MEASUREMENT OF BODY PARAMETERS UNDER CRITICAL CONDITIONS
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Abstract: In this project we have dealt with the problems faced by the soldiers in warfare. We are able to recover anything in this world, but till now it’s impossible to get back a life when dead. That too lives like soldiers are very important to us. They are the persons who protect our lives. As engineers it is our work to make devices which would help protect their valuable lives. This device which we have developed, is a microcontroller based project where we have used GSM & GPS technology and this will be fixed with the soldier and it keeps on monitoring their heart rate, blood pressure, their body temperature and their blood loss. It also tracks their latitude and longitude position by which we get their location. This information’s are send to the control room, where they get the information about all the soldiers and they analyze about the same. When they recognize that there is an emergency they order the rescue team to take up the required steps. By this we are able to recover the injured soldiers and bring them to the military camp to hospitalize them and also to recover the bodies of the dead soldiers.

Index terms: GSM, GPS, Heart rate sensor, PIC Microcontroller, RS232, Temperature Sensor.

I. INTRODUCTION
The main aim of this project is to develop a device which helps to protect the soldier’s life by helping the rescue operation to be performed immediately when there is an emergency. The rescue operations are carried out only when the team goes in search of the soldiers lying down or when the soldier gives information through their communication system.

This system fails when the concerned soldier is faint or its hard to recover the dead body when they are thrown away somewhere during some explosion.

In the transmitter side, the heart beat sensor is connected to the channel three of the PIC microcontroller. It senses the pulse rate by the means of IR rays. IR transmitter and receiver are fixed across the human wrist, which senses the blood cells and gives the voltage difference as the input to the microcontroller. The temperature sensor, thermostat LM35 senses the body temperature and gives the voltage difference as the input to the microcontroller. The GPS modem is connected to the PIC microcontroller. This modem gives the values of the latitude and the longitude of the microcontroller, by which the position of the soldier can be determined. The PIC microcontroller gives the equivalent digital value of the voltage difference of the sensors; these values are then converted into analog values by the means of ADC (analog to digital converter). All these values are then driven to GSM modem. By the means of GSM modem the data are transmitted to the control room, i.e. the GSM modem in the receiver side.

In the receiver side, the GSM modem receives the SMS from the transmitting GSM modem and then gives the same to the computer. In the computer the database of the received data is displayed.

II. MICROCONTROLLER UNIT
The microprocessor is the core of computer systems. Nowadays many communications, digital entertainment, portable devices, are controlled by them. A designer should know what types of components he needs, ways to reduce production costs and product reliable.

To perform the various operations and conversions required to switch, control and monitor the devices a processor is needed. The processor may be a microprocessor, micro controller or embedded controller. In this project an embedded controller has been preferred because of its industrial advantages in power electronics like built in ADC, RAM, ROM, ports, USART, DAC. This leads to lesser space occupation by the circuit and also the speed of embedded controllers are more compared to other processors. The embedded controller selected for this project is PIC16F877A due to its various features

A. FEATURES OF PIC16F877A:
(1) High-performance RISC(Reduced Instruction Set Controller) CPU.
(2) Only 35 single word instructions to learn.
(3) All single cycle instructions except for program branches which are two cycle.
(4) Operating speed: DC - 20 MHz clock input and DC - 200 ns instruction cycle.
(5) 4K x 14 words of Program Memory (EPROM).
(6) 256 x 8 bytes of Data Memory (RAM).
(7) Interrupt capability (up to 14 internal/external interrupt sources).
B. REQUIREMENTS OF PIC16F877A:

1. A separate power supply for digital and analog supplies must be provided to prevent affecting the quality of analog measurement due to digital current fluctuations.
2. Double regulated completely filtered analog reference supply.
3. Needs external power on reset and CPU synchronization switch.
4. External quartz crystal to be used for frequency stability.
5. 10 MHz for 9600 baud rate
6. 20 MHz for 19200 baud rate
7. RS232 converter is used to link it with the computer.
8. For all the analog inputs voltage should not exceed 5V.
9. For digital outputs we should not consume current beyond 25mA.
10. All the logical inputs must reach PIC16F877A as a perfect square wave form.

Thus PIC 16F877A is an active low reset microcontroller. The data from the RFID reader is fed to Port A (pins 2, 3, 4, 5, 7) of the PIC 16F877A. Four pins of Port B (pins 33, 34, 35, 36) are used to drive the gate mechanism. As the gate needs large currents it cannot be directly connected to the microcontroller.

Two pins of Port C (RC6 and RC7) are used in communication with the PC. They are given to the MAX 232 which acts as the voltage level shifter. A constant regulated power supply of 5V is given to the circuit from the power supply section RS 232

An RS-232 port was once a standard feature of a personal computer for connections to modems, printers, data storage, uninterruptible power supplies, and other peripheral devices. However, the limited transmission speed, relatively large voltage swing, and large standard connectors motivated development of the universal serial bus which has displaced RS-232 from most of its peripheral interface roles. Many modern personal computers have no RS-232 ports and must use an external converter to connect to older peripherals. Some RS-232 devices are still found, especially in industrial machines or scientific instruments.

A. MAX 232

The Max 232 is a dual RS-232 receiver / transmitter that meets all EIA RS232C specifications while using only a +5V power supply. It has 2 onboard charge pump voltage converters which generate +10V and –10V power supplies from a single 5V power supply. It has four level translators, two of which are RS232 transmitters that convert TTL/CMOS input levels into +9V RS232 outputs. The other two level translators are RS232 receivers that convert RS232 inputs to 5V.
TTL/CMOS output level. These receivers have a nominal threshold of 1.3V, a typical hysteresis of 0.5V and can operate upto 30V input.

Suitable for all RS232 communications.

+12V power supplies required.

Voltage quadruplar for input voltage upto 5.5V (used in power supply Section of computers, peripherals, and modems).

Three main sections of MAX232 are

1. A dual transmitter
2. A dual receiver
3. +5V to + 10V dual charge pump voltage converter.

B. Power supply

The MAX232 power supply section has 2 charge pumps the first uses external capacitors C1 to double the +5V input to +10V with input impedance of approximately 200Ω. The second charge pump uses external capacitor to invert +10V to –10V with an overall output impedance of 45Ω.

C. Transmitter section

Each of the two transmitters is a CMOS inverter powered by + 10V internally generated supply. The input is TTL and CMOS compatible with a logic threshold of about 26% of Vcc. The input if an unused transmitter section can be left unconnected: an internal 400KΩ pull up resistor connected between the transistor input and Vcc will pull the input high forming the unused transistor output low.

The open circuit output voltage swing is guaranteed to meet the RS232 specification + 5v output swing under the worst of both transmitter driving the 3KΩ.

Minimum load impedance, the Vcc input at 4.5V and maximum allowable ambient temperature typical voltage with 5KΩ and Vcc = +4.5v .The slow rate at output is limited to less than 30V/μs and the powered down output impedance will be a minimum of 300Ω with +2V applied to the output with Vcc = 0V. The outputs are short circuit protected and can be short circuited to ground indefinitely.

D. Receiver section

The two receivers fully conform to RS232 specifications. They’re input impedance is between 3KΩ either with or without 5V power applied and their switching threshold is within the +3V of RS232 specification. To ensure compatibility with either RS232 IIP or TTL/CMOS input. The MAX232 receivers have VIL of 0.8V and VIH of 2.4V the receivers have 0.5V of hysteresis to improve noise rejection.

IV. SENSORS

A sensor is a converter that measures a physical quantity and converts it into a signal which can be read by an observer or by an instrument. For example, a mercury-in-glass thermometer converts the measured temperature into expansion and contraction of a liquid which can be read on a calibrated glass tube. A thermocouple converts temperature to an output voltage which can be read by a voltmeter. For accuracy, most sensors are calibrated against known standards.

Sensors are used in everyday objects such as touch-sensitive elevator buttons and lamps which dim or brighten by touching the base. There are also innumerable applications for sensors of which most people are never aware. Applications include cars, machines, aerospace, medicine, manufacturing and robotics.

A. Heart Rate Sensor

Heart rate is the most important parameter in our project. It defines the life status of the soldier. It is the basic and most important parameter in the medical science from the olden days till now. From the heart rate we can determine other parameters like blood pressure, blood flow and some other parameters. In our device we use the non invasive heart rate sensor which detects the heart rate by the means of transmitting and reception of the IR rays. The IR rays of frequency 980nm are transmitted through the tip of the finger which senses the blood cells, and gives the equivalent output voltage, which is fed to the microcontroller. Microcontroller gives the heart rate.

B. Temperature Sensor

There are many temperature sensor for application and the one which we use in our project is the Thermistor (Thermal Resistor). A thermistor is a ceramic semiconductor which exhibits a large change in resistance with a change in its body temperature. The type of thermistor we use in this project has Negative Temperature Coefficient (NTC). These NTC thermistors are composed of oxides such as the oxides of the Manganese, Nickel, Cobalt, Copper, Iron and Titanium.

The availability of high resistance values allows the thermistor to be used with long extension leads, since the lead resistance or contact resistance effects can be greatly diminished. The non-linearity of the thermistor resistance-temperature characteristics gives out a practical limit on the temperature span over which a thermistor can be operated in measurement or control circuit. Apart from this we have a specification chart of the thermistors.

For room temperature (~ 30°C) Resistance = 800 ohms
For 50°C temperature Resistance = 650 ohms
For 100°C temperature Resistance = 500 ohms

We use this thermistor for measuring the body temperature.
V. GSM

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.

It is a cellular network which means that cell phones connect to it by searching for cells in the immediate vicinity. There are five different cell sizes in a GSM network—macro, micro, pico, femto and umbrella cells.

The coverage area of each cell varies according to the implementation environment. Macro cells can be regarded as cells where the base station antenna is installed on a mast or a building above average roof top level. Micro cells are cells whose antenna height is under average roof top level; they are typically used in urban areas. Picocells are small cells whose coverage diameter is a few dozen metres; they are mainly used indoors. Femtocells are cells designed for use in residential or small business environments and connect to the service provider’s network via a broadband internet connection. Umbrella cells are used to cover shadowed regions of smaller cells and fill in gaps in coverage between those cells.

A. Description

GSM, the Global System for Mobile communications, is a digital cellular communication system, which has rapidly gained acceptance and market share worldwide, although it was initially developed in 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, and the signalling functional architecture.

A GSM modem could also be a standard GSM mobile phone with the appropriate cable and software driver to connect to a serial port on your computer. Phones such as the Nokia 7100 with a DLR-3 cable, or various Ericsson phones, are often used for this purpose. A dedicated GSm modem (external or PC card) is usually preferable to a GSM mobile phone. This is because of some compatibility issues that can exist with mobile phones. For example, if you wish to be able to receive inbound MMS messages with your gateway, and you are using a mobile phone as your modem, you must utilize a mobile phone that does not support WAP push or MMS. This is because the mobile phone automatically processes these messages, without forwarding them via the modem interface. Similarly some mobile phones will not allow you correctly receive SMS text messages longer than 160 bytes. This is because these long messages are actually sent as separate SMS messages, and the phone attempts to reassemble the message before via the modem interface.

When you install your GSM modem, or connect your GSM mobile phone to the computer, be sure to install the appropriate windows modem driver from the device manufacturer. To simplify configuration, the now SMS/MMS gateway will communicate with the device via this driver. an additional benefit of utilizing this driver is that you can use windows diagnostis to ensure that the modem is communicating properly with the computer.

B. Differences between GSM and CDMA

In cellular service there are two main competing network technologies: Global System for Mobile communications (GSM) and Code Division Multiple Access (CDMA). Cellular carriers including Sprint PCS, Singular Wireless, Version and T-Mobile use one or the other. Understanding the difference between GSM and CDMA will allow you to choose a carrier that uses the preferable network technology for your needs.

The GSM Association is an international organization founded in 1987, dedicated to providing, developing, and overseeing the worldwide wireless standard of GSM. CDMA, a proprietary standard designed by qualcomm in the United States, has been the dominant network standard.
for North America and parts of Asia. However GSM networks continue to make inroads in the United States, as CDMA networks make progress in other parts of the world. There are camps on the both sides that firmly believe either GSM or CDMA architecture is superior to the other. That said, to the non-invested consumer who simply wants bottom line information to make a choice, the following considerations may be helpful.

C. Coverage

The most important factor is coverage in the areas you will be using your phone. Upon viewing competitors’ coverage maps you may discover that only GSM or CDMA carriers offer cellular service in your area. If so, there is no decision to be made, but most people will find that they do have a choice.

D. Data Transfer Speed

With the advent of cellular phones doing double and triple duty as streaming video devices, broadcast receivers and email devices, speed is important to those who use the phone for more than making calls. CDMA has been traditionally faster than GSM, though both technologies continue to rapidly leapfrog along this path. Both boast “3G” standards, or 3rd generation technologies

E. Subscriber Identity Module (SIM) cards

GSM phones use SIM cards. The removable SIM card allows phones to be instantly activated, interchanged, swapped out and upgraded, all without carrier intervention. The SIM itself is tied to the network, rather than the actual phone. CDMA carriers require proprietary handsets that are linked to one carrier only and are not card-enabled to upgrade a CDMA phone, the carrier must deactivate the old phone then activate the new one. The old phone becomes useless.

F. SMS (Short Messaging Service)

SMS is an acronym standing for Short Messaging Service. It is commonly referred to as text messaging or “texting” as well. SMS is a method by which messages can be sent to a cell phone via another cell phone, a computer connected to the internet, a regular landline, or a handheld device such as a blackberry. The original specifications for SMS were developed in 1985, though real implementation and popularity took nearly a decade to achieve.

SMS messages may be sent either from one point to another point, or may be sent to all devices within a specific geographical region. The former, known as SMS-PP, is used primarily between individuals communicating with one another, while the latter known as SMS-CB, and may be used to broadcast public announcements such as road or weather conditions, region-specific advertising messages, or messages from a cell provider regarding the new coverage area.

Some online services, most notably Google, have integrated SMS capability to allow for the easy retrieval of information through one’s cell phone. By texting a special number, for example, a cell phone user may receive information ranging from local weather, to sports scores.

G. GSM modem

A GSM modem is a wireless modem that works with a GSM wireless network. A wireless modem behaves like a dial-up modem. The main difference between them is that a dial-up modem sends and receives data through a fixed telephone line while a wireless modem sends and receives data through radio waves. A GSM modem can be an external device or a PC Card / PCMCIA Card.

VI. GPS MODEM

A. Introduction

The Global Positioning System (GPS) is a U.S. space-based global navigation satellite system. It provides reliable positioning, navigation, and timing services to worldwide users on a continuous basis in all weather, day and night, anywhere on or near the Earth which has an unobstructed view of four or more GPS satellites.

GPS is made up of three segments: Space, Control and User. The Space Segment is composed of 24 to 32 satellites in Medium Earth Orbit and also includes the boosters required to launch them into orbit. The Control Segment is composed of a Master Control Station, an Alternate Master Control Station, and a host of dedicated and shared Ground Antennas and Monitor Stations. The User Segment is composed of hundreds of thousands of U.S. and allied military users of the secure GPS Precise Positioning Service, and tens of millions of civil, commercial and scientific users of the Standard Positioning Service (see GPS navigation devices). GPS satellites broadcast signals from space that GPS receivers use to provide three-dimensional location (latitude, longitude, and altitude) plus precise time.

B. Concept Of GPS

A GPS receiver calculates its position by precisely timing the signals sent by the GPS satellites high above the Earth. Each satellite continually transmits messages which include

(1) the time the message was transmitted
(2) precise orbital information (the ephemeris)
(3) The general system health and rough orbits of all GPS satellites (the almanac)

The receiver utilizes the messages it receives to determine the transit time of each message and computes the distances to each satellite. These distances along with the satellites’ locations are used with the possible aid of trilateration to compute the position of the receiver. This position is then displayed, perhaps with a moving map display or latitude and longitude; elevation information may be included.
The GPS signal allows repeating this calculation every 6 seconds. Many GPS units show derived information such as direction and speed, calculated from position changes.

Three satellites might seem enough to solve for position, since space has three dimensions and a position on the Earth's surface can be assumed. However, even a very small clock error multiplied by the very large speed of light, the speed at which satellite signals propagate—results in a large positional error. Therefore receivers use four or more satellites to solve for the receiver's location and time. The very accurately computed time is effectively hidden by most GPS applications, which use only the location. A few specialized GPS applications do however use the time; these include time transfer, traffic signal timing, and synchronization of cell phone base stations.

Although four satellites are required for normal operation, fewer apply in special cases. If one variable is already known, a receiver can determine its position using only three satellites.

C. Position Calculation

Using messages received from a minimum of four visible satellites, a GPS receiver is able to determine the times sent and then the satellite positions corresponding to these times sent. The x, y, and z components of position, and the time sent, are designated as \([x_i, y_i, z_i, t_i]\) where the subscript \(i\) is the satellite number and has the value 1, 2, 3, or 4. Knowing the indicated time the message was received, the GPS receiver can compute the transit time of the message as \((t_r - t_i)\). Assuming the message travelled at the speed of light, c, the distance travelled, can be computed as \((t_r - t_i)c\).

A satellite's position and distance from the receiver define a spherical surface, centered on the satellite. The position of the receiver is somewhere on this surface. Thus with four satellites, the indicated position of the GPS receiver is at or near the intersection of the surfaces of four spheres. (In the ideal case of no errors, the GPS receiver would be at a precise intersection of the four surfaces.)

The intersection of a third spherical surface with the first two will be its intersection with that circle; in most cases of practical interest, this means they intersect at two points. Another figure, Surface of Sphere intersecting a Circle (not disk) at Two Points, illustrates the intersection. The two intersections are marked with dots. Again the article trilateration clearly shows this mathematically.

![Fig. 3. Two Sphere Surfaces Intersecting In A Circle](image3)

![Fig. 4. Surface of sphere intersecting a circle (not disk) at two points](image4)

VII. CONCLUSION

At the completion of this project all the operations like the blood pressure calculation, temperature measurement, heart beat measurement, the transmission and the reception which uses a VB script would be performed successfully. By implementing this project, we can very well monitor the status of a person from a remote location. There by we can save valuable life by giving them proper medical aid at the right time. In future we can enhance a reception device used for communication to the soldier, by which the control room can automatically send message that he can board a rescue team at a particular location. This project can also be implemented with advance microcontroller’s in the years to come.

REFERENCES

[4] Linear Integrated Circuits- Roy Chowdary
[8]. Linear Data book by Texas corporation.