Literature Review

2.1 Related Work:

The system is builds upon the integration of wireless communications into medical applications to revolutionize personal healthcare. The objective of this project is to build a wireless heart beat monitoring system using GSM Technology, which could potentially be an integral part of a suite of personal healthcare appliances for a large-scale remote patient monitoring system. As its name implies this is a Health monitoring system, with a feature of sending SMS to doctor and patients relative in event of emergency, hence the system can be used at hospitals as well as at home. [3].

The fixed monitoring system can be used only when the patient is on bed and this system are huge and only available in the hospitals in ICU development of a microcontroller based system for wireless heartbeat and temperature monitoring using ZigBee. The system is developed for home use by patients that are not in a critical condition but need to be constant or periodically monitored by clinician or family. In any critical condition the SMS is send to the doctor or any family member. So that we can easily save many lives by providing them quick service [5]. Using Wireless Sensor Networks (WSNs) in health care system has yielded a tremendous effort in recent years.

In most of these researches, tasks like sensor data processing, health state decisions making and emergency Messages sending are completed by a remote server. Transmitting and handing with a large scale of data from body sensors consume a lot of communication resource, bring a burden to the remote server and delay the decision time and notification time. In this paper, we present a prototype of a smart gateway that we have implemented.

This gateway is an interconnection and services management platform especially for WSN health care systems at home environment. By Building a bridge between a WSN and public communication networks, and being compatible with an onboard data decision system and a lightweight database, our smart gateway system is enabled to make patients' health state decisions in low-power and low-cost embedded system and get faster response time o the emergencies. We have also designed the communication protocols between WSN, gateway and remote servers. Additionally Ethernet, WI-Fi and GSM/GPRS Communication module are integrated into the smart gateway in order to report and notify information to care-givers [7].

Difficult for people to be constantly available for their near ones who might need them while they are suffering from any disease or physical disorder. So also constant monitoring of the patients body parameters such as temperature, pulse rate, sugar level etc. becomes difficult. Also in intensive care units it is necessary to monitor continuously the patient’s health Parameters and keep their record. But there is a possibility of human errors. Hence to remove human errors and to lessen excessive burden of continuously monitoring patient’s health from doctor’s head, we are proposing patient monitoring system using GSM. A patient monitoring system which provides Continuous monitoring of a patient includes a data acquisition & processing module which receives physiological data from the patient and GSM module to transmit acquired data to doctor’s mobile. This unit may be inserted in a bedside display unit to display the physiological condition of the patient. Patient monitoring systems measure physiological characteristics either continuously or at Regular intervals over time [1]. There is a vast growth of VLSI technology and GSM communication in these days. This project deals about the implementation of GSM technology in Medical applications.

This wireless communications would not only provide them with safe and accurate monitoring but also the freedom of movement. In this, heart beat and temperature of patient are measured by using sensors as analog data. Later it is converted into digital data using ADC using paging messages through GSM modem. AT89S52 micro controller device is used for temporary storage of the data used for transmission [4]. Smart phones are very popular in today's life. Cameras with high resolution, High end processors and built-in sensors such as accelerometer, orientation sensor and light-sensors are equipped in today's phones. Motivated by this statistic and the diverse capability of smart phones, the Blood pressure is a significant vital sign; blood pressure monitoring has a great significance to determine the health status of patients. In this project blood pressure, Temperature and heart beat are estimated by using sensors and the result is viewed in smart phones by using GSM and if any abnormal result. Estimate the systolic and diastolic pressure.

Transmission of the vital signs measured using the smart phone can be a life saver in critical situations [8]. System for people who stay alone at home or suffering from heart disease. Developing a hardware which will sense Heart rate blood pressure and body temperature. Using GSM modem all information lively transmitted to smart phone, from smart phone all information transmitted to server using GPRS [6].

2.2 Heart Beat:

A person's heartbeat is the sound of the valves in his/her's heart contracting or expanding as they force blood from one region to another. The number of times the heart beats per minute (BPM), is the heart beat rate and the beat of the heart that can be felt in any artery that lies close to the skin is the pulse.

Manual Way: Heart beat can be checked manually by checking one's pulses at two locations- wrist (the radial pulse) and the neck (carotid pulse). The procedure is to place the two fingers (index and middle finger) on the wrist (or neck below the windpipe) and count the number of pulses for 30 seconds and then multiplying that number by 2 to get the heart beat rate. pressure should be applied minimum and also fingers should be moved up and down till the pulse is felt. Designed to give digital output of heat beat when a finger is placed on it. When the heart beat detector s working, the beat LED flashes in unison with each heart beat. This digital output can be connected to microcontroller directly to measure the Beats per Minute (BPM) rate.

2.2.1 Principle of Heartbeat Sensor:

The sensor consists of super bright red LED and light detector. The LED needs to be super bright as the maximum light must pass spread in figure and detected by detector. Now, when the heart pumps a pulse of blood through the blood vessels. The finger becomes slightly more opaque and so less light reached the detector with each heart pulse the detector signal varies. This variation is converted to electrical pulse. This signal is amplified and triggered through an amplifier which output +5v logic level signal. The output signal is also indicated by a LED which blinks on each heart beat.

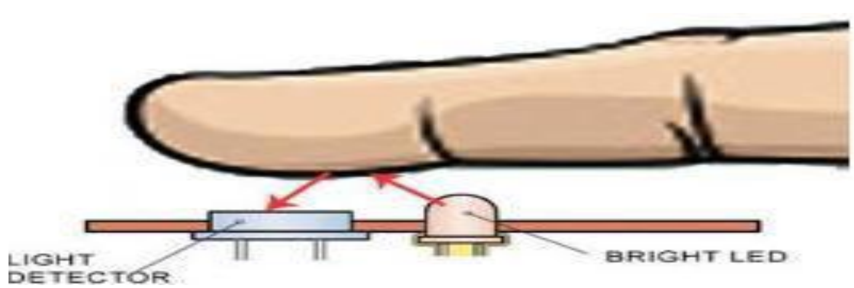

Figure (2-1): Heart beat sensor

Sensor Connect regulated DC power supply of 5 Volts. Black wire is Ground, Next middle wire is Brown which is output and Red wire is positive supply. These wires are also marked on PCB. To test sensors you only need power the sensor by connect two wires +5V and GND. can leave the output wire as it is.

When Beat LED is off the output is at 0V. Put finger on the marked position and you can view the beat LED blinking on each heartbeat. The output is active high for each beat and can be given directly to microcontroller for interfacing applications. As shown in Figure (2-2):

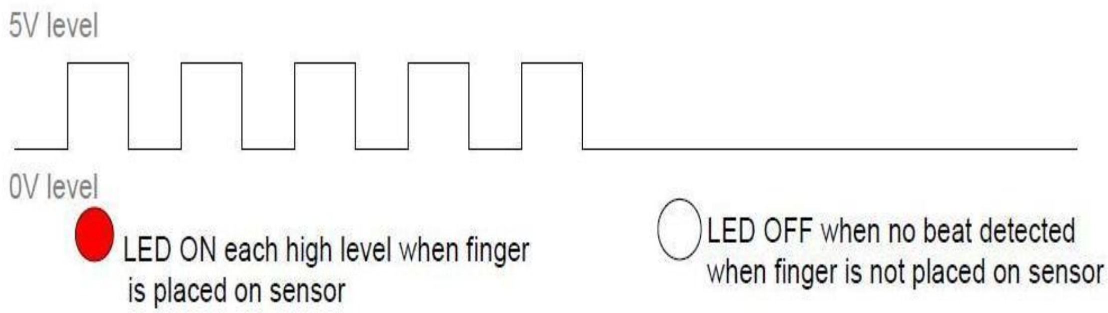

Figure (2-2): Heart beat output signal

Put finger on the marked position and you can view the beat LED blinking on each heartbeat. The output is active high for each beat and can be given directly to microcontroller for interfacing applications.

2.2.2 Types of photophlethysmography :

1- **Transmission**: Light emitted from the light emitting device is transmitted through any vascular region of the body like earlobe and received by the detector.

2- **Reflection**: Light emitted from the light emitting device is reflected by the regions.

2.2.3 Practical Heartbeat Sensor

Practical heartbeat Sensor examples are Heart Rate Sensor (Product No PC-3147). It consists of an infrared LED and an LDR embedded onto a clip like structure. The clip is attached to the organ (earlobe or the finger) with the detector part on the flesh.

Figure (2-3): Practical Heartbeat Sensor

Another example is TCRT1000, having 4 pins, Pin1 to give supply voltage to the LED, Pin2 and 3 are grounded. Pin 4 is the output. Pin 1 is also the enable pin and pulling it high turns the LED on and the sensor starts working. It is embedded on a wearable device which can be worn on the wrist and the output can be sent wirelessly (through Bluetooth) to the computer for processing.

2.3 Blood pressure sensor:

Blood pressure refers to the force exerted by circulating blood on the walls of blood vessels, and constitutes one of the principal vital signs. The pressure of the circulating blood decreases as blood moves through arterioles, capillaries, and veins, the term blood pressure generally refers to arterial blood pressure, i.e., the pressure in the larger arteries; arteries being the blood vessels which take blood away from the heart .

Blood pressure is most commonly measured via a sphygmomanometer, which uses the height of a column of mercury to reflect the circulating pressure. Although many modern blood pressure devices no longer use mercury, blood pressure values are still universally reported in millimeters of mercury (mmHg). Blood pressure sensor measure the pressure flowing through the blood vessels against the walls of the arteries. If blood flow is normal, then blood pressure is normal (average 120/80). If blood flow becomes restricted in some way, blood pressure goes up. If increased blood pressure goes undetected, the person is at risk of severe medical problems.

2.3.1 Mean Arterial Pressure:

The human heart is a pulsatile pump in that its function is characterized by alternating periods of contraction and relaxation. During the contraction phase (systole), blood is ejected from both the left and right ventricles and pumped into the systemic circulation and pulmonary circulation, respectively. During the relaxation phase of the heart (diastole), the ventricles are filled with blood in preparation for the next contraction phase. While the left and right ventricles contract nearly simultaneously, each pumps blood into a different artery. Contraction of the left ventricle leads to the opening of aortic semilunar valve in order to eject blood into the aorta and, hence, the systemic circulation. Contraction of the right ventricle leads to the opening of pulmonary semilunar valve in order to eject blood into the pulmonary trunk (which branches out into the right pulmonary artery and left pulmonary artery) and, hence, the pulmonary circulation. To prevent back flow of blood into the ventricles, the semilunar valves close during ventricular diastole. The cycles of ventricular contraction and relaxation lead to maximum (systolic) and minimum (diastolic) levels of blood pressure.

In the major arteries in which blood is initially pumped. Typical systolic and diastolic arterial blood pressure values are 120/80 mm Hg (millimeters of mercury) for the systemic circulation and 30/10 mm Hg for the pulmonary circulation. The difference between the systolic pressure and diastolic pressure is referred to as the pulse pressure. the mean arterial pressure (MAP) that drives blood through the vasculature from the arteries to arterioles, capillaries, venules, veins, and back to the heart. The mean arterial pressure is a time-weighted average of pressure values in large systemic arteries during the cardiac cycle. The mean arterial pressure is a function of the rate at which the heart pumps blood into the large arteries. The rate of blood flow out of the large arteries to enter smaller arteries and arterioles, and arterial wall compliance [9]. If the ventricles spent an equal length of time in systole and diastole, the mean arterial pressure could simply be estimated as the mathematical average of systolic and diastolic pressure values. In reality, however, the ventricles spend approximately one-third (1/3) of their time in systole, and two-thirds in diastole. Therefore, a simple average of the systolic and diastolic pressure values is not an adequate estimate of the mean arterial pressure. Instead, a simple approximation equation is typically used to estimate the mean arterial pressure, where mean arterial pressure = diastolic pressure + (1/3) × pulse pressure (see below).

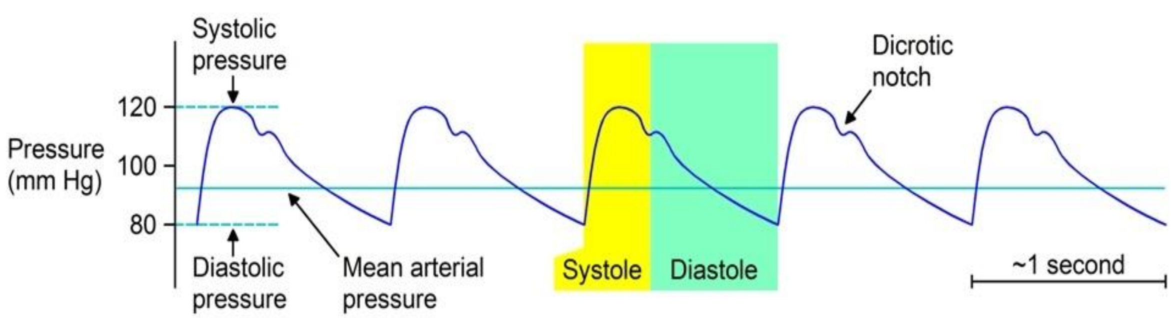

Figure (2-4): Normal blood pressure fluctuations in the aorta

Mean arterial pressure equation:

Mean Arterial Pressure = diastolic pressure + [1/3* Pulse Pressure]

Pulse Pressure = systolic Pressure - diastolic pressure

* Mean Arterial Pressure is an approximation for the time-weighted average of blood pressure values in large system arteries during the cardiac cycle.

* Diastolic Blood Pressure is the minimum blood pressure measured in large systemic arteries. The lowest value occurs just before the start of every ventricular systole.

* Pulse Pressure is the difference between systolic blood pressure and diastolic blood pressure. Therefore, Pulse Pressure = Systolic Pressure -Diastolic Pressure.

2.3.2 Interpretation of mean arterial pressure:

The mean arterial pressure represents the average arterial pressure throughout the cardiac cycle, and is the force that drives blood through the vasculature. Because resistance to blood flow is very low in large arteries, there is very little difference between the mean arterial pressure in the aorta and large systemic arteries. It is for this reason that the brachial artery in the upper arms can be used to measure blood pressure. In humans, a mean arterial pressure of at least 60 mm Hg is required to keep blood flowing through the vasculature. It must be kept in mind that there are situations in which vastly different systolic and diastolic pressure values lead to the same estimate of mean arterial pressure. For example, the calculated mean arterial pressure is the same whether the systolic/diastolic pressure values are 120/80 mm Hg or 160/60 mm Hg.

While this may be an extreme example, there are pathophysiological situations in which a reduction in arterial compliance leads to an elevated systolic pressure and reduced diastolic pressure, yielding a calculated mean arterial pressure that is close to normal.

2.4 Temperature (LM35) sensor:

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

Figure (2-5): Temperature (LM35) sensor

The LM35 does not require any external calibration or trimming to provide typical accuracies of ±¼°C at room temperature and ±¾°C over a full -55 to +150°C temperature range. Low cost is assured by trimming and calibration at the wafer level. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies. As it draws only 60 µA from its supply, it has very low self-heating, less than 0.1°C in still air.

The LM35 is rated to operate over a -55° to +150°C temperature range, while the LM35C is rated for a -40° to +110°C range (-10° with improved accuracy).The LM35 series is available packaged in hermetic TO-46 transistor packages, while the LM35C, LM35CA, and LM35D are also available in the plastic TO-92 transistor package. The LM35D is also available in an 8-lead surface mount small outline package and a plastic TO-220 package [12].

Temperature equation :

Temp = voltage * 100

Feature:

* Calibrated directly in ° Celsius (Centigrade).
* Linear + 10.0 mV/°C scale factor.
* 0.5°C accuracy guarantee able (at +25°C).
* Rated for full -55° to +150°C range.
* Suitable for remote applications.
* Low cost due to wafer-level trimming.
* Operates from 4 to 30 volts.
* Low impedance output, 0.1 W for 1 mA load.

2.5 Microcontroller:

A microcontroller is a single chip, self-contained computer which incorporates all the basic components of a personal computer on a much smaller scale. Microcontrollers are often referred to as single chip devices or single chip computers. The main consequence of the microcontroller's small size is that its resources are far more limited than those of a desktop personal computer. In functional terms.

The microcontroller is a programmable single chip which controls a process or system. Microcontrollers are typically used as embedded controllers where they control part of a larger system, a computer peripheral. Microcontrollers are designed to be low cost solutions; therefore using them can drastically reduce part and design costs for a project. Physically, a microcontroller is an integrated circuit with pins along each side. The pins presented by a microcontroller are used for power, ground, oscillator, I/O ports, interrupt request signals, reset and control. In contrast, the pins exposed by a microprocessor are most often memory bus signals (rather than I/O ports).

Microcontroller has seven main components:

* Central processing unit (CPU)
* ROM
* RAM
* Input and Output
* Timer
* Interrupt circuitry
* Buses

Feature:

* Advanced RISC Architecture

* Up to 16 MIPS Throughput at 16 MHz

* 16K Bytes of In-System Self-Programmable Flash

* 512 Bytes EEPROM

* 1K Byte Internal SRAM

* 32 Programmable I/O Lines

* 8-channel, 10-bit ADC

* Two 8-bit Timer/Counters with Separate Prescalers and Compare

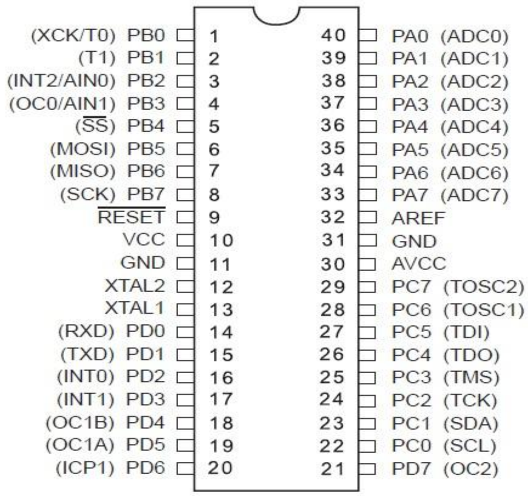

Figure (2-6): Pin Configuration AT Mega 16 Microcontroller

Pin Description AT Mega 16 Microcontroller:

VCC: Digital supply voltage. (+5V).

GND: Ground. (0 V) Note there are 2 ground Pins.

Port Z: Z= A, B, C, D: Port a serves as the analog inputs to the A/D Converter. Port A also serves as an 8-bit bi-directional I/O port, if the A/D Converter is not used. When pins PA0 to PA7 are used as inputs and are externally pulled low. Port B is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). Port C is an 8-bit bi-directional I/O port with internal pull-up resistors.

Port D is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit).

AVCC: AVCC is the supply voltage pin for Port A and the A/D Converter. It should be externally connected to VCC, even if the ADC is not used. If the ADC is used, it should be connected to VCC through a low-pass filter.

RESET: Reset Input. A low level on this pin for longer than the minimum pulse length will generate a reset, even if the clock is not running.

2.5.1 Digital Input Output Port:

So let’s start with understanding the functioning of AVR. We will first discuss about I/O Ports. Again I remind you that I will be using and writing about Atmega-16. Let’s first have a look at the Pin configuration of Atmega-16. Image is attached, click to enlarge. You can see it has 32 I/O (Input/output) pins grouped as A, B, C & D with 8 pins in each group. This group is called as PORT.

* PA0 - PA7 (PORTA)
* PB0 - PB7 (PORTB)
* PC0 - PC7 (PORTC)
* PD0 - PD7 (PORTD)

Notice that all these pins have some function written in bracket. These are additional function that pin can perform other than I/O. Some of them are.

* ADC (ADC0 - ADC7 on PORTA).
* UART (Rx, TX on PORTD).
* TIMERS (OC0 - OC2).
* SPI (MISO, MOSI, SCK on PORTB).
* External Interrupts (INT0 - INT2).

Registers:

All the configurations in microcontroller is set through 8 bit (1 byte) locations in RAM (RAM is a bank of memory bytes) of the microcontroller called as Registers. All the functions are mapped to its locations in RAM and the value at that location that is at that Register configures the functioning of microcontroller.

2.5.2 Analog to Digital Conversion (ADC):

Microcontroller understands only digital language. the inputs available from the environment to the microcontroller are mostly analog in nature, In order to understand the inputs by the digital processor, a device called Analog to Digital Converter (ADC) is used. As the name suggests this peripheral gathers the analog information supplied from the environment and converts it to the controller understandable digital format. Microcontroller then processes the information and provides the desired result at the output end.

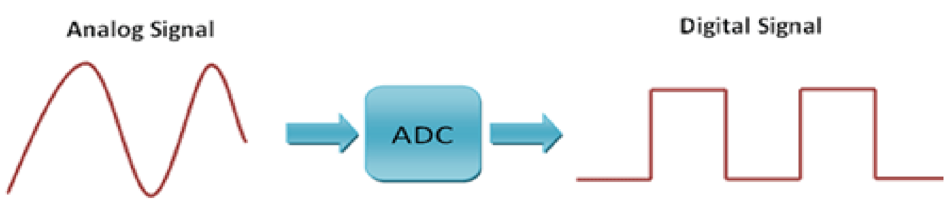

Figure (2-7): Analog to Digital Conversion

* If an analog value (voltage) should be measured ADC is used.

* Since there is only one ADC unit this inputs are multiplexed.

* The ADC needs a reference voltage (different options).

* The conversion needs time (check Flag or IR).

0V —— 0000000000 bits

5V —— 1111111111 bits = 2ˆ10 = 1024

V —— E

V = E * 5/1024

2.5.3 Timers:

The Atmel ATmega16 has three Timer/Counters:

* Timer/Counter0 is a general purpose, single channel, 8-bit Timer/Counter module.

* Timer/Counter1 is a 16-bit general purpose Timer/Counter also incorporates wave generation.

* Timer/Counter2 is an 8-bit Timer/Counter with PWM and Asynchronous Operation. This is a general purpose, single channel, 8-bit Timer/Counter module. Difference between this unit and the previous two is that it supports clocking from External 32 kHz Watch Crystal Independent of the I/O Clock for Real Time Clock applications.

Prescaler: Prescaler for divition crystal to be clocks source for timer 1.

Prescaler = 8000000/1024 = 7812.5 (1Sec)

For 2Sec = 7812.5 * 2 = 15625

15625 —— 2Sec

TCNT 1 —— X Sec X Sec = TCNT 1 * 2Sec/15625

2.6 LCD (Liquid Crystal Display) 16x2:

A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD.

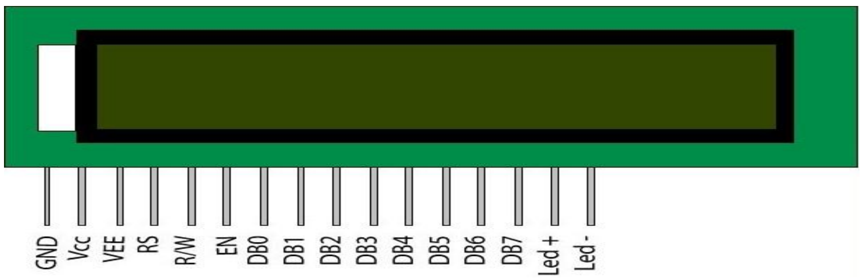

Figure (2-8): Pin Diagram 16x2 LCD

Table (2-1): Pin Description 16x2 LCD

Pin No	Function	Name
1	Ground (0V)	Ground
2	Supply voltage; 5V (4.7V – 5.3V)	Vcc
3	Contrast adjustment; through a variable resistor	V_{EE}
4	Selects command register when low; and data register when high	Register Select
5	Low to write to the register; High to read from the register	Read/write
6	Sends data to data pins when a high to low pulse is given	Enable
7-14	8-bit data pins	DB0- DB7
15	Backlight V_{CC} (5V)	Led+
16	Backlight Ground (0V)	Led

2.7 Serial Communication (RS-232):

Well-established standard, developed by the EIA (Electronics Industry Association) in 1960s Originally intended as an electrical specification to connect computer terminals to modems Defines the interface between a DTE and a DCE, DTE = Data Terminal Equipment (terminal), DCE = Data Communications Equipment (modem) A "modem" is sometimes called a "data set" A "terminal" is anything at the "terminus" of the connection VDT (video display terminal), computer, printer, etc. RS-232 Specifications Data rate Maximum specified data rate is 20 Kbits/s with a maximum cable length of 15 meters However…It is common to "push" an RS-232C interface to higher data rates Data rates to 1 Mbit/s can be achieved (with short cables!) Configuration Serial, point-to-point

2.7.1 Serial Data Transmission:

* Asynchronous: The transmitting and receiving devices are not synchronized. A clock signal is not transmitted along with the data.

* Synchronous: The transmitting and receiving devices are synchronized, a clock signal is transmitted along with the data (and is used to synchronize the devices). Most (but not all) RS-232C interfaces are asynchronous.

Asynchronous Data Transmission: Data are transmitted on the TD (transmit data) line in packets, typically, of 7 or 8 bits. Each packet is "framed" by a "start bit" (0) at the beginning, and a "stop bit" (1) at the end. Optionally, a "parity bit" is inserted at the end of the packet (before the stop bit). The parity bit establishes either "even parity" or "odd parity" with the data bits in the packet. E.g., even parity: the total number of bits "equal to 1" (including the data bits and the parity bit) is an "even number.

1’s and 0’s in RS-232C, A “1” is called a “mark” , A “0” is called a “ space”, The idle state for an RS-232C line is a 1 (“mark”),Idle state is called “marking the line”, Voltages on an RS-232C line, Well… that’s another story, and it’s not really a concern to us.

Data Transmission: Plot of the asynchronous RS-232C transmission of the ASCII character ‘a’ with odd parity:

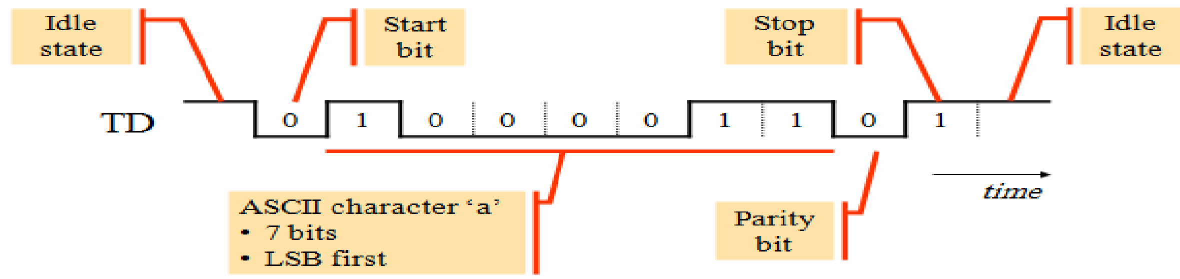

Figure (2-9): Data Transmission

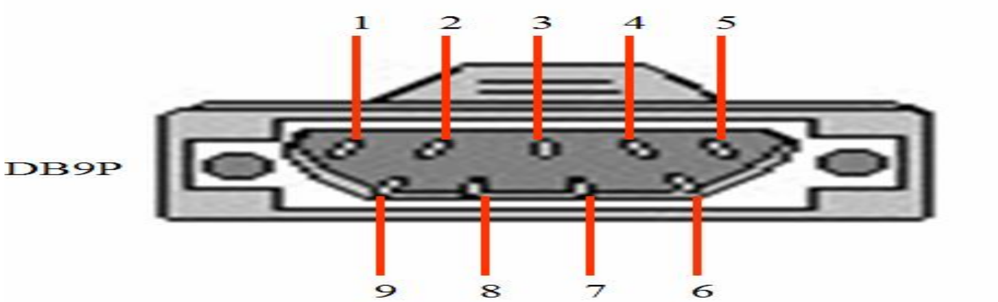

Figure (2-10): RS-232C Pin Numbers

2.8 GSM Technique:

GSM stands for Global System for Mobile Communications. Just like computers, mobile phones have evolved over time. There were first generation mobile phones in the 70's, there are 2nd generation mobile phones in the 80's and 90's, and now there are 3rd generation mobile phones which we call as 3G phones.

GSM is a 2nd generation, or 2G communications technology. Now, GSM makes use of two principles. The first called Time division Multiplexing is very simple.

Let's say that one of your friends possesses the new and sleek Apple's I Phone. Everyone wants to try a hand at your new accessory. What do you'll do? You lend it to your friend Time for some time, then you let John listen to music on it, then you let Linda check her e-mails on it, and finally you let Nancy search on Google. So what did you do? You allowed each of your friends to share you I Phone for some time. That is, you allowed you I Phone to be shared in time. On the same lines, in GSM, the radio frequency say 890 MHz is shared by different users in time. This means if user A, B, C and D all talk at the same time. You assign the 890 MHz frequency to A for some time and allow him to talk, then you assign 890 band to B for some time to speak, then to C , and finally to D, before coming back to A. So the process continues in a round robin fashion, as long as A, B, C, and D want to talk. This way many users talk at same time on the same frequency. This has to be done, because as we now frequency or Bandwidth is a scarce resource and is not available in plentiful, so it must be shared. Now the second principle that GSM uses is Frequency Division Multiplex. In Frequency Division Multiplex, users A, B, C and D.All use different frequency say 890, 900, 910, 920 for their respective communications. A very good example of this is Radio broadcasting. Because all the radio operators like Rad FM, Go FM, and Radio Mirchi want to operate in the same area, they use different frequencies for communication 91.0FM, 93.5FM, 94.6 FM, 108FM. So to listen to different communications, you have to tune in the receiver set to different frequencies. Now, GSM uses a combination of TDMA and FDMA. This means that users A and B are not only sharing the channel in time but also frequency. then jumps to910Mhz for the next 2 seconds .

Table (2-2): GSM overall efficiency

For Subscribers	For Operators
Low cost entry handsets	Economies of scale due to dominant market Share
Wide choice and availability of handsets	Choice of multiple vendors
International roaming	Capex optimization
Easy subscription	Lower subscriber acquisition cost
	Seamless interoperability

2.9 Amplitude-Shift Keying (ASK) Modulation:

The amplitude shift keying - ASK - in the context of digital communications is a modulation process, which imparts to a sinusoid two or more discrete amplitude levels. These are related to the number of levels adopted by the digital message. For a binary message sequence there are two levels, one of which is typically zero. Thus the modulated waveform consists of bursts of a sinusoid. Illustrates a binary ASK signal (lower), together with the binary sequence which initiated it (upper). Neither signal has been band limited.

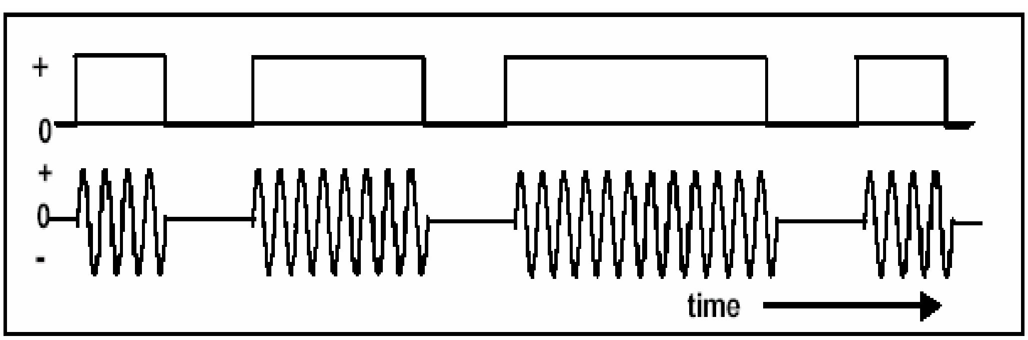

Figure (2-11): ASK signal and the message

2.9.1 RF Module (Transmitter & Receiver):

The RF module, as the name suggests, operates at Radio Frequency. The corresponding frequency range varies between 30 kHz & 300 GHz. In this RF system, the digital data is represented as variations in the amplitude of carrier wave. This kind of modulation is known as Amplitude Shift Keying (ASK). Transmission through RF is better than IR (infrared) because of many reasons. Firstly, signals through RF can travel through larger distances making it suitable for long range applications. IR mostly operates in line-of-sight mode, RF signals can travel even when there is an obstruction between transmitter & receiver. RF transmission is more strong and reliable than IR transmission. RF communication uses a specific frequency unlike IR signals which are affected by other IR emitting sources. This RF module comprises of an RF Transmitter and an RF Receiver. The transmitter/receiver (Tx/Rx) pair operates at a frequency of 434 MHz an RF transmitter receives serial data and transmits it wirelessly through RF through its antenna connected at pin4. The transmission occurs at the rate of 1Kbps - 10Kbps.The transmitted data is received by an RF receiver operating at the same frequency as that of the transmitter. Disadvantages of ASK, compared with FSK and PSK, for example, is that it has not got a constant envelope. This makes its processing more difficult, since linearity becomes an important factor. However, it does make for ease of demodulation with an envelope detector.

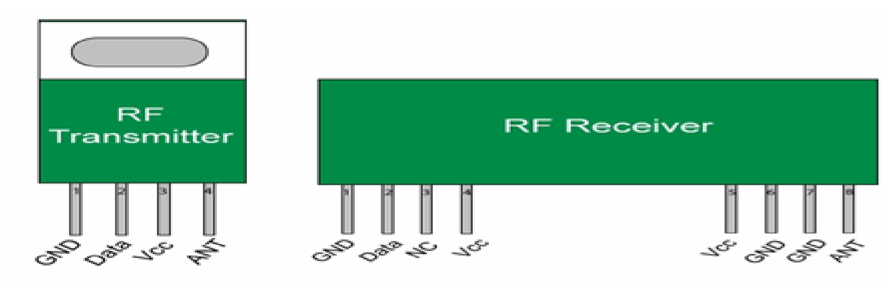

Figure (2-12): RF Module (Transmitter & Receiver)

Table (2-3): Pin Description RF Transmitter

Pin No	**Function**	**Name**
1	Ground (0V)	Ground
2	Serial data input pin	Data
3	Supply voltage; 5V	Vcc
4	Antenna output pin	ANT

Table (2-4): Pin Description RF Receiver

Pin No	**Function**	**Name**
1	Ground (0V)	Ground
2	Serial data output pin	Data
3	Linear output pin; not connected	NC
4	Supply voltage; 5V	Vcc
5	Supply voltage; 5V	Vcc
6	Ground (0V)	Ground
7	Ground (0V)	Ground
8	Antenna input pin	ANT