To operate the LCD display, which requires maximum of +5V DC power supply. In this project, the LCD is used to display the status of the GSM modem and also displays the heart beat rate and B.P.

The power supply is used drive all the hardware components, which are work at the maximum voltage of +5V DC. The 230V AC is a power supply which is used for operate our general home appliance. But our hardware components which requires just +5V DC voltage. A step-down transformer is used to step down the 230V AC to the required AC voltage and thereafter it is meant for filtering with the help of a capacitor. Thereby, the circuit is meant for the regulation to get the constant +5V DC. This output +5V DC power supply is getting at the load ie., may be a capacitor for rectification purpose, ie., any AC ripples should be minimized with the help of this capacitor at the load.

5. Software Used

5.1 Introduction to Embedded ‘C’

5.1.1 Data Types

U people have already come across the word “Data types” in C- Language. Here also the functionality and the meaning of the word is same except a small change in the prefix of their labels. Now we will discuss some of the widely used data types for embedded C- programming.

Data Types	Size in Bits	Data Range/Usage
unsigned char	8-bit	0-255
signed char	8-bit	-128 to +127
unsigned int	16-bit	0 to 65535
signed int	16-bit	-32,768 to +32,767
sbit	1-bit	SFR bit addressable only
bit	1-bit	RAM bit addressable only
sfr	8-bit	RAM addresses 80-FFH only

Table 5.1:Data Types

Unsigned char

The unsigned char is an 8-bit data type that takes a value in the range of 0-255(00-FFH). It is used in many situations, such as setting a counter value, where there is no need for signed data we should use the unsigned char instead of the signed char. Remember that C compilers use the signed char as the default if we do not put the key word.

Signed char

The signed char is an 8-bit data type that uses the most significant bit (D7 of D7-D0) to represent the – or + values. As a result, we have only 7 bits for the magnitude of the signed number, giving us values from -128 to +127. In situations where + and – are needed to represent a given quantity such as temperature, the use of the signed char data type is a must.

Unsigned int

The unsigned int is a 16-bit data type that takes a value in the range of 0 to 65535 (0000-FFFFH).It is also used to set counter values of more than 256. We must use the int data type unless we have to. Since registers and memory are in 8-bit chunks, the misuse of int variables will result in a larger hex file. To overcome this we can use the unsigned char in place of unsigned int.

Signed int

Signed int is a 16-bit data type that uses the most significant bit (D15 of D15-D0) to represent the – or + value. As a result we have only 15 bits for the magnitude of the number or values from -32,768 to +32,767.

Sbit (single bit)

The sbit data type is widely used and designed specifically to access single bit addressable registers. It allows access to the single bits of the SFR registers.

5.1.2I/O PROGRAMMING IN EMBEDDED "C"

In this topic we look at C- programming of the I/O ports and also both byte and bit I/O programming.

Byte size I/O

As we know that ports P0-P3 are byte accessible, we use the P0-P3 labels as defined in the header file.

Bit – addressable I/O programming

The I/O ports of P0-P3 are bit- addressable, so we can access a single bit without disturbing the rest of the port.

We use the sbit data type to access a single bit of P0-P3.the format is Px^y where x is the port and y is the bit.

Accessing SFR addresses 80-FFH

Another way to access the SFR RAM space 80-FFH is to use the sfr data type. This is shown in the below example .Both the bit and byte addresses for the P0-P3 ports are given in the table. Notice in the given example that there is no #include<reg51.h> statement which allows us to access any byte of the SFR RAM space 80-FFH.

Single Bit Addresses of Ports

P0	**Addr**	**P1**	**Addr**	**P2**	**Addr**	**P3**	**Addr**	**Ports Bit**
P0.0	80H	P1.0	90H	P2.0	A0H	P3.0	B0H	D0
P0.1	81H	P1.1	91H	P2.1	A1H	P3.1	B1H	D1
P0.2	82H	P1.2	92H	P2.2	A2H	P3.2	B2H	D2
P0.3	83H	P1.3	93H	P2.3	A3H	P3.3	B3H	D3
P0.4	84H	P1.4	94H	P2.4	A4H	P3.4	B4H	D4
P0.5	85H	P1.5	95H	P2.5	A5H	P3.5	B5H	D5
P0.6	86H	P1.6	96H	P2.6	A6H	P3.6	B6H	D6
P0.7	87H	P1.7	97H	P2.7	A7H	P3.7	B7H	D7

Single Bit Addresses of Ports

5.1.3 DATA CONVERSION PROGRAMS IN EMBEDDED C

Many micro-controllers have a real time clock (RTC) where the time and date are kept even when the power is off. These time and date are often in packed BCD by RTC. To display them they must be converted to ASCII. So, in this topic we are showing application of logic and instructions in the conversion of BCD and ASCII.

ASCII numbers

On ASCII key boards, when the key “0” is activated, “0110000” (30h) is provided to the system. Similarly 31h (0110001) is provided for the key “1”, and so on as shown in the table

Packed BCD to ASCII conversion

The RTC provides the time of day (hour, minutes, seconds) and the date (year, month, day) continuously, regardless of whether the power is ON or OFF. In the conversion procedure the packed BCD is first converted to unpacked BCD. Then it is tagged with 0110000 (30h).

ASCII code for Digits 0-9

Key	**ASCII (hex)**	**Binary**	**BCD (unpacked)**
0	30	011 0000	0000 0000
1	31	011 0001	0000 0001
2	32	011 0010	0000 0010
3	33	011 0011	0000 0011
4	34	011 0100	0000 0100
5	35	011 0101	0000 0101
6	36	011 0110	0000 0110
7	37	011 0111	0000 0111
8	38	011 1000	0000 1000
9	39	011 1001	0000 1001

Table 5.3: ASCII code for Digits 0-9

ASCII to packed BCD conversion

To convert ASCII to packed BCD it is first converted to unpacked and then combined to make packed BCD. For example 4 and 7 on the keyboard give 34h and 37h respectively the goal is to produce 47h or “0100 0111” which is packed BCD.

Key	**ASCII**	**unpacked BCD**	**packed BCD**
4	34	00000100	
7	37	00000111	01000111 or 47h

Table 5.4: ASCII to packed BCD conversion

Checksum byte in ROM

To ensure the integrity of ROM contents, every system must perform the checksum calculation. The process of checksum will detect any corruption of the contents of ROM. One of the cause of the ROM corruption is current surge either when the system is turned on or during operation. To ensure data integrity in ROM the checksum process uses, what is a **checksum byte**. There is an extra byte that is tagged to the end of the series of data.

To calculate the checksum byte of a series of bytes of data, the following steps can be used

1) Add the bytes together and drop the carries.
2) Take the 2's complement of the total sum. This is the checksum byte , which becomes the last byte of the series

Binary (hex) to decimal and ASCII conversion in embedded C

In C-language we use a function call "printf" which is standard IO library function doing the conversions of data from binary to decimal, or vice versa. But here we are using our own functions for conversions because it occupies much of memory.

One of the most commonly used is binary to decimal conversion. In devices such as ADC chips the data is provided to the controller in binary. In order to display binary data we need to convert it to decimal and then to ASCII. Since the hexadecimal format is a convenient way of representing binary data we refer to binary data as hex. The binary data 00-FFH converted to decimal will give us 000 to 255.

One way to do this is to divide it by 10 and keep the remainder, for example 11111101 or FDH is 253 in decimal. The following is one version of the algorithm for conversion of hex (binary) to decimal.

.

5.2 ABOUT SOFTWARE

Software's used are:

*Keil software for C programming

*Express PCB for lay out design

*Express SCH for schematic design

What's New in µVision3?

µVision3 adds many new features to the Editor like Text Templates, Quick Function Navigation, and Syntax Coloring with brace high lighting Configuration Wizard for dialog based startup and debugger setup. µVision3 is fully compatible to µVision2 and can be used in parallel with µVision2.

What is µVision3?

µVision3 is an IDE (Integrated Development Environment) that helps you write, compile, and debug embedded programs. It encapsulates the following components:

- A project manager.
- A make facility.
- Tool configuration.
- Editor.
- A powerful debugger.

To help you get started, several example programs (located in the **\C51\Examples**, **\C251\Examples**, **\C166\Examples**, and **\ARM\...\Examples**) are provided.

- **HELLO** is a simple program that prints the string "Hello World" using the Serial Interface.
- **MEASURE** is a data acquisition system for analog and digital systems.
- **TRAFFIC** is a traffic light controller with the RTX Tiny operating system.
- **SIEVE** is the SIEVE Benchmark.
- **DHRY** is the Dhrystone Benchmark.
- **WHETS** is the Single-Precision Whetstone Benchmark.

Additional example programs not listed here are provided for each device architecture.

Building an Application in µVision2

To build (compile, assemble, and link) an application in µVision2, you must:

1. Select Project -(forexample,**166\EXAMPLES\HELLO\HELLO.UV2**).
2. Select Project - Rebuild all target files or Build target.

   µVision2 compiles, assembles, and links the files in your project.

Creating Your Own Application in µVision2

To create a new project in µVision2, you must

1. Select Project - New Project.
2. Select a directory and enter the name of the project file.
3. Select Project - Select Device and select an 8051, 251, or C16x/ST10 device from the Device Database™.
4. Create source files to add to the project.
5. Select Project - Targets, Groups, Files. Add/Files, select Source Group1, and add the source files to the project.
6. Select Project - Options and set the tool options. Note when you select the target device from the Device Database™ all special options are set automatically. You typically only need to configure the memory map of your target hardware. Default memory model settings are optimal for most applications.
7. Select Project - Rebuild all target files or Build target.

Debugging an Application in µVision2

To debug an application created using µVision2, you must:

1. Select Debug - Start/Stop Debug Session.
2. Use the Step toolbar buttons to single-step through your program. You may enter **G, main** in the Output Window to execute to the main C function.
3. Open the Serial Window using the **Serial #1** button on the toolbar.

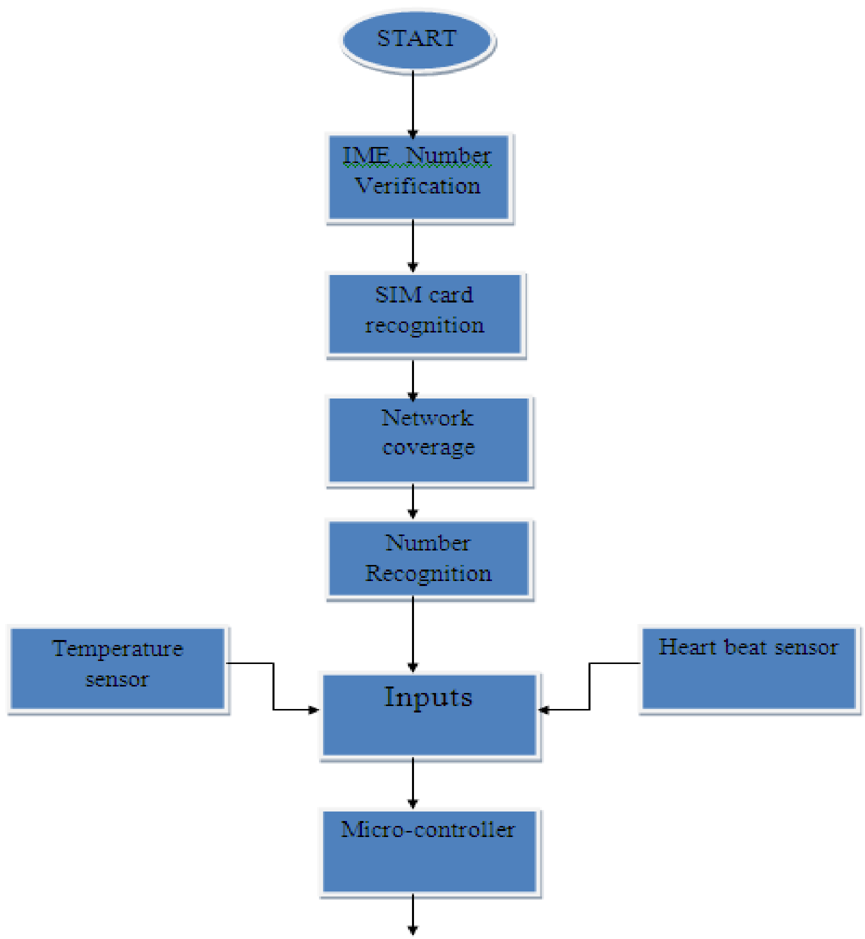
Debug your program using standard options like Step, Go, Break, and so on.

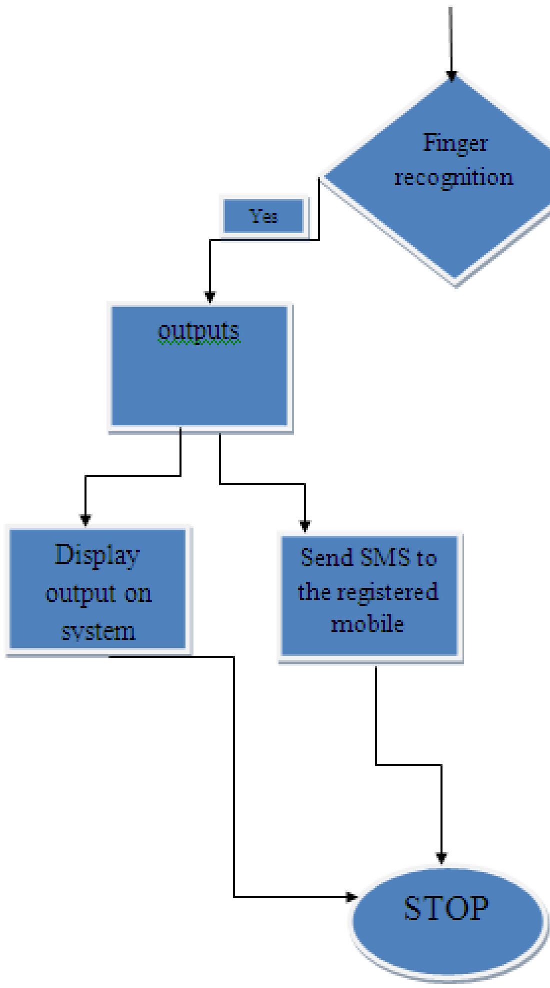
Disassembly Window

The Disassembly window shows your target program as mixed source and assembly program or just assembly code. A trace history of previously executed instructions may be displayed with Debug – View Trace Records. To enable the trace history, set Debug – Enable/Disable Trace Recording.

If you select the Disassembly Window as the active window all program step commands work on CPU instruction level rather than program source lines. You can select a text line and set or modify code breakpoints using toolbar buttons or the context menu commands.

You may use the dialog Debug – Inline Assembly… to modify the CPU instructions. That allows you to correct mistakes or to make temporary changes to the target program you are debugging.




Finger recognition
Yes
No
outputs
Return to START
Display output on system
Send SMS to the registered mobile
STOP

7.Conclusion and Future Scope

Thousands people died every single day as a result of the COVID19 pandemic, which has become a global health crisis. If effective therapy is given at the right time, the mortality rate canbe reduced. To guarantee adequate therapy, a variety of measures have been taken, including regular pulse rate, SpO2 level, and temperature monitoring. However, a COVID-19 patient's oxygen level drops over time, and if no emergency measures are done, the patient will die quickly. In light of the foregoing, a COVID-19 patient-specific health monitoring system was based on internet of things was created. During an emergency, both the patient and the doctor can receive warnings from the system, which is powered by an IoT-based smartphone application. As a result, anyone can efficiently use this system wherever. Because the system is completely IOT based, further functionality can be added in the future. Furthermore, this researchentails a wide examination of the system's components as well as their utility. It provides list of methods that may be used to plan out this system. From the outset of this system's development, we set out to design a well organized application based gadget that can be utilized in today's environment.

Research Paper

Secure Remote Health Monitoring System

During the current COVID-19 epidemic, IoT-based health monitoring devices could be incredibly useful for COVID 19 sufferers. This learning develops a real time health monitoring system based on the Internet of Things that incorporates patient's measured pulse rate, body temperature, and oxygen saturation, which are the most significant critical care indicators. The LCD shows the current heart rate , body temperature and oxygen saturation level .This can easily be synced with a mobile app for quick retrieval, Using an Arduino Uno-based system, the suggested IoT based technique was verified and tested on five homosapians test participants. The result of the system were promising: the information it gathered was saved.

1 Introduction

COVID-19 was one of the most pressing worldwide health concerns. Acc to survey on 19 November persons worldwide who have been verified to have been purulent with SARS COV 2 is greater than 56.3 million, with more than 1.35 million deaths from the coronavirus, demonstrating that COVID-19 cases are on the rise .

As of November 21, 2020, there were total 445,281 active COVID 19 cases in Bangladesh, with 6350 deaths from the corona virus [2].breath shortness ,fever low oxygen saturation ,vomiting, diarrhea, throat probelom, head ache, dry cough, loss of smell and taste, body pain, and irregular rate of pulse are all signs of COVID-19 [3]. High fever, and low oxygen saturation, an irregular rate of are all considered dangerous symptoms.

Hypoxemia and hypoxia are caused by shortness of breath . Patients with hypoxemia and pulse rate issues have a lower likelihood of survival and patients may fail to notice hypoxemia and an increased pulse rate, and as a result, they die without receiving necessary treatment. The patients of COVID-19 should be known about their health problems on a frequent basis, particularly their body temperature, heart rate, and SpO2 .

As the person becomes older, it becomes increasingly important for them have regular medical checkup exams. Because getting frequent health checkup visits can be time consuming and can be difficult for most of the people, IoT arrangements can be advantageous for individuals h a v e routine health exams . IoT has evolved into a critical innovation having countless use. Any system of physical equipment that obtains and exchanges data via wireless networks is referred to as a wireless network.

without the need for human intervention . With a significant rise in the active COVID 19 cases during the second wave, every country was having difficulty treating their patients properly. The most fundamental indicators of human health are body temperature and pulse rate. The number of pulses per minute, often called as rate of beat, is the pulse rate. For most people, The average pulse rate is 60 to 100 beats in a minute. Adult males and girls have similar resting pulse rates of 70 and 75 beats per minute, respectively [8, 9]. Pulse rates in women above the age of 12 are typically higher than in men. COVID-19 patients, on other hand, have an irregular pulse rate that necessitates the assistance of an emergency medical technician. Internal heat levels in healthy people fluctuate b/w 97.8 degrees fahrenheit (36.5 degrees celsius) and 99 degrees fahrenheit (37.2 degrees celsius) depending on a variety of parameters such as surrounding gender, temperature, arnd dietary pattern [9–11]. A fluctuation in body temperature can be caused by a variety of circumstances, including low-temperature influenza, hypothermia, and other disorders. Fever is a common sign of various disorders, including COVID-19; consequently, it is critical to monitor body temperature on a regular basis. In COVID-19 patients, oxygen saturation is also important. The human body's typical oxygen saturation (SpO2) varies from 95 to 100 percent. If a COVID-19 patient's SpO2 (oxygen saturation) level falls below 95%, they require immediate medical attention. Silent hypoxia is caused due to the SARS-COV-2 coronavirus, which causes SpO2 levels to drop below 90% without causing shortness of breath. Monitoring SpO2 with a pulse oximeter can detect silent hypoxia [10, 11]. A COVID-19 patient's oxygen saturation level may be dangerously low, and the patient may die. It's critical to keep an eye on early signs including cough, fever, SpO2 and heart rate when dealing with COVID-19.

Various types of instruments have recently been employed to measure these variables. In most countries, A fingertip pulse oximeter, for example,is commercially available and monitors SpO2 and pulse rate . This is a high-end portable pulse oximeter that can measure heart rate and SpO2 . is also commercially available, however it costs around 299 $. A pulse oximeter worn on wrist can be used to assess heart rate and SPO2 and is available over the counter. This gadget, like the others described, does not include the temperature of body monitoring capabilities. The pulse oximeter worn on wrist is pricey, costing 179 USD. Thermometers in both analogue and the digital formats are available on the market , although the majority of them are prohibitively expensive . Devices described previously are not based in Iot. Some display values, but obtaining measurements from various equipment is time-consuming. As a result, it is impossible for a doctor in Bangladesh to collect updates from all of his or her patients at the same time. Rapidmonitoring of covid patients with significant symptoms is in high demand. Patients can now receive COVID-19 treatment from the comfort of their own homes, thanks to technological advancements . Patients with low saturation of oxygen, fever, and an increasing/falling pulse rate benefit from this system. The pulse rate of an individual is determined by their body size, age, emotional stability and heart health. Because a patient's rate of pulse and saturation of oxygen are linked, As level of oxygen drops, their heart rate rises. The Internet of Things based healthcare systems are real- time patient monitoring technology that has assisted healthcare business tremendously . From a research standpoint, IoT based smart health care devices have recently gotten a lot of interest. The studied literature [18] discusses the rise of smart healthcare monitoring systems in IoT setting. In this study, we employed an Android-based pulse-monitoring system with a SpO2 based sensor, a temperature based sensor, and heart rate based sensor. did not utilise the SpO2 measuring sensor, but the collected data was communicated via the internet. For asthma patients, proposed an IoT based lungs functioning monitoring device. that did not include temperature, SpO2, or pulse rate. Heart rate monitoring systems based on Arduino, Android, and microcontrollers have been proposed in . Only a hardware prototype was made for the system in , which is based on the clous computing and Arduino uno. However, there is no data from real- world testing. A monitoring system of heart rate based on a mobile application was exhibited in. In this system, pulse rate sensor were used to measure the pulse rate of patients, and the data was analysed using Arduino. The data from the measurements was sent to the Android app. The sensors used in the study was limited . Various wireless health monitoring system based on IOT have been presented by various authors. However, IoT based solutions for tracking the rate of heart, temperature, and the SpO2 in one device for patients of covid have apparently not yet been shown.

The primary purpose of this research is to develop and test a novel health monitoring system based on IOT covid patients that is based on pulse, body temperature, and oxygen saturation.

Through a mobile application, the device may display measured oxygen saturation level, human body temperature, and the pulse rate, allowing patient to seek the medical assistance even if doctor is physically available or not. A clinician will need the patient's rate of pulse and human temperature of body, to treat covid patient. Patients may inform clinicians about conditions of health by using our system proposed. Patients with COVID-19, as well as those with asthma and chronic obstructive pulmonary disease (COPD) , may benefit from the device. COPD was responsible for 5% of all fatalities globally in 2005, and it is expected to continue to be a global health concern in the future . As a result, this system may be beneficial to certain patients. The technology emits a buzz to inform the patient If the patient's rate of pulse and patient's saturation of oxygen are abnormal, seek medical attention immediately. The oxygen saturation level, heart rate, and body temperature may all be evaluated by patients. are abnormal, seek medical attention immediately. The oxygen saturation level, heart rate, and body temperature may all be evaluated by patients using a mobile application to avert critical health problems. This system was put to the test on five people. The data can be read by the patient and doctor at any time during the day making use of mobile app . The technology also has capability of measuring temperature of body , which has done never before.

2 Materials and Procedures

2.1 *Methodologies* To visualise the order of steps to be followed, a flow chart and block were utilised asguides.

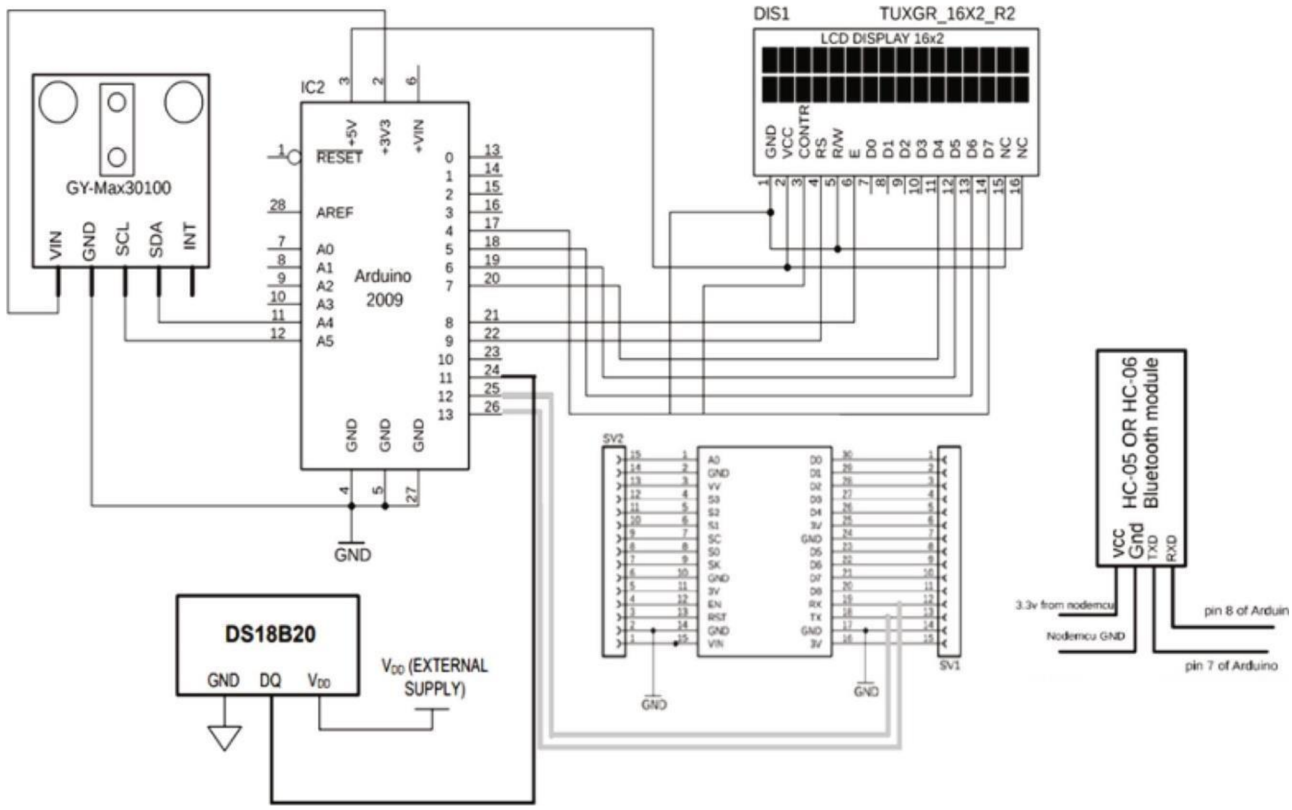


Figure 1: The system's block diagram.

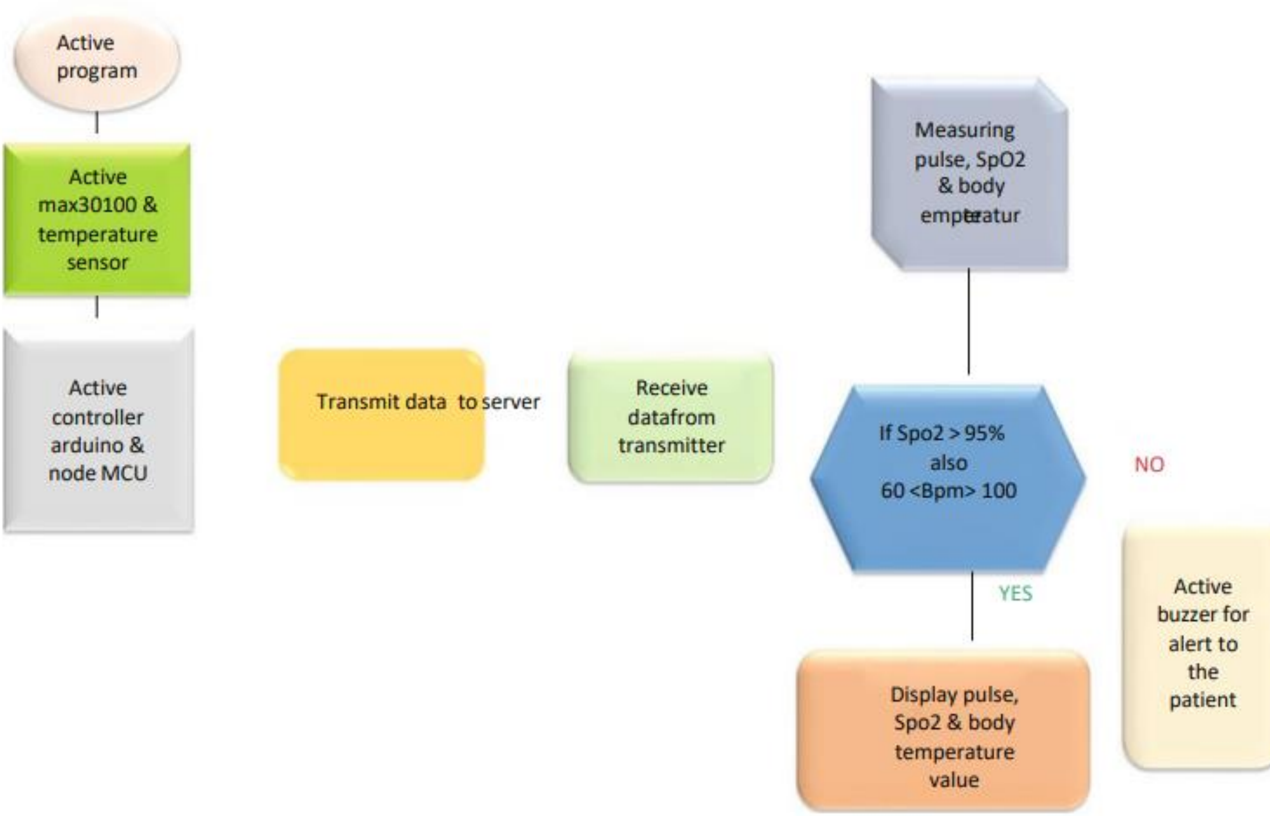


Figure 2: Flow chart of the system.

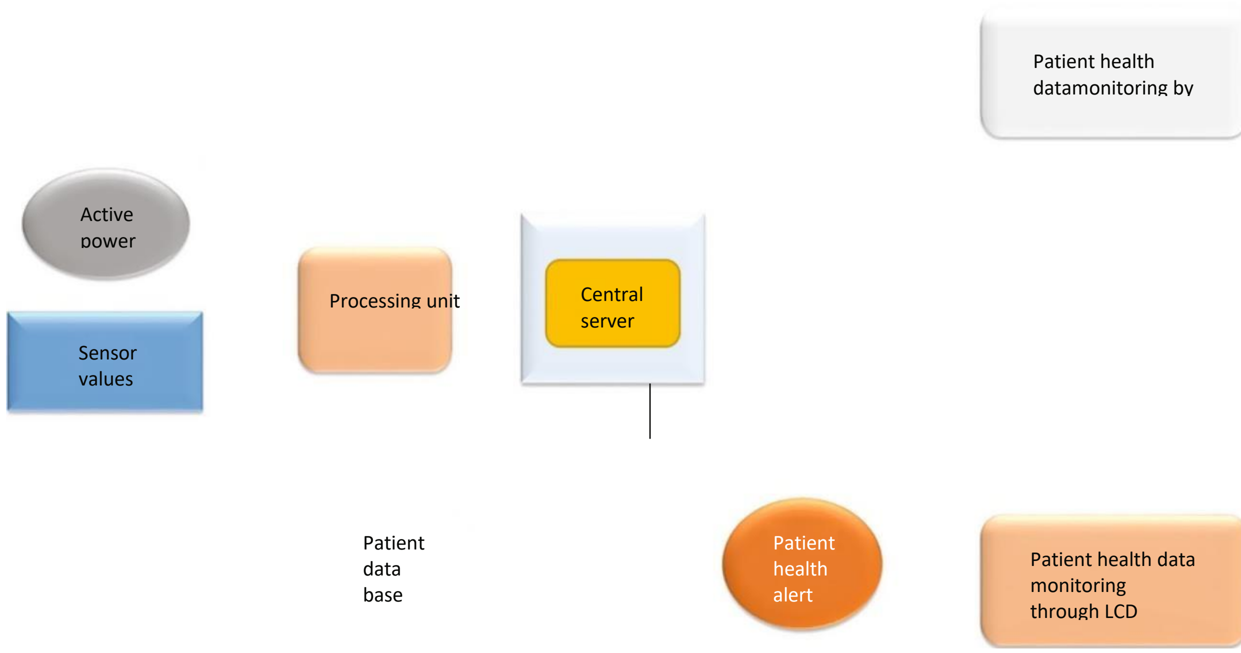


figure 3 : the circuit system's block diagram.

Table 1: A list of the hardware components that are necessary, as well as their amount and price..

Item description	Unit price	Quantity	Total price (BDTK)
Arduino Uno	420	1	420
Temperature	450	1	450
SpO2 Pulse	1400	1	1400
Node MCU WirelessModule	525	1	525
Bluetooth	280	1	280
16 × 2 LCD display	285	1	285
Buck converter	82	1	82
3.7 lithium battery	60	2	120
3.7 lithium batteryprotector	45	2	90
2 s lithium battery	1850	1	1850
2 s lithium battery protector	250	1	250
9 V 2A battery adapter	100	1	100
Wire set	120	2	240
Switch	10	1	10
Buzzer	18	1	18
Total			

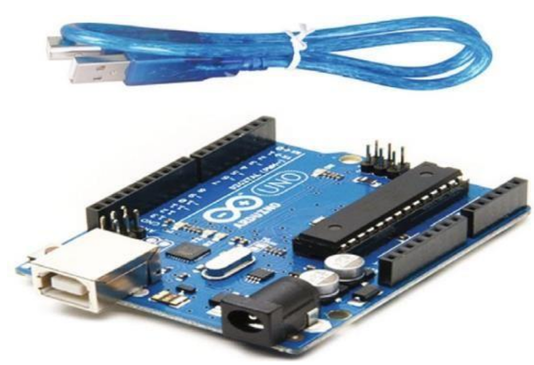


Figure 4: Arduino Uno [25]

Figure 5: Pulse Sensor (MAX30100) [27].

throughout the process of system management The cycle stream was established to direct critical times of any future actions from the start to the finish of a system. Electrical and electronic gears were planned, developed, and supported using circuit diagrams. These diagrams were extremely important for a well-developed system. The suggested system is depicted in Figure 1 as a block diagram.

The sensor begins taking values when the system's power is turned on, as shown in the system block diagram. There are two sensors for detecting pulse rate,temperature and SpO2 in this system. Sensors capture physiological data from the body and transmit analogue values to Arduino, which translates them to the digital values.

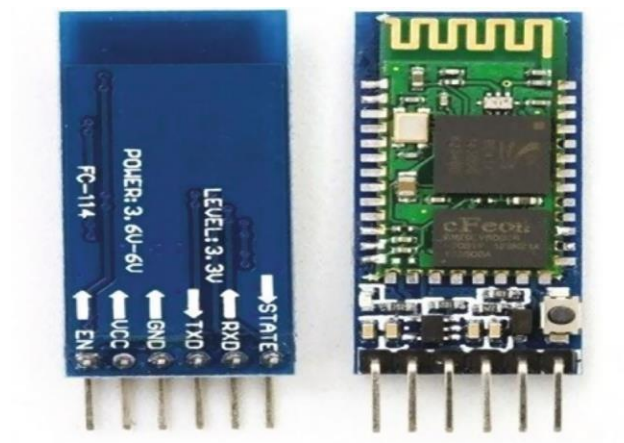


Figure 6: Bluetooth module .

digital data. The measured data is simultaneously delivered to the mobile application and shown on an LCD display by the server. Users can check their saturation of oxygen, temperature, and rate of pulse using the mobile app and gadget.

The system's flow chart is shown in Figure 2. When the device's power is turned on, It starts by taking measurements and sending them to the Arduino Uno, the primary controller, and the MCU Node. The value measured is sent to the server fixed via Node MCU. The system then display the recorded rate of pulse, temperature,and saturation of oxygen and if the detected saturation of oxygen is less than 95% and rate of pulse is less than 60 or greater than 90, system notifies the patient and doctor. Users may see measured values on the device LCD display and on a mobile app at the same time.

The block diagram of entire circuit system is shown in Figure 3. This figure shows pin connections b/w the Arduino Uno, the MCU node, the module of bluetooth, the sensor of SpO2, the sensor of temperature, and the system's supply of power. Proteus Design Suite software was used to create this circuit diagram. The fully automated system is turned on by pressing the active power button. The sensors collect data and transfer it to the processing unit, where it is analysed before being made available on the mobile application.

1.1 The Hardware Materials That Were Used The system is made up of two components: the equipments and a mobile application. Both components are essential to the system's operation. The system of health monitoring can detect saturation of oxygen , heart rate, and temperature of body in humans. The implementation of this multifunction system necessitates the use of various components. Implementation is accomplished by carrying out the tasks outlined in a work plan. The implementation of the design is critical to the system's success. The components needed to run this system are listed below in brief. Table 1 shows the hardware components that are necessary, as well as their quantities and prices. The hardware components for this system cost a total of 6120 Bangladeshi Taka, or 71.50 $.

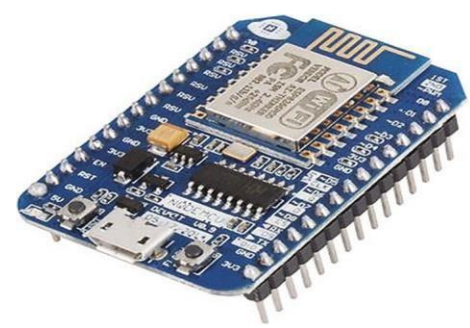


Figure 7: Node MCU ESP8266

Figure 8: Buck converter

1.1.1 Arduino Uno. The Arduino Uno, Arduino Mega, Arduino Due, and Arduino Leonardo are examples of commerciallyaccessible Arduino boards. 14 digital I/O pins 20 I/O pins, and six analogue I/O pins make up Arduino Uno. There are 54digital I/O pins, 12 analogue pins of input , and two analogue pins of output on Arduino Due. There are 54 pins of digital I/O ,16 analogue inputs, and 0 output pins on Arduino Mega.There are 20 pins of digital I/O , 12 analogue inputs, and 0 output pins on the Arduino Leonardo [26]. We used Arduino Uno to build system since the configuration of pin ofthis module meets our requirement and it is system's principal controller. It's one of the most well-known ATmega328p-based open-source microcontroller boards. The Arduino IDE can be used to programme this microcontroller. It is quite important in this system.

Figure 9: 16×2 Liquid crystal display.

Figure 10 : DS18B20 Sensor .

It serves as a link between IOT and other sensor devices. Figure 4 depicts Arduino Uno model.

1.1.2 Pulse Detection (MAX30100). The MAX30100 is sensor used to determine saturation of blood oxygen and rate of pulse. Prototype of SpO2 sensor of pulse is shown in Figure 5. (MAX30100). The amount of oxygenated haemoglobin in the circulation is measured by peripheral oxygen saturation , which is the measurement of blood vessel saturation of oxygen. SpO2 levels in human body typically vary from 90 to 100 percent. A MAX 30100 pulse oximeter is suitable for this setup. It's combination of a oximeter used for measuring beat and a sensor for heart rate that gives precise results. This sensor is suited for this system because it combines a photo detector, two LEDs, low-noise analogue and improved optics flag processing to recognise heart rate signals and beat oximetry .

Bluetooth Module 1.1.3 Commercially accessible Bluetooth modules come in a variety of shapes and sizes. Because it is user friendly, we chose HC05 module of bluetooth for our system. The Bluetooth HC05 module is a Bluetooth serial port protocol module that enables for both wireless and serial communication with Bluetooth-enabled devices with micro-controllers. The 2.45-GHz frequency band is used by the HCO5 Bluetooth module, which has range of 10 m. It has a rate of data transfer about 1 megabit per second. It can work with a 4–6 V power supply. There are two working modes for the HC05 Bluetooth module: data mode and command mode . The HC05 Blue-tooth module prototype is shown in Figure 6.

MCU Node 1.1.4 Because the ESP8266 is a wireless module, we use MCU ESP8266 node for this system.

Figure 11: Mobile application logo.

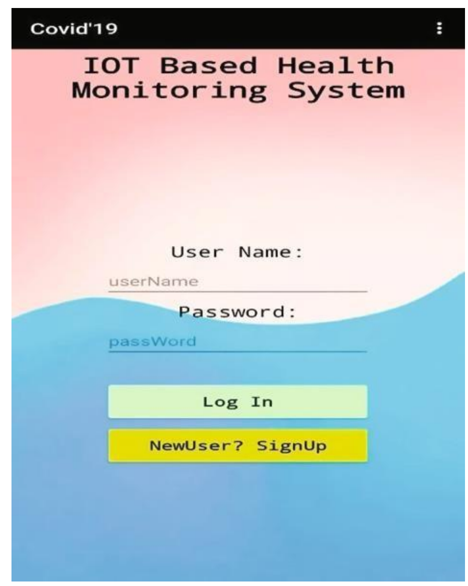
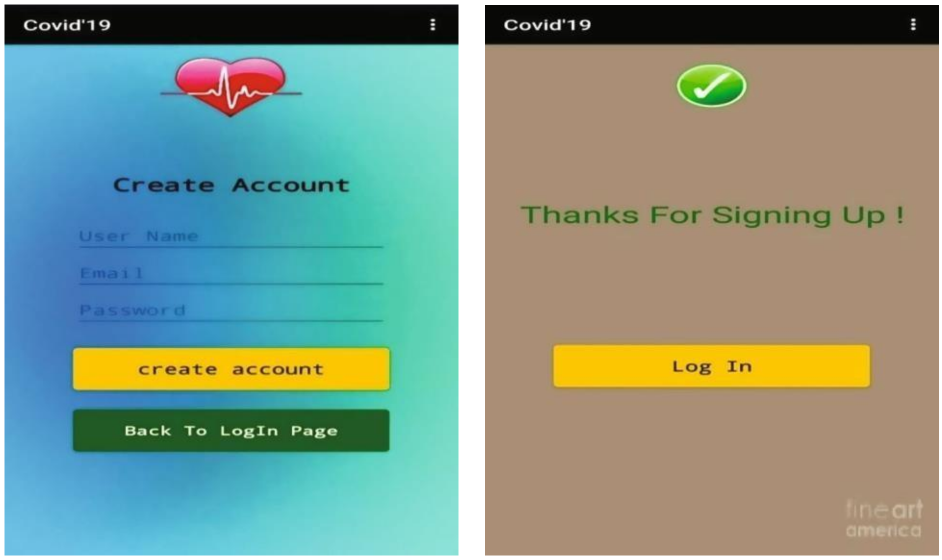


Figure 12: The mobile application's login interface.

Node MCU features wireless system that can communicate data to server, and microcontroller has Wi-Fi functionality. The Bluetooth module communicates with the MCU node via a module of asynchronous receiver- transmitter serial communication . The node MCU ESP8266 microcontroller requires a 3.3 V operating voltage and 7 V to 12 V input voltage to operate. It has 4 MB flash memory and a 64 KB SRAM. There are 16 digital input and output pins on the board, as well as one analogue input pin. A PCB antenna is also included with the node MCU .The detected pulse rate, oxygen saturation, and temperature are sent to the server via the node MCU wireless module. Because it connects the server's IP address to the MCU of the node, this component was chosen. allowing a mobile application to retrieve the measured value.



1.a (b)

Figure 13: (a) Mobile application sign-up UI and (b) successful sign-up

The MCU node is advancement board and open source firmware based on Lua. It is designd particularly for Internet of Things (IoT) applications. and it's an important part of our system. Figure 7 depicts the node MCU ESP8266 microcontroller prototype.

Buck Converter (version 1.1.2). A buck converter is a common and straightforward DC to DC converter. Buck converters were utilised in the system since their voltage of otput is smaller than their voltage of input. This converter is used for efficient transformation control, which extends life of battery while reducing heat. Figure no 8 depicts a buck converter prototype.

1.1.3 LCD Display with 16 x 2 pixels. A 16×2 LCD is typical display module of alphanumeric LCD that can display letters as well as numbers. It has two rows and 16 columns and may be utilised in a wide range of applications. This monitor indicated the patient's oxygen saturation, heart rate, and temperature. Each character is represented by a 588 pixel matrix. The 16 2 LCD display's working voltage ranges from 4.7 to 5.3 V. When not lighted by a background, its current usage is 1 mA [33]. Figure 9 depicts a 16 2 LCD display prototype.

Sensor DS18B20, version 1.1.4 Figure 10 illustrates DS18B20 sensor, which uses the Technique of communicating using just one wire. Only the information pin requires a pull-up resistor to connect to the microcontroller, while the other two pins are used for control.. The pull-up resistor is used to retain the line in a high condition while transport is not in use. Temperature measurements are taken with this sensor. The temperature detected by the sensor will be missing from a 2-byte register inside the sensor.. By delivering them in a data arrangement, these data can be evaluated using the 1-wire technique. There are two different forms of

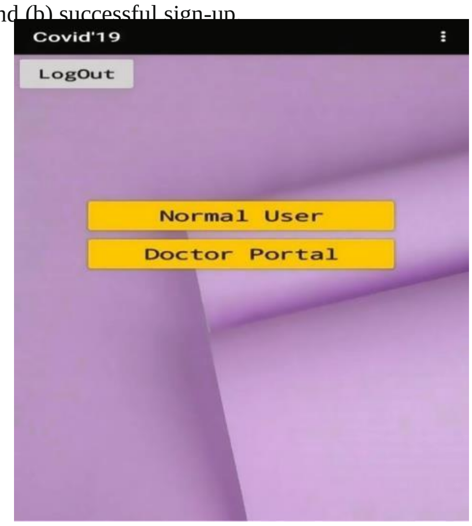


Figure 14: The mobile application's user portal interface.

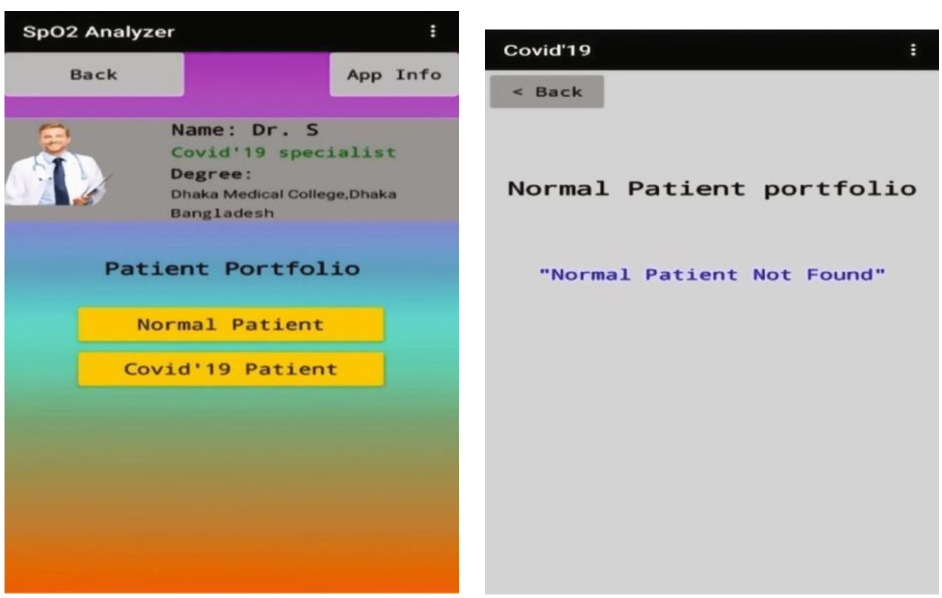
To evaluate the values, send two commands: one might be ROM command and other could be a functioning command .

Implementation of software (1.2). App Inventor from the MIT was used to construct the mobile application. MIT App Inventor is an online platform for student to create mobile apps. The MIT App Inventor allows system designers to create mobile apps for both iOS and Android. The data is stored on a Firebase backend server, which is used to create the mobile application. The languages utilised to create this application are Java and JavaScript [35].

1.2.1 User Interface for Mobile Applications There were nine different interfaces in the smartphone app. The interfaces are depicted in the diagrams below.

1.b (b)

Figure 15: (a) A typical mobile application user interface. (b) SpO2, pulse rate, and temperature were all measured.



(a) (b)

Figure 16: (a) The mobile application's doctor portal interface. (a) A typical patient portfolio for a mobile app.

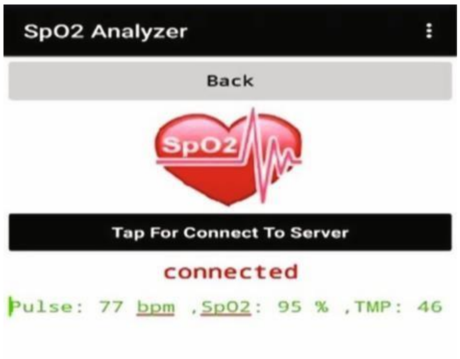
The SpO2 analyzer is a group of mobile applications. The mobile application's logo is seen in Figure 11.

Figure 12 depicts the mobile application's login interface. New users must do account creation, while existing users can log in with their password and username.

The mobile application's sign-up screen is depicted in Figure 13. Users can create an account by entering their email addresses, usernames, and passwords. After successfully signing up, the user data will be saved on cloud platform firebase, and the user will be presented with a new UI containing a login button. The user can log into mobile application by tapping login button.

The user portal interface is shown in Figure 14. This interface will show after you have successfully logged in. By pressing the normal button of user, the patient may view their measured data. By accessing the doctor portal, doctors may keep track of their patients' measured data. A "Logout"button is also available. By clicking logout button, users can exit the mobile application.

The standard user interface is depicted in Figure 15(a). This interface will appear when patient presses the regular user button. By pressing the check health condition button, the user may examine the measured pulse rate and oxygen saturation data in this interface. When the user presses the connect button on the tap,



SpO2, pulse rate, and temperature were all measured in Figure 17.

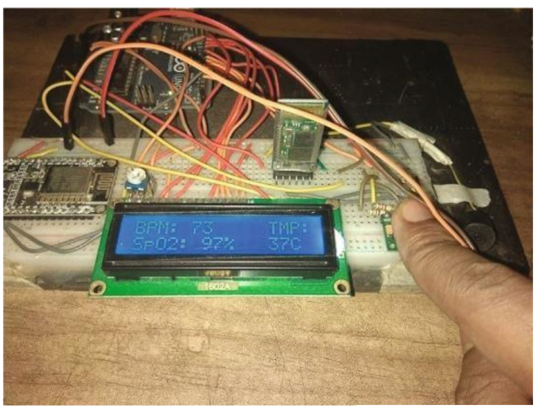


Figure 19 : Sytem’s Prototype

The button that controls the server. Using the server button, the mobile application will be connected to the device and display patient's measured saturation of oxygen, rate of pulse and temperature. Figure 15 depicts saturation of oxygen, rate of pulse, and temperature interaction (b).
The doctor portal interface is shown in figure 16(a). This screen will show if the doctor hits the doctor's portal button. By clicking on COVID patient and normal patient buttons, clinicians may compare the temperatures, SpO2, and pulse rates of normal and COVID-19 patients. A typical patient portfolio is shown in Figure 16(b). This interface will appear when user hits standard patient button. This interface will display a list of normal patients who are unaffected by COVID-19.
This interface will appear when the user clicks on portfolio of COVID paient (see Figure 17). Doctor can see the measured patient SpO2, temperature, and rate of pulse by pressing check patient button, as seen in Figure 17.

2 Results

The mobile application and the hardware are both components of the system. Both elements are necessary for the system to function, and both provide users with outcomes. The flow chart and circuit diagram in Figures 2 and 3 were used to construct this system. The system prototype can be seen in Figure 18. LCD display, The Arduino Uno, buzzer, pulse sensor, and temperature sensor are allpresent in this project.

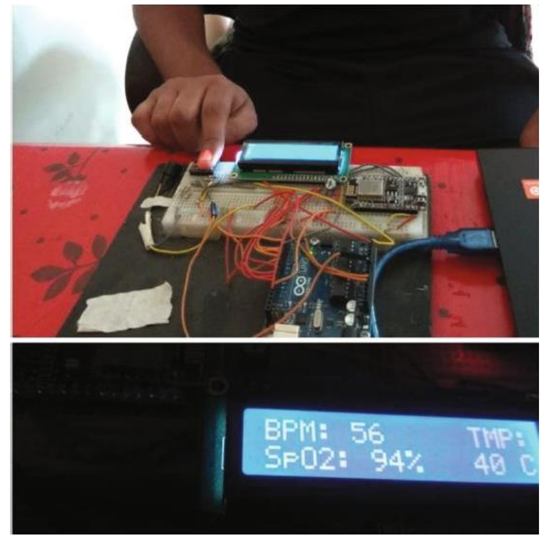


Figure 19: The user's perspective (device is testing for real human test subject).

Figure 20: In a mobile application, the user's value is measured.

The system was completed with the addition of a sensor of temperature , a MCU node, and a module of Bluetooth. The measured SpO2 level, rate of pulse, and temperature of body are displayed on system's display; if measured SpO2 and level of pulse rate fall out of range then the buzzer sounds. This prototype is straightforward and straightforward to use. Because it is a lightweight prototype, it may be readily transferred from one site to another. The overall outcome is good because all of the components are correctly positioned.

After inspecting the system separately, it was discovered that it functioned properly. This indicates that the project's system design and implementation procedures were correct, and that the user's data were accurately measured. There are two key aspects to the entire system. By selecting the COVID-19 patient and normal patient buttons, you may learn more about COVID-19.

On a real human, the system was put to the test. The user's experience, as well as the measured values of vital signs, are depicted in Figure 19. LCD and mobile device applications

TABLE 2: This system's pulse rate, SpO2, and temperature measurements for five distinct users.

Person	Age	SpO2 (%)	Pulse (bpm)	Temperature (C)
Person 01	25	97	75	37
Person 02	32	97	73	36
Person 03	34	93	70	40
Person 04	56	97	74	37
Person 05	23	97	75	40

show the user the observed heart rate, SpO2, and temperature, as well as the system's displayed results This system sends data to a mobile app, which is one of its most important components. Users can receive the desired results using this equipment and a mobile app; consequently, this method is convenient and user friendly and the system has performed admirably.

The user's SpO2, pulse rate, and temperature were all measured in Figure 20. It is a crucial interface for mobile apps because it displays the system's major findings. All of the sensors performed admirably.

This device was utilised by five people ranging in age from 23 to 56. It supplied exact values for all of the features featured in this system. Table 2 shows the measured values of saturation of oxygen level, temperatures and rate of pulse for each of five users. Most persons have a SpO2 level of 97, which is close to the typical norms, according to Table 2. The measured results for the different subjects' pulse rates were comparable. Different test individuals had different physiological data measured. All of the measured values were correct when compared to comparable commercially available equipment. This system is both dependable and user friendly, as seen in Table 1.

3 Conclusions

Thousands people died every single day as a result of the COVID19 pandemic, which has become a global health crisis. If effective therapy is given at the right time, the mortality rate can be reduced. To guarantee adequate therapy, a variety of measures have been taken, including regular pulse rate, SpO2 level, and temperature monitoring. However, a COVID-19 patient's oxygen level drops over time, and if no emergency measures are done, the patient will die quickly. In light of the foregoing, a COVID-19 patient-specific health monitoring system was based on internet of things was created. During an emergency, both the patient and the doctor can receive warnings from the system, which is powered by an IoT-based smartphone application. As a result, anyone can efficiently use this system wherever. Because the system is completely IOT based, furtherfunctionality can be added in the future.

Furthermore, this research entails a wide examination of the system's components as well as their utility. It provides list of methods that may be used to plan out this system. From the outset of this system's development, we set out to design a well organized application based gadget that canb be utilised in today's environment.

pandemic. COVID 19 patients, as well as people with asthma and COPD , can utilise this device. The device is non invasive, cost effective, and adaptable, making it easier to monitor patients' health no matter where they are. It also sends real time alerts to concerned consumers and medical professionals about any situation that demands immediate attention. This system can help throughout Bangladesh. including in remote areas, resulting in a reduction in the number of patients. Early detection of medical illness can assist the patient in taking important emergency steps that may save the patient's life. As a result, smart health monitoring systems are required to make all lives risk-free. To summarise, this system is critical in the medical field since it has the potential to help people live longer lives around the world. More sensors might be added to this system in the future to measure more physiological indicators in the human body.

Data Availability

These research findings were not based on any data.

Interest Conflicts

In this paper, the authors state that they have no competing interests to report.

Acknowledgments

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