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Simulation of Patient Monitoring System using Microcontroller

تصميم نظام مراقبة مريض باستخدام المتحكم الدقيق

A Thesis Submitted in Partial Fulfillment to the Requirements for the Degree of M.Sc. in Electrical Engineering (Microprocessor and Control)

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الآية

(فَتَعَالَى الله الْمَلِكُ الْحَقُّ وَلَا تَعْجَلْ بِالْقُرْآنِ مِنْ قَبْلِ أَنْ يُقْضَى إِلَيْكَ وَحْيُهُ وَقُلْ رَب زِدْنِي عِلْمًا)

صدق الله العظيم

سوره طه الايه (114)

DEDICATIONS

I dedicate this thesis to Allah, my Creator, my Source of inspiration, wisdom, knowledge and understanding. He has been the Source of my strength throughout this research.

I also dedicate this work to my great parents whose love, and prayers make me able to get such success and honors.

To my dear family and friends, without them I would not be able to be successful in my work.

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My deep thanks go to my dearest Parents for their hard work and their spiritual support throughout my life and their sacrifices, blessings and constant prayers for our advancements, my sisters and me.

I extend special thanks to my aunts, my uncles and my lovable sisters for taking care of me, and finally I want to thank all my friend .

ABSTRACT

The problem of health is increasing with the increase in pollution in the world. Continued control of the patient in hospitals is needed for heart attacks before and after operation and the temperature related to diseases and other physical disorders. Control of patient needs a high cost and hands of workers available throughout the time and there is also the possibility of errors humanity, to remove these human errors and relieve stress work for medical staff we suggest a monitoring system using GSM.

The proposed study concerns with system consisting of several devices controlled by microcontroller to monitor the situation of the patient by different sensors (heart beat sensor, blood pressure sensor and temperature sensor), and this was done by reading patient accurate signals, high efficiency and more speed. These signals are send to the doctor by SMS to determine the state of emergency for the patient. The proposed system was controlled with Atmiga 16 and the results obtained proved that each sensor was shows the patient emergency and the proper treatment he received.

مستخلص

مشكله الصحة في تزايد مستمر مع زيادة التلوث في العالم حيث ان استمرار السيطره على المريض في المستشفيات باحتياج نوبات القلب قبل وبعد العمليات ودرجة الحراره المتعلقه بالامراض وغيرها من الاضطربات الفيزيائيه . السيطرة على المريض تحتاج الى تكلفة عالية وايدي عامله متوفرة على طول الوقت و هناك احتمال الاخطاء البشرية , لازالة هذه الاخطاء البشريه وتخفيف ضغط العمل عن الطاقم الطبي نقترح نظام مراقبة المريض باستخدام النظام العالمي للاتصال المحمول.

تتعلق الدراسة المقترحة بنظام يتكون من عدة اجهزة يتحكم فيها المعالج الدقيق للسيطره على حالة المريض بواسطة محساسات مختلفة (محساس ضربات القلب , محساس ضغط الدم , محساس درجة الحرارة) وتم ذلك بقراءة اشارات المريض بطريقة اكثر دقة وكفاءه عالية وسرعة اكثر وارسالها الى الطبيب عن طريق رسالة نصيه تحدد حالة الطوارئ للمريض . تم السيطره على النظام المقترح باستخدام اتميغا 16 والنتائج التي تم الحصول عليها والتي اظهرت ان كل مستشعر يظهر حالة المريض الطارئة والعلاج المناسب الذي تلقاه .

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LIST OF ABBREVIATIONS

PMS	Patient Monitoring System	5
ECG	Electrocardiograph	5
SPO2	Oxygen Saturation	5
BPM	Heart Beat Minutes	6
MMHG	A Millimeter Of Mercury	7
ETSI	European Telecommunication Standard Institute	11
AMPS	Advance Mobile Phone Service	12
TACS	Total Access Communication System	12
SMS	Short Message Service	12
GPRS	General Packet Radio Service	12
LAN	Local Area Network	12
WBSN	Web-Based Social Net Work	13
WMHRN	Wireless Multi –Hop Relay Node	13
GUI	Graphical User Interface	13
WPANs	Wireless Personal Area Network	14
WSN	Wireless Sensor Network	14
ICU	Intensive Care Unit	17
CCU	Cardic Care Unit	17
LED	High Emitting Diode	21
AC	Alternating Current	25
DC	Direct Current	25
MAP	Mean Arterial Pressure	29
CMOS	Complementary Metal-Oxide Semiconductor	30
TTL	Transistor –Transistor Logic	30
PMOS	Positive Channel Metal-Oxide Semiconductor	30
NMOS	Negative Channel Metal-Oxide Semiconductor	30
LCD	Liquid Crystal Display	32
GSM	Global System Mobile Communication	38
TDMA	Time Division Multiple Access	38
CDMA	Code Division Multiple Access	38
DTE	Data Terminal Equipment	38
DCE	Data Communication Equipment	38
EIA	Electronic Industry Association	38
ADC	Analog Digital Conversion	40
CPU	Central Processing Unit	41
RAM	Random Access Memory	41
ROM	Read Access Memory	41
AVR	Alfand Vegard's RISC Processor	46

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Chapter one

Introduction

CHAPTER ONE

Introduction

1.1 Overview

Human health is one of the most important concerns in the world today and everything becomes meaningless when a person becomes sick or dies due to improper medical care. For health reasons, people, governments and many voluntary organizations spend a lot of money to ensure better health care for themselves and for all residents, where health care is maintained or improved by health diagnosis, treatment, prevention of disease, injury and other physical disabilities of persons, These services are usually provided by the medical staff and patient monitoring systems. Here is the importance of patient monitoring systems which are one of the major improvements in the global health care program because of the advanced technology [1].

The modern visionary of healthcare industry is to provide better healthcare to people anytime and anywhere in the world in a more economic and patient friendly manner. Therefore for increasing the patient care efficiency, there arises a need to improve the patient monitoring devices and make them more mobile, As the bio instrumentation, computers and telecommunications technologies are advancing, it has become feasible to design more portal vital sign tele monitoring systems to acquire, record, display and to transmit the physiological signal from the human body to any location. Recent works in communication technologies have inspired the development of telemedicine to a large extent. Telemedicine benefits not only the customers who are able to receive health care more efficiently; it also benefits the doctors who can streamline their efforts to assist more patients [2].

In the present area of technology everything is becoming technology driven, The health care is vast area requiring continuous Monitoring. In our attempt to develop a device which takes the Physiological changes of the patient as input and message of whether it is high or lower than the normal value, In this search the main aim to make a small contribution in this field , Therefore, scientists and engineers are always working on a way to maintain a healthy state of sound for all through the invention of many techniques, both electrical / mechanical tools used in providing health care today [3], for example the heart is a very sensitive device in the human body just stop beating Another important issue is that if the procedures are taken early the heart condition can be managed effectively by doctors.

These days it is not easy for doctors and the nurses to remain close to a patients bed side to monitor their heath condition, In medicine, monitoring is the observation of a disease, condition or one or several medical parameters over time and This search deals with the monitoring of the patient parameters such as temperature , heartbeat , blood pressure and how to give the patient treatment directly by order of the microcontroller [3] . Here we have designed a microcontroller based prototype model where we are monitoring the above mentioned parameters through the microcontroller. For measurement of these parameters we need sensors which respond to the changes in the parameters appropriately. As the signals measured are of very low value therefore their amplification is very necessary as these sensors measure the necessary information for the patient and send them to the doctor or nurses via the GSM device , The major aim and objective of this design is to help the doctors and family members to keep track of the heartbeat and any situation for patient condition of their loved ones .

1.2 Problem Statement

- It is hard job for doctor and medical personnel to monitor each patient for 24 hours.
- Remove human error and ease the burden of controlling patient health from the head doctor.
- Today many hospital uses traditional bade side patient monitoring system, these currently available patient monitoring system suffer from certain technical limitation, this system is very expensive also to handle this system more number of staff is required.
- demand on patient monitor is high but a variety of problems appeared in terms of lack of space in hospitals and also need high cost maintenance for wiring and installation.

1.3 Objectives

The aims of this study is to develop monitoring of patient health care system works from a distance by using high efficiency and accuracy sensors. One of the most important aims is time factor, where the patient is treated in a record time to avoid health problems at an earlier time.

1.4 Methodology

Objective are achieved by using Atmega 16 microcontroller as main controller of the system with the help three sensors (heart beat sensor, temperature sensor and blood pressure sensor) and the study the other main components. System software simulation is done by using proteus software.

1.5 Thesis Layout

This thesis is presented in five chapters. Chapter one gives an introduction to the thesis, including overview, problem statement, objectives and methodology. Chapter two gives theoretical introduction about health , background and literature review related to previous studies of the subject. chapter three describes the implementation of the main circuit and the components used in this work. Chapter four discuses the simulation of the system design and results. Finally chapter five provides conclusion and recommendations.

Chapter two

Background & literature review

Chapter Two

Background and literature Review

2.1 Introduction

The Patient Monitoring System (PMS) s very critical monitoring system , it is used for monitoring physiological signals , including electrocardiograph (ECG) , respiration invasive and non- invasive blood pressure, oxygen saturation in human blood pressure (SPO2) body temperature and other cases [4].

The health problem is rising along with increasing population in the today's world. In hospitals, continuous monitoring is needed for heart attack, after major/minor operation, temperature related illness, physical disorders and either the nurse or the doctor has to move physically from one person to another for health check, which may not be possible to monitor their conditions continuously But the monitoring of patients is difficult and also leads to high cost, [5]. Thus any critical situations cannot be found easily unless the nurse or doctor checks the person's health at that moment. This may be a strain for the doctors who have to take care of a lot number of people in the hospital. This system is proposed to control the patient's remote system by facilitating the work of the doctor's so that the signals reach him via GSM and the patient's treatment is given by the system in less time , here we find the time factor is very important in health care , where the control system allows speed , accuracy and high efficiency [6] .

The health care sensors are playing a vital role in hospitals, patient monitoring system is one of the major improvements because of its advance technology [7], Here some basic of the physiological parameters are reviewed which that are controlled by the microcontrollers:

2.2 Heart Beat

A person's heartbeat is the sound of the valves in his/hers heart contracting or expanding as they force blood from one region to another, Figure (2.1). 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. However, this search will clarify a more accurate and effective way to calculate the heart beat patient by use heart beat sensor and this will be explained later [8] .

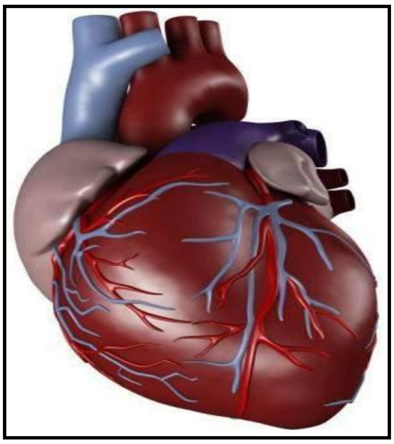


Figure 2.1: Heart

2.3 Blood Pressure

Blood pressure refers to the force exerted by circulating blood on the walls of blood vessels as Figure (2.2), 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 [9].

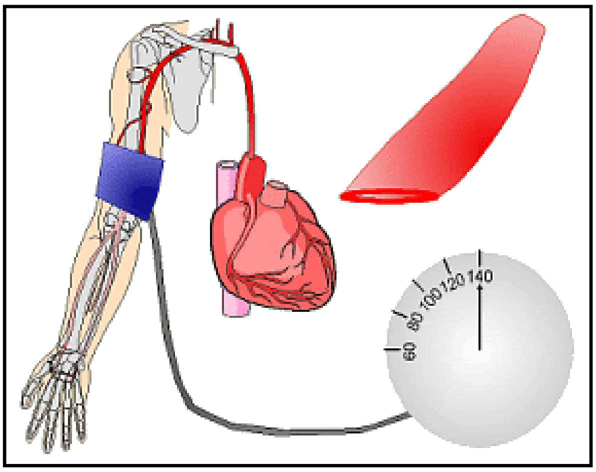


Figure 2.2: the measured of blood pressure

2.4 Temperature

thermometer is a device that measures temperature or a temperature gradient as Figure(2.3). A thermometer has two important elements: a temperature sensor (e.g. the bulb of a mercury-in-glass thermometer) in which some physical change occurs with temperature, and some means of converting this physical change into a numerical value (e.g. the visible scale that is marked on a mercury-in-glass thermometer). Thermometers are widely used in industry to control and regulate processes, in the study of weather, in medicine, and in scientific research. There are various principles by which different thermometers operate, they in clued the thermal expansion of solids or liquids with temperature, and the change in pressure of a gas on heating or cooling. Mercury is the only one in liquid state at room temperature, and has high coefficient of expansion. Hence, the slightest change in temperature is notable when it's used in a thermometer. This is the reason behind mercury and alcohol being used in. However, thermometer No matter what thermometer you choose, no matter how new, it may still not be perfectly accurate. There is always some variation among thermometers, some small, some large. The important thing is for patients to be able to see the changes in their temperatures with proper T3 therapy. Therefore it would be more accurate to control the temperature of the patient using a temperature sensor and this will be explained later [10].

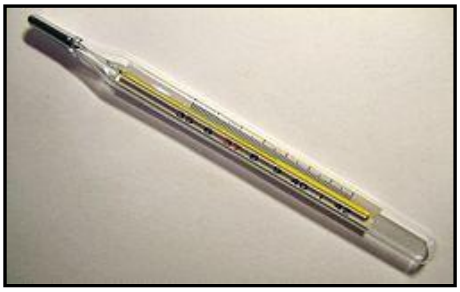


Figure 2.3 : the thermometer

2.5 Related Works

This search alert to Doctors/Nurse as well as patients relatives for take care of patient in the hospital also give the information about patient health and continuously alerting for the time to time providing the medicine to patient, This search describes the design of a simple, microcontroller based wireless sensors measuring device with display the information on LCD display [11].

Recently wireless sensors and sensor networks plays a vital role in the research, technological community. But there are different from traditional wireless networks as well as computer networks, today the progress in science and technology offers miniature, speed, intelligence, sophistication, and new materials at lower cost, resulting in the development of various high-performance smart sensing system. Many new research is focused at improving quality of human life in terms of health by designing and fabricating sensors which are either in direct contact with the human body (invasive) or indirectly (noninvasive) [12].

Wireless system is used to transmit the measured data to a remote location. The transmitter transmits the calculated beat rate and is received in another terminal called receiver module. Inconvenience of using wire is avoided in this paper. Finally, the data are displayed in the mobile screen at the receiving end where the specialist or physician can analyses the data and will be able to provide aid. The developed system is reliable, economical and user friendly. Though, there are certain limitations and advantages of the system whether it is implemented with RF module or GSM
module [13].

The RF module worked only for limited range. The specification stated that it would work for about 100m in an open space but in this paper found out that it worked only for about 14m with oceqcasional inaccuracies and sometimes the signal was hard to catch. GSM module surpasses this drawback as it could send data to any location where network was available. The RF module had another serious disadvantage of initial cost. The initial cost of setting up the device with RF module is very high compared to GSM module which has low initial cost as it requires only a GSM module and a mobile device. However, the running cost of RF module was found out to be very low compared to GSM module. The GSM module requires a SMS to be sent to a mobile device which may require paying for SMS to the mobile operator unless the government takes an initiative to make the service free of charge which would increase the reliability of the device. The RF module requires a license after certain range from the government depending upon the geographical location while GSM module does not require license. The license needs to be purchased which adds the cost to the system implemented with RF module. The RF module does not require a SIM card whereas GSM module requires a SIM card. The RF module does not depend on the network of mobile operator while GSM module depends on it. The RF module uses wireless serial data link while GSM module uses mobile phone protocol [13].

This wireless patient monitoring system in this search measures heartbeat, body temperature, blood pressure then transmitter this value to doctors or nurses by GSM, Zigbee and Bluetooth. Compared to Bluetooth, ZigBee and GSM provides higher network flexibility and a larger number of nodes, and a better transmission range with low power consumption. Large number of nodes enables the expansion of such systems, this technique presents a system to upgrade existing health monitoring systems in the hospitals by providing monitoring capability and a thus a better cure. This system is based upon wireless technology providing low cost effective solution. The proposed technique has the advantages: Easy and Reliable fo2.5cmr Doctors , Increase efficiency and More Accurate , This intelligent monitoring system provides long term monitoring capability useful for the staff in the hospitals and reduces their workload [14] .

A Zigbee node is connected to every patient monitor system which will send the patient's vital information .Upon system boot up, the mobile patient monitor system will continuously monitor the patients vital parameters like Heart Beat, body temperature etc and will periodically send those parameters to a centralized server using Zigbee node configured as co-coordinator [12].

There is Healthcare Monitoring system using WSN with Zigbee. But main drawback of this system is that we can monitor the patients for 100 meter distance only. There is Healthcare Monitoring system using WSN with GSM we can monitor the patients anywhere across the world [14]. During the early 1980s, analog cellular telephone system was experiencing rapid growth in Europe, particularly in Scandinavia and United Kingdom, but also in France and Germany. Each country developed its own system, which was incompatible with everyone else’s in equipment and operation. This was an undesirable situation, because not only was the mobile equipment limited to operation within national boundaries, which in a unified Europe were increasingly unimportant, but there was also a very limited market for each type of equipment, so economies of scale and the subsequent savings could not be realized. The Europeans realized this early on, and in 1982 the conference of European posts and telegraphs formed a study group called the group special mobile (GSM) to study and develop a pan-European public land mobile system. In 1989, GSM responsibility was transferred to the European Telecommunication Standards Institute (ETSI), and phase I of the GSM specifications were published in 1990. Commercial service was started in mid-1991, and by 1993 there were 36 GSM networks in 22countries, with 25 additional countries having already selected or considering GSM. Although standardized in Europe, GSM is not only a

European standard. GSM networks are operational or planned in almost 60 countries in Europe, the Middle East, the Far East, Africa, South America, and Australia. In the beginning of 1994, there were 1.3 million subscribers worldwide. By the beginning of 1995, there were over 5 million subscribers. The acronym GSM now aptly stands for Global System for Mobile communications. The developers of GSM chose an unproven (at the time) digital system, as opposed to the then-standard analog cellular systems like AMPS in the United States and TACS in the United Kingdom [15].

Body sensor network systems can help people by providing healthcare services such as medical monitoring, memory enhancement, medical data access, and communication with the healthcare provider in emergency situations through the SMS or GPRS . these systems provide useful methods to remotely acquire and monitor the physiological signals without the need of interruption of the patient's normal life, thus improving life quality, Although present systems allow continuous monitoring of patient vital signs, these systems require the sensors to be placed bedside monitors or PCs, and limit the patient to his bed. But now, there is no relation between the sensors and the bedside equipment due to the wireless devices and wireless networks. These systems do not require the patient to be limited to his bed and allow him to move around but requires being within a specific distance from the bedside monitor. Out of this range, it is not possible to collect data. In most cases, health monitoring will be done by infrastructure-oriented wireless networks such as commercial cellular/3G networks or wireless LANs. But, the coverage of the infrastructure-oriented networks changes with time or location. Sometimes, the coverage of wireless network is not available, or the coverage is available but we cannot access to the network due to a lack of available bandwidth. So, with these problems and restrictions, continuous health monitoring is not possible and emergency signals may not be transmitted from a patient to healthcare providers [15].

The concept of Ubiquitous healthcare system is to place unobtrusive wireless sensors on a person's body to form a wireless network which can communicate the patient's health status with base station connected to the monitoring PC. The system consists of four parts: (i) the WBSN includes four sensors which are responsible for collecting the physiological signals from patient, (ii) the WMHRN(Wireless Multi-Hop Relay Node), consist of a number of wireless relay nodes which is in charge of forwarding the health data to the base station, (iii) a BS (Base Station) which receives the relayed data and sends it to the PC through a cable and (iv) and the graphical user interface (GUI) which is responsible for storing, analyzing and presenting the received data in graphical and text format, and sending an SMS to the healthcare provider or patient's family in emergency conditions through the GPRS or GSM modem , Wireless BSN technology is emerging as a significant element of next generation healthcare services [15].

A ZigBee node is connected to every patient monitor system that consumes very low power and is extremely small in size. These are specifically designed for low power consumption, with minimal circuit components intended for small packet, long distance range applications and typically consist of a low power processor with minimal resources and interface capabilities. They also have a conservative transceiver that is capable of transmitting 8 bytes of data at a time and has a moderate transmitting range of about 130 m. Therefore, WPANs seem to be a perfect fit for remote patient monitoring, the system has been designed to take several inputs to measure physiological parameters of human such as temperature, heart rate, detection of any fall and the saline level [16] .

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. 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 [17].

The implications of aging populations on health care management are increasingly attracting the attention of all governments , The GUI is created using Visual Basics through which Temperature, heart rate and blood glucose is display on personal computer in observation center [2].

The 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 caregivers [17].

As a means of making monitoring systems cost effective and flexible, the work “A Low Cost Optical Sensor Based Heart Rate Monitoring System” , This proposes the design and implementation of a single Microcontroller based heart rate measuring device that integrates most of the key features of the aforementioned devices and models. The device is compact in size, energy efficient, portable, capable of data storage and well suited for communicating with an external remote device via Bluetooth and cellular communication in case of a medical emergency or routine [8].

Driven by the confluence between the need to collect data about people’s physical, physiological, psychological, cognitive, and behavioral processes in spaces ranging from personal to urban and the recent availability of the technologies that enable this data collection, wireless sensor networks for healthcare have emerged in the recent years [18].

The proposed patient monitoring system would be beneficial for medical practitioners to do proper and better treatment; also it would be useful for health care providers to improve disease management. The patient is monitored from ICU and the data transferred to the PC is wired [6].

In hospitals where a large number of patients whose physical conditions have to be monitored frequently as a part of diagnostic procedure, the need for a cost effective and fast responding alert mechanism is inevitable. Proper implementation of such systems can provide timely warnings to the medical staffs and doctors and their service can be activated in case of medical emergencies. Present-day systems use sensors that are hardwired to a PC next to the bed. The use of sensors detects the conditions of the patient and the data is collected and transferred using a microcontroller. Doctors and nurses need to visit the patient frequently to examine his/her current condition. In addition to this, use of multiple microcontroller based intelligent system provide high level applicability in hospitals where a large number of patients have to be frequently monitored [1].

Chapter three

Methodology

CHAPTER THREE

Methodology

3.1 system Description

The system is builds upon the integration of wireless communications into medical applications to revolutionize personal healthcare. The objective of this search is to build a wireless patient 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 this system are huge and only available in the hospitals in ICU development of a microcontroller based system for wireless communication monitoring using GSM. This wireless communication would not only provide them with safe and accurate monitoring but also the freedom of movement, The proposed system is to monitoring the patients continuously from remote areas using wearable sensors [19].

The advantages of a patient monitoring system are it can reduce the risk of infection and other complication in order to make the patients comfortable. Furthermore, implement of patient monitoring in hospitals might reduce the costs in terms of installation and also maintenance of wiring . Since many critical patients need a high attention in Intensive Care Unit (ICU) and Cardiac Care Unit (CCU), thus the bedside in the hospitals over the limit as provided to the patients. Otherwise, this creation will help more elderly patients who need constant monitoring, both in the hospital or home environment [19] .

3.2 System Block Diagram

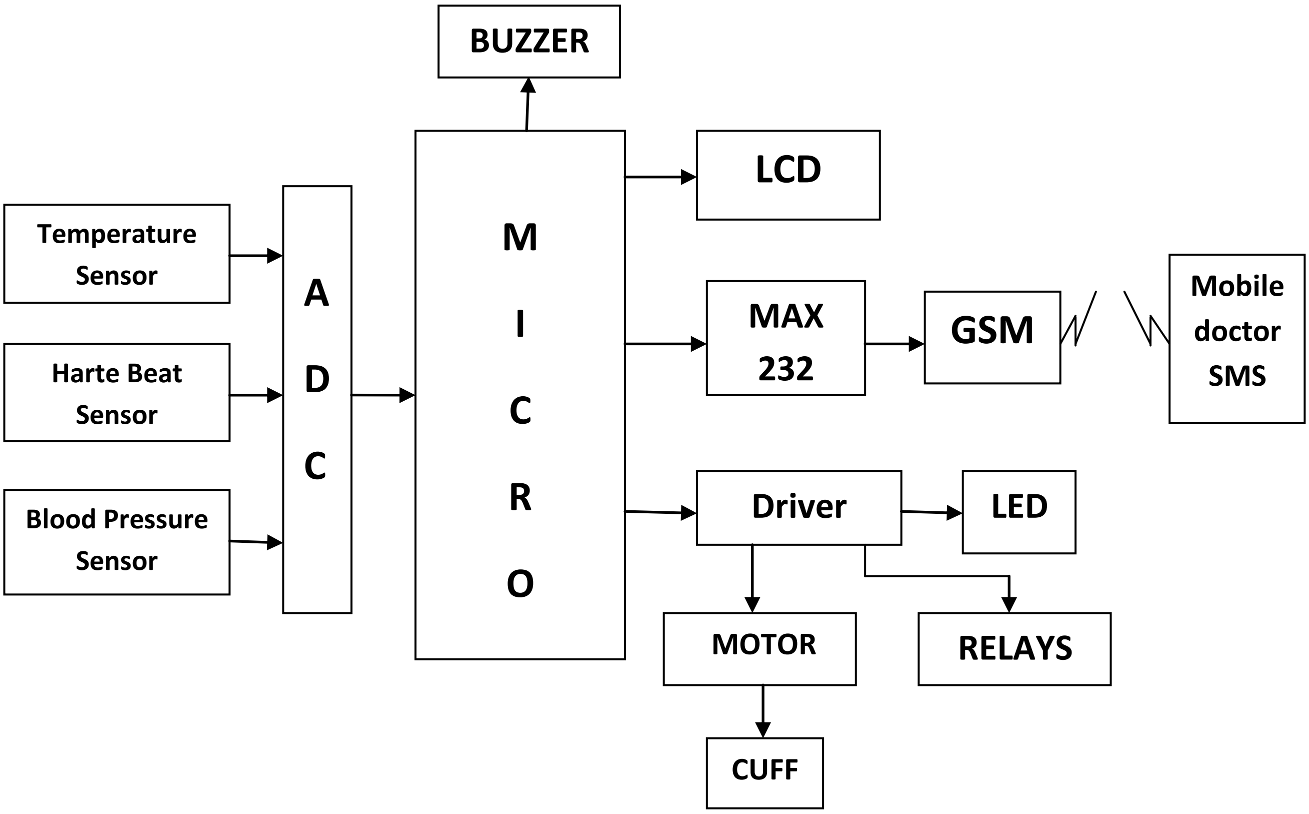


Figure 3.1: system block diagram

As shown in figure (3.1) , this system consists of three sensors the temperature, blood pressure and heart beat. The temperature sensor is used to measure the temperature of the body where the value of the Sensor is compared with threshold value as shown in the Table (3.1) , this threshold value is defined by the programmer at the time of programming the microcontroller, If it exceeds the provided threshold value immediately send this information to the doctor's mobile phone or relatives via SMS using GSM modem , in this case the microcontrollers give a direct treatment through the vein of the patient who is In the form of a solution containing a drug Barastmol If the system gave a rise in the temperature of the patient more than 40°C inject the patient from the solution connected to the patient through cannula, Which consists of several sizes and the appropriate size is used according to the weight and age of the patient Figure (3.2), by 50 ml until the temperature of the patient's body is reduced to the normal situation .

The Pressure sensor is used to find the pressure level of the patient. Here, if the device gave a higher blood pressure more than the value of the 180\110 mmhg, the microcontrollers give a treatment in the form of distilled solution also contains 5 mg of Amlodipine every 24 hours and if the pressure increases the dosage The injection of a given mg is controlled until the blood pressure is adjusted and thus the injection of the solution is stopped . If the blood pressure drops less than 90/60, the microcontroller is administered by a normal saline and gives the patient 100 ml every 4 hours and is at a constant rate until the blood pressure rises to normal.

Heart beat sensor is one type of sensor which monitors the heart beat pulses for every minute, If the heartbeat of the patient is higher than the value of 120 pulse per minutes, the microcontroller is given a treatment that is in the form of a solution also containing 10 mg propranolol, which is brought in a specific way by the doctors until the vein is injected through the canuula until the patient's heartbeat is normalized But if the heart rate drops below the threshold value of less than 60 here the microcontrollers give the order to inject the patient from a solution containing adrenaline by 10 mg. The microcontroller should send a message to the doctor explaining the problem of the patient and how the solution was to give him the appropriate treatment.

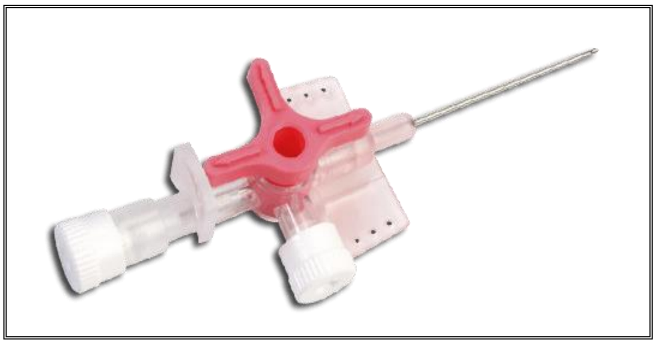


Figure 3.2: Cannula

Table 3.1: The threshold value

Heart beat	60 – 120 pulse per minutes
Blood pressure	90\60 – 180\110 mmhg
Temperature	18°C - 40°C

The patient monitoring system is one of the major improvements because of its advance technology, Here we will review some of the physiological parameter that are controlled by the microcontrollers.

3.3 System Hardware

Here are the components of this work.

3.3.1 Heartbeat sensor

A Heartbeat sensor is a monitoring device that allows one to measure his or her heart rate in real time or record the heart rate for later study. It provides a simple way to study the heart function. This sensor monitors the flow of blood through the finger and is designed to give digital output of the heartbeat when a finger is placed on it, as shown in Figure (3.3). This digital output can be connected to the microcontroller directly to measure the Beats per Minute (BPM) rate. It works on the principle of light modulation by blood flow through finger at each pulse.

Figure 3.3: Heart beat sensor

The sensor consists of a super bright red LED and light detector shown in Figure (3.4). The LED needs to be super bright as the light must pass through finger and detected at other end. 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 outputs +5V logic level signal. The output signal is also indicated on top by a LED which blinks on each heartbeat [13].

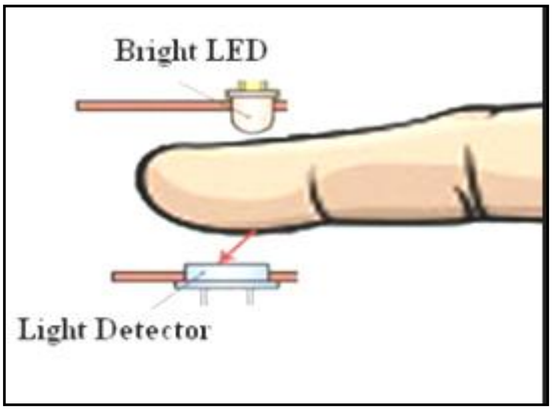


Figure 3.4 : components of the sensor

3.3.2 Temperature sensor

The temperature monitoring unit consists of the components that are required to measure the temperature of the body. This unit comprises of a temperature sensor which measures the temperature of the body and is connected directly to a microcontroller. The temperature sensor that is used in this circuit is LM35 for the measurement of the body temperature. This temperature sensor is an analog sensor which produces an analog voltage by sensing the temperature. This sensor is held by the finger for a while (about 15 sec) in order to measure the body temperature. The body temperature on the body surface is about 1 degree centigrade less than the temperature of other parts. The analog voltage produced by the LM35 temperature sensor is directly proportional to the body temperature. The analog voltage needs to be converted to a digital value. For the conversion, the microcontroller is used which has a built-in analog to digital converter due to which an extra component for converting analog voltage to digital voltage is removed and the circuit configuration becomes less bulky. The digital equivalence of analog voltage produced by LM35 sensor can now be used by the microcontroller for further processing. The microcontroller receives the data in analog form and converts it into digital form then sends it to the GSM module so that the data can be sent to the remote end. At the receiving end, a mobile device which utilizes the GSM system receives the message. The message received at the mobile device is displayed at the screen along with the data of heartbeat. The data shown in the screen also shows the date and time of the measurement [13].

The LM35 is a precision integrated circuit temperature sensor that is used here to measure temperature, as shown in Figure (3.5). The electrical output voltage of LM35 is linearly proportional to the Celsius or centigrade temperature. The LM35 has an advantage over linear temperature sensors calibrated in degree Kelvin, as it is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. Besides, the LM35 does not require any external calibration or trimming to provide typical accuracies of +/- 1/4 degree C at room temperature and +/- 8/4 degree C. The trimming and calibration are done at wafer level. So, it is an inexpensive device. 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 0.10 in still air. Thermistor can also be used for temperature measuring. Another reason for using LM35 is that it accurately measures the temperature in comparison to thermostat and it is not subjected to oxidation as the sensor circuitry is sealed. Besides, the output voltage of LM35 does not need to be amplified. The low output impedance, linear output and precise inherent calibration of the LM35 make its interfacing to control circuitry very easy. Moreover, the LM35 is rated to operate over a -55 °C to +150 °C temperature range. The output voltage varies by 10 mV in response to every °C rise/fall in ambient temperature, i.e. its scale factor is 0.01 V/ °C. For measuring temperature of a patient, the left pin and right pin of LM35 is connected to the power (5V) supply and ground respectively. The middle pin generates analog voltage that is directly proportional to the temperature. Here, analog voltage is independent of power supply. Thus, the middle pin is connected to the microcontroller for further processing. The microcontroller has ADC in it and it keeps the digital data in the memory [13].

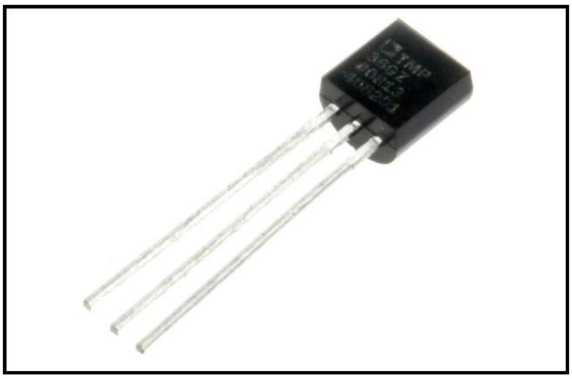


Figure 3.5: Temperature sensor

3.3.3 Blood Pressure Sensor

The Pressure sensor is used to measure the systolic and the diastolic pressure level using the device. Systolic is the higher of the two number measures the pressure in the arteries when the heart beats. Diastolic is the lower of the two number measures in the arteries between heart beats. It is measured in millimeter mercury (mmHg). Blood pressure changes from minute to minute .Heart beats occur faster than the time that it takes to deflate an occlusion cuff. So it may seem odd that the diastolic (blood pressure in between beats) would not be noted until the sounds are too faint to hear. This is done because after the blood is reintroduced to the artery the artery takes some time to return to its normal size. It is only at this normal artery size that the diastolic pressure is noted [20] , here the used sensor is MPX4115 in this search as shown in Figure (3.6) , pressure sensors provide a very accurate and linear voltage output, directly proportional to the applied pressure. These standard, low cost, uncompensated sensors permit manufacturers to design and add their own external temperature compensation and signal conditioning networks. Compensation techniques are simplified because of the predictability of Freescale's single element strain gauge design [21].

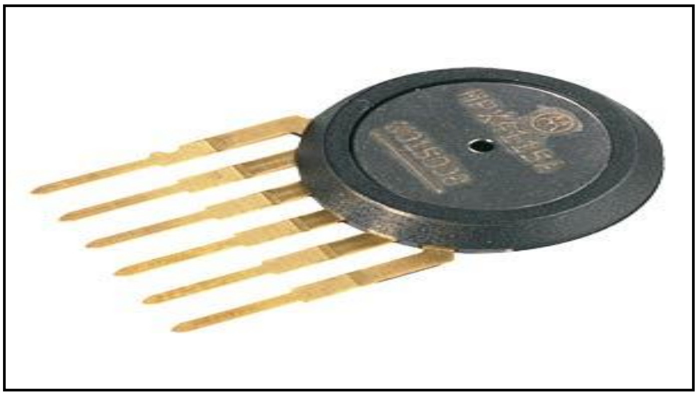


Figure 3.6: MPX4115 sensor

3.3.4 Motor

Micro air pump as shown in Figure (3.7) powered by an electric motor is a non-complex device, but the application of it has revolutionized the world of industry. Most electric motors or electric machines operate through the interaction of magnetic fields and current-carrying conductors to generate force. There are several types of electric motors powered by an AC (alternating current) or DC (direct current) electric motor , The purpose of the micro air pump or micro motor is to provide enough pressure to the cuff, so the patient can successfully test his/her own blood pressure or a nurse can test the blood pressure of the patient. Micro air pump has an extraordinary size and can generate the perfect amount of power to execute a blood pressure test without any concerns Also, about 95% of the power being 99 generated by the four AAA batteries is supporting the micro air pump once it is turned on when both switches TS12A4514 and TPS1101PWR are closed.. There are several types of micro air pumps in the market, consequently makes the decision more challenging, the motor #P54A02R was the chosen to be used in this search. This motor has the following specifications: cylinders is 3, rated voltage is 6V DC, flow (No

Load) is 1.8L/min, current (No Load) is 170mA, max current is 290mA, max pressure is 95KPa, noise is 50dB, life is 71 hours, and life test condition is rated voltage - 500ml volume pressurizing from 0 to 40KPa - 1 cycle .It does successfully pump air into the cuff in a short period of time without any concerns [20].

Figure 3.7 : Air pump motor (P54A02R)

3.3.5 Valve

A valve is a device that regulates, directs or controls the flow of a fluid (gases, liquids, fluidized solids, or slurries) by opening, closing, or partially obstructing various passageways as shown in figure (3.8). Valves are technically pipe fittings, but are usually discussed as a separate category. The micro air valve has a major importance in this project as part of the micro air pump because it controls the amount of air being pumped into the cuff. If there was not a valve to control the amount of air being pumped into the cuff, the patient could potentially hurt him/her self, and consequently it would cause bruises and intense pain. The micro valve is working together with the micro sensor and the micro air pump. Once the sensor does not feel any vibration on the cuff which means that the blood flow has stopped, it does alert the micro controller to send a low signal to the switches TS12A4514 and TPS1101PWR which are controlling the micro air pump to turn off, and sends a high signal to the switch TS12A4514 which is controlling valve to turn on (to open). For this project, the micro valve known as KSV05B was used because it fits perfectly to the goals . KSV05B, the micro valve is a high frequency solenoid and has the following specifications: rated voltage is DC6V/DC12V, rated current is 60mA/45mA, and exhaust time is max. 6.0 seconds from 300mmHg reduce to 15mmHg at 500CC tank, resistance is 100Ω±10%/270Ω±10%, and leakage is max. 3mmHg/min from 300mmHg at 500CC tank [20]

Figure 3.8: KSV05B Valve

3.3.6 Cuff

The cuff is an integral part of the blood pressure tester project and is one of the most important components as shown in figure (3.9). The cuff is normally placed smoothly and snugly around an upper arm, at roughly the same vertical height as the heart while the subject is seated with the arm supported. It is essential that the correct size of cuff is selected for the patient. When too small a cuff results in too high a pressure, while too large a cuff results in too low a pressure, so it comes in four sizes, for children up to obese adults. Also, it is made of a non-elastic material, and the cuff used is about 20% bigger than the arm. The cuff is inflated until the artery is completely occluded [20] .

Figure 3.9: Cuff

3.3.7 Calculating Blood Pressure (Oscillometric Method)

It is based on the principle that blood pumped through the arteries by the heart causes the arterial walls to flex. When a cuff (placed around the upper .arm to occlude the brachial artery) is inflagted and then slowly deflated at a constant rate, an arterial pressure pulse forms. These pressure pulses pass from the arteries, through the arm, and into the pressure cuff it self [22]..,
When the artery is fully compressed, blood flow stops along with the, pulsat,ions. As the pressure in the cuff is slowly decreased, the arterial blood pr essure increases to the point that blood is forced through the artery in short pulses. As the pressure in the cuff continues to decrease, more blood flows through the occluded artery and the pulses become increasingly significant until maximum amplitude is reached. Further decrease of the cuff pressure minimizes the occlusion of the artery and the pul,ses\ continue to decrease until the occlusion is removed.

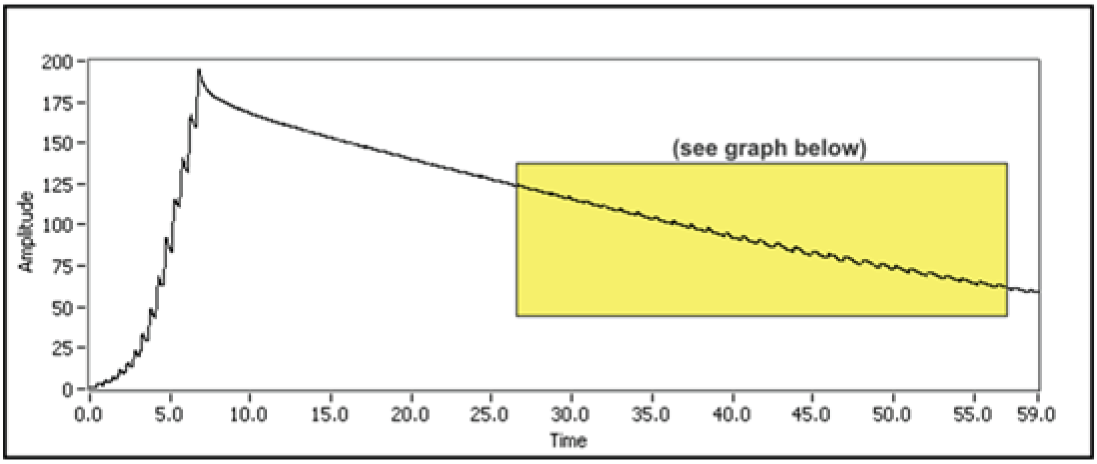


Figure 3.10: Cuff pressure waveform

These pressure pulses, when separated from the decaying mean pressure of the cuff, form an oscillating waveform. The peak-to-peak amplitudes of this waveform create a bell shaped "envelope" as shown in figure (3.10). Within the envelope, the amplitudes of the waveform increase through the systolic blood pressure and continue increasing until the mean arterial pressure (MAP) is reached. Physiologically, the cuff pressure corresponding to the maximum amplitude approximates the mean arterial pressure. Generally, the systolic blood pressure is calculated by determining the point along the envelope prior to the MAP using a known percentage of the maximum amplitude. Diastolic blood pressure is calculated using the same method and the portion of the envelope following the MAP [22].

3.3.8 Darlington transistor array (ULN2803)

ULN2803 is a high voltage, high current transistor array IC used especially with microcontroller where we need to drive high power loads. The IC consists of a eight NPN Darlington connected transistors with common clamp diodes for switching the loads connected to the output. This IC is widely used to drive high loads such lamps, relays, motors etc. it is usually rated at 50v/500mA. This article brings out the working of ULN2803 IC and how to use it in a circuit. Most of the chip operates with low level singles such as TTL, CMOS , PMOS, NMOS which operates at the range of (0-5)v and are incapable to drive high power inductive loads . However this chip takes low level input signals (TTL) and use that to switch / turn off the higher voltage loads that is connected to the output side [23].

In electronics the Darlington transistor is a semiconductor device which combines two bipolar transistors in tandem (often called a "Darlington pair") in a single device so that the current amplified by the first is amplified further by the second transistor shown in Figure (3.11). This gives it high current gain (written β or hFE), and takes up less space than using two discrete transistors in the same configuration. The use of two separate transistors in an actual circuit is still very common, even though integrated packaged devices are available. This configuration was invented by Bell Laboratories engineer Sidney Darlington. The idea of putting two or three transistors on a single chip was patented by him, but not the idea of putting an arbitrary number of transistors, which would have covered all modern integrated circuits. As shown in Figure (2.15) A similar transistor configuration using two transistors of opposite type (NPN and PNP) is the Sziklai pair, sometimes called the "complementary Darlington".

A Darlington pair behaves like a single transistor with a very high current gain. This is beneficial as many commonly-used transistors with high gains have a low current threshold. The total gain of the Darlington is the product of the gains of the individual transistors:

$$\beta \text{Darlington} = \beta 1 + \beta 2 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.1)$$

A typical modern device has a current gain of 1000 or more, so that only a tiny base current is required to make the pair switch on. Integrated devices have three leads (B, C and E) which are equivalent to the leads of a standard individual transistor. The base-emitter voltage is also higher; it is the sum of both base-emitter voltages:

$$VBE = VBE1 + VBE2 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.2)$$

To turn on there must be ~0.6 V across both base-emitter junctions which are connected in series inside the Darlington pair. It therefore requires more than 1.2V to turn on. When a Darlington pair is fully conducting, there is a residual saturation voltage of 0.6V in this configuration, which can lead to substantial power dissipation. Another drawback is that the switching speed can be slow, due to the inability of the first transistor to actively inhibit the current into the base of the second device. This can make the pair slow to switch off. To alleviate this, a resistor of a few hundred ohms between the second device's base and emitter is often used. Integrated Darlington pairs often include this resistor. It has more phase shift at high frequencies than a single transistor and hence can become unstable with negative feedback much more easily [23].

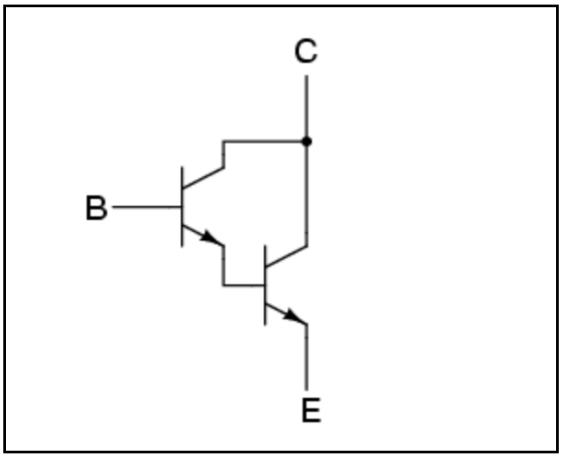


Figure 3.11: Darlington transistor

3.3.9 Liquid crystal display

Liquid crystal display (LCD) is an electro-optical amplitude modulator realized as a thin, flat display device made up of any number of color or monochrome pixels arrayed in front of a light source or reflector. It is often utilized in battery-powered electronic devices because it uses very small amounts of electric power. A comprehensive classification of the various types and electro-optical modes of LCDs is provided in the article LCD classification, Shown Figure (3.12) [14].

Figure 3.12: Liquid crystal display (LCD)

3.3.10 A buzzer

A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric and finds extensive use in electronics circuits and designs especially to trigger an alarm or as a system alert device. The buzzer is simply powered with a regulated 5v, Figure (3.13) [8].

Figure 3.13: buzzer

3.3.11 Timer

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 [24].

3.3.12 Relay

A relay is an electrical switch that opens and closes under the control of another electrical circuit. In the original form, the switch is operated by an electromagnet to open or close one or many sets of contacts. Because a relay is able to control an output circuit of higher power than the input circuit, it can be considered, in a broad sense, to be a form of an electrical amplifier. in figure (3.4) shows the relay[23].

Figure 3.14: the relay

3.3.13 Resistors

A resistor is a two-terminal electronic component designed to oppose an electric current by producing a voltage drop between its terminals in proportion to the current. That is in accordance with Ohm's law V = IR. The resistance R is equals to the voltage drop V across the resistor divided by the current I through the resistor. Figure (3.15) show the resistance [23].

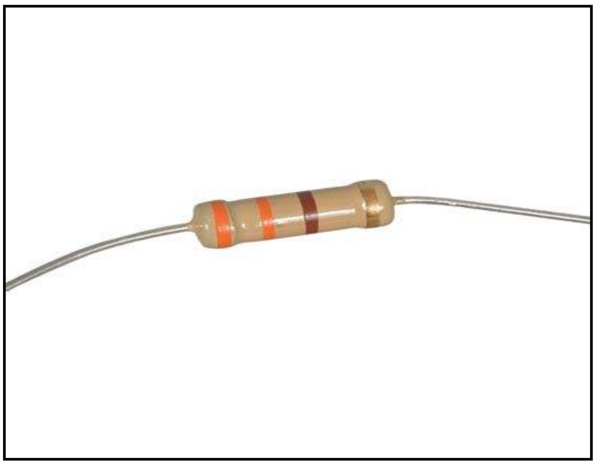


Figure 3.15: Resistor

3.3.14 10Voltage Regulator

A voltage regulator is an electrical regulator designed to automatically maintain a constant voltage level. A voltage regulator may be a simple feed forward. Design or may include negative feedback control loops. It may use an electromechanical mechanism, or electronic components. Depending on the design, it may be used to regulate one or more Alternating current (AC) or (DC) voltages. Figure (3.16) shows the type of voltage regulator.

Figure 3.16: Popular three pin 12 V DC voltage regulator IC.

Electronic voltage regulators are found in devices such as computer power supplies where they stabilize the DC voltages used by the processor and other elements. In automobile alternators and central power station generator plants, voltage regulators control the output of the plant. In an electric power distribution system, voltage regulators may be installed at a substation or along distribution lines so that all customers receive steady voltage independent of how much power is drawn from the line [25].

3.3.15 Crystal Oscillator

A crystal oscillator is an electronic oscillator circuit that uses the mechanical resonance of a vibrating crystal of piezoelectric material to create an electrical signal with a very precise frequency. This frequency is commonly used to keep track of time (as in quartz wristwatches), to provide a stable clock signal for digital integrated circuits, and to stabilize frequencies for radio transmitters and receivers. The most common type of piezoelectric resonator used is the quartz crystal, so oscillator circuits designed around them became known as crystal oscillators. figure (3.17)

Figure 3.17:Crystal oscillator

Quartz crystals are manufactured for frequencies from a few tens of kilo hertz to tens of Mega Hertz. More than two billion crystals are manufactured annually. Most are used for consumer devices such as wrist watches, clocks, radios, computers, and cell phones. Quartz crystals are also found inside test and measurement equipment, such as counters, signal generators, and oscilloscopes [23].

3.3.16 Capacitor

A capacitor (formerly known as condenser) is a device for storing electric charge. The forms of practical capacitors vary widely, but all contain at least two conductors separated by a non-conductor. Capacitors used as parts of electrical systems, for example, consist of metal foils separated by a layer of insulating film. A capacitor is a passive electronic component consisting of a pair of conductors separated by a dielectric (insulator). When there is a potential difference (voltage) across the conductors, a static electric field develops across the dielectric, causing positive charge to collect on one plate and negative charge on the other plate. Energy is stored in the electrostatic field. An ideal capacitor is characterized by a single constant value, capacitance, measured in farads. This is the ratio of the electric charge on each conductor to the potential difference between them. Capacitors are widely used in electronic circuits for blocking direct current while allowing alternating current to pass, in filter networks for smoothing the output of power supplies, in the resonant circuits that tune radios to particular frequencies and for many other purposes. The capacitance is greatest when there is a narrow separation between large areas of conductor hence capacitor conductors are often called "plates," referring to an early means of construction. In practice the dielectric between the plates passes a small amount of leakage current and also has an electric field strength limit, resulting in a breakdown voltage, while the conductors and leads introduce an undesired inductance and resistance. A ceramic capacitors with 22PF capacitance used in this thesis to complete the crystal oscillator to oscillate to run the internal pointer of the PIC microcontroller [23].

3.3.17 GSM

GSM (Global System for Mobile communication) modem is used to alert the caretakers when there is a abrupt change in the measured parameters. Gsm is a digital mobile telephone system that is widely used in all parts of the world as shown the Figure (3.18). GSM uses a variation of Time Division Multiple Access (TDMA) and is the most widely used of the three digital wireless telephone technologies (TDMA, GSM, and CDMA). GSM digitizes and compresses data, then sends it down a channel with two other streams of user data, each in its own time slot. It operates at either the 900 MHz or 1,800 MHz frequency band [11].

Figure 3.18: GSM modem

3.3.18 Serial Communication (RS-232)

Well-established standard, developed by Electronics Industry Association(EIA) 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. shown in Figure (3.19) 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 [26].

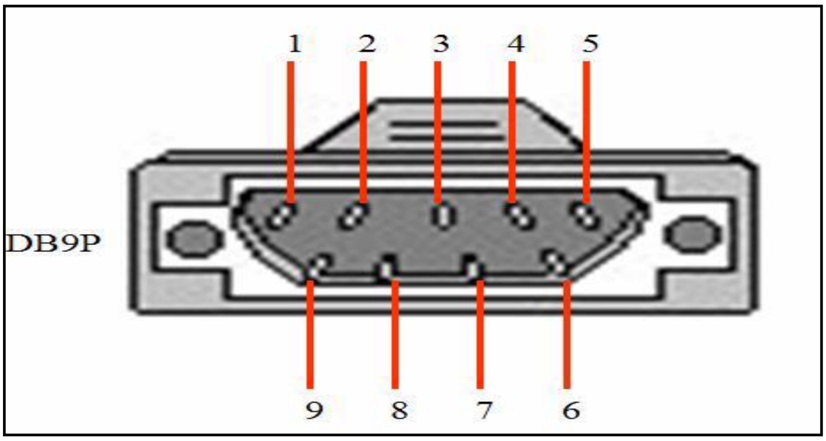


Figure 3.19: RS232 pin number

3.3.19 Serial Data Transmission

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 “ spac, 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:

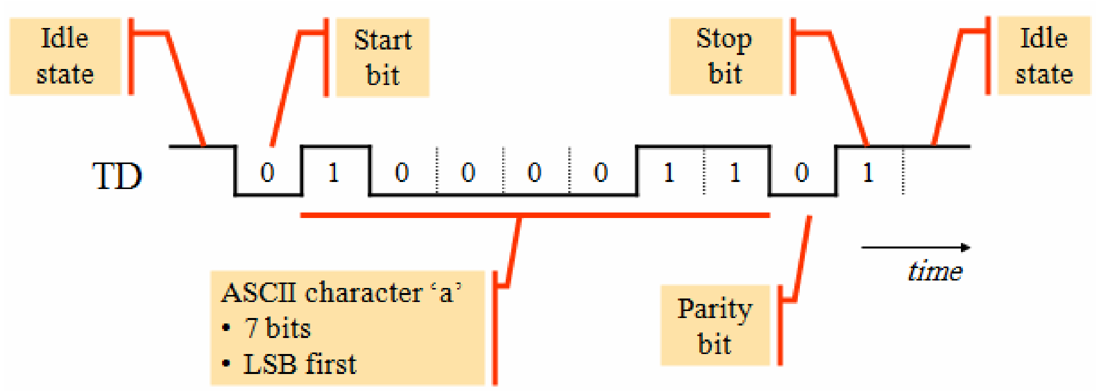


Figure 3.20: Data Transmission

3.3.18 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 show in Figure (3.21). 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.

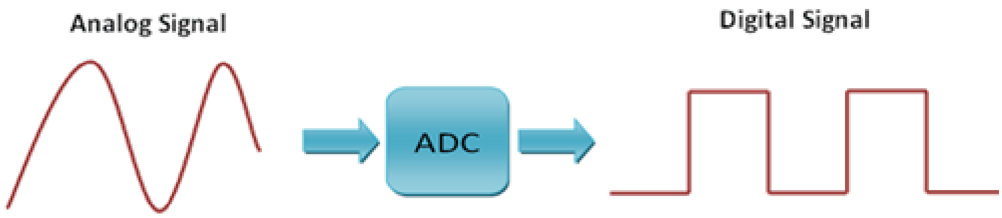


Figure 3.21: Analog to digital conversion

3.4 Microcontroller

A microcontroller is a computer with most of the necessary support chips onboard. All computers have several things in common, namely:

- A Central Processing Unit (CPU) that 'executes' programs.
- Some Random-Access Memory (RAM) where it can store data that is variable.
- Some Read Only Memory (ROM) where programs to be executed can be stored.
- Input and Output (I/O) devices that enable communication to be established with the outside world i.e. connection to devices such as keyboard, mouse, monitors and other peripheral.

There are a number of other common characteristics that define microcontrollers. If a computer matches a majority of these characteristics, then it can be classified as a 'microcontroller'. Microcontrollers may be:

- 'Embedded' inside some other device (often a consumer product) so that they can control the features or actions of the product. Another name for a microcontroller is therefore an 'embedded controller'.

- Dedicated to one task and run one specific program. The program is stored in ROM and generally does not change.
- A low-power device. A battery-operated microcontroller might consume as little as 50 mill watts [27].

It emphasizes high integration, in contrast to a microprocessor which only contains a CPU the kind used in a Personal Computer (PC). In addition to the usual arithmetic and logic elements of a general purpose microprocessor, the microcontroller integrates additional elements such as read-write memory for data storage, read only memory (ROM) for program storage, flash memory for permanent data storage, peripherals, and input/output interfaces. At clock speeds of as little as 32 KHz, microcontrollers often operate at very low speed compared to microprocessors, but this is adequate for typical applications. They consume relatively little power (mill watts or even microwatts), and will generally have the ability to retain functionality while waiting for an event such as a button press or interrupt. Power consumption while sleeping (CPU clock and peripherals disabled) may be just nano watts, making them ideal for low power and long lasting battery applications. Microcontrollers are used in automatically controlled products and devices such as automobile engine control systems, remote controls, office machines, appliances, power tools, and toys. By reducing the size, cost, and power consumption compared to a design using a separate microprocessor, memory, and input/output devices, microcontrollers make it economical to electronically control many more processes [28] Figure (3.22) shows the microcontroller architecture.

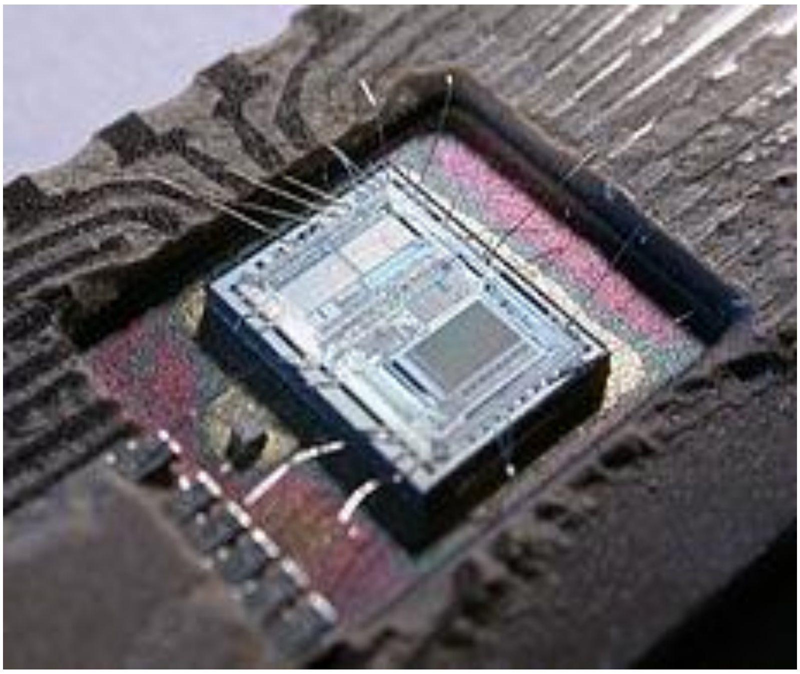


Figure 3.22: Microcontroller architecture

Any microcontroller (or computer) system consists of two primary components: hardware and software. The hardware is the actual physical components of the system. The software is a list of instructions which reside inside the hardware. We will now create the hardware, and then write a software program to "control it".

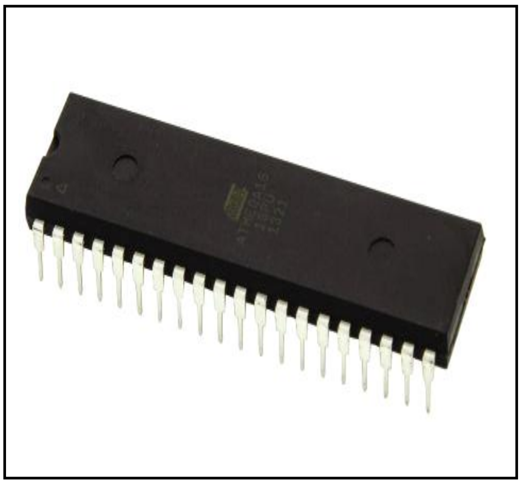
In order for our microcontroller to interact with the real world, we need to assemble some "hardware". We'll be using a PCB called the "Board of Education". This board was created to simplify connecting "real world stuff" to the BASIC Stamp. Connectors are provided for power (wall transformer or 9 volt battery), the programming cable, and the Input / Output pins of the BASIC Stamp. There is also a "prototyping area" or breadboard (the white board with all the holes in it). It is this area that we'll be building our circuitry.

3.5 System Software

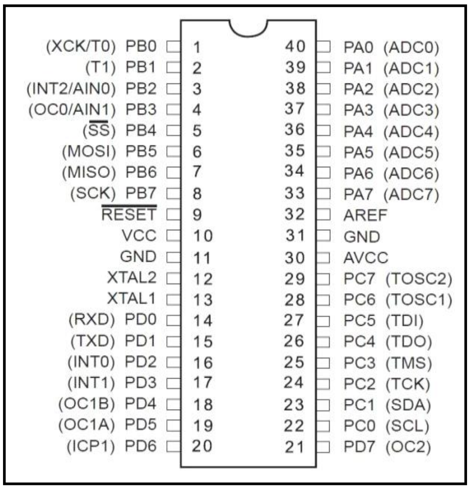
Microcontroller programs must fit in the available on-chip program memory, since it would be costly to provide a system with external, expandable, memory. Compilers and assembly language are used to turn high-level language programs into a compact machine code for storage in the microcontroller's memory. Depending on the device, the program memory may be permanent, read-only memory that can only be programmed at the factory, or program memory may be field-alterable flash or erasable read-only memory. Microcontrollers were originally programmed only in assembly language, but various high-level programming languages are now also in common use to target microcontrollers. These languages are either designed especially for the purpose, or versions of general purpose languages such as the C programming language. Compilers for general purpose languages will typically have some restrictions as well as enhancements to better support the unique characteristics of microcontrollers. Some microcontrollers have environments to aid developing certain types of applications. Microcontroller vendors often make tools freely available to make it easier to adopt their hardware. Many microcontrollers are so quirky that they effectively require their own non-standard dialects of C, such as SDCC for the 8051, which prevent using standard tools (such as code libraries or static analysis tools) even for code unrelated to hardware features. Interpreters are often used to hide such low level quirks. Interpreter firmware is also available for some microcontrollers. Simulators are available for some microcontrollers, such as in Microchip's MPLAB environment. These allow a developer to analyze what the behavior of the microcontroller and their program should be if they were using the actual part. A simulator shows the internal processor state and also that of the outputs, as well as allowing input signals to be generated. While on the one hand most simulators will be limited from being unable to simulate much other hardware in a system, they can exercise conditions that may otherwise be hard to reproduce at will in the physical implementation, and can be the quickest way to debug and analyze problems [29].

3.6 Atmel AVR:

AVR is a modified Harvard architecture 8-bit RISC single chip microcontroller which was developed by Atmel in 1996. The AVR was one of the first microcontroller families to use on-chip flash memory for program storage, as opposed to one time programmable ROM, Erasable program read only memory(EPROM), or Electrical Erasable program read only memory EEPROM used by other microcontrollers at the time. The original AVR MCU was developed at a local ASIC house in Trondheim Norway, where the two founders of Atmel Norway were working as students. It was known as a μRISC (Micro RISC). When the technology was sold to Atmel, the internal architecture was further developed by Alf and vegard at Atmel Norway, a subsidiary of Atmel founded by the two architects. The acronym AVR has been reported to stand for advanced virtual RISC, but it has also been rumored to stand for the initials of the chip's designers: Alf and Vegard's RISC. Atmel says that the name AVR is not an acronym and does not stand for anything in particular. Note that the use of "AVR" in this article generally refers to the 8-bit RISC line of Atmel AVR microcontrollers. Among the first 17 of the AVR line was the AT90S8515, which in a 40-pin DIP package has the same pin out as an 8051 microcontroller, including the external multiplexed address and data bus. The polarity of the RESET line was opposite (8051's having an active-high RESET, while the AVR has an active-low RESET), but other than that, the pin out was identical. Figure (3.23) Show the AVR Atmega16L microcontroller overview and pin configuration [28].



(a) Over view



(b) Pin configuration

Figure 3.23: AVR Atmega16L microcontroller

3.7 Flowchart:

The flowchart illustrates the data flow of the software inside the microcontroller, as shown in Figure (3.24)

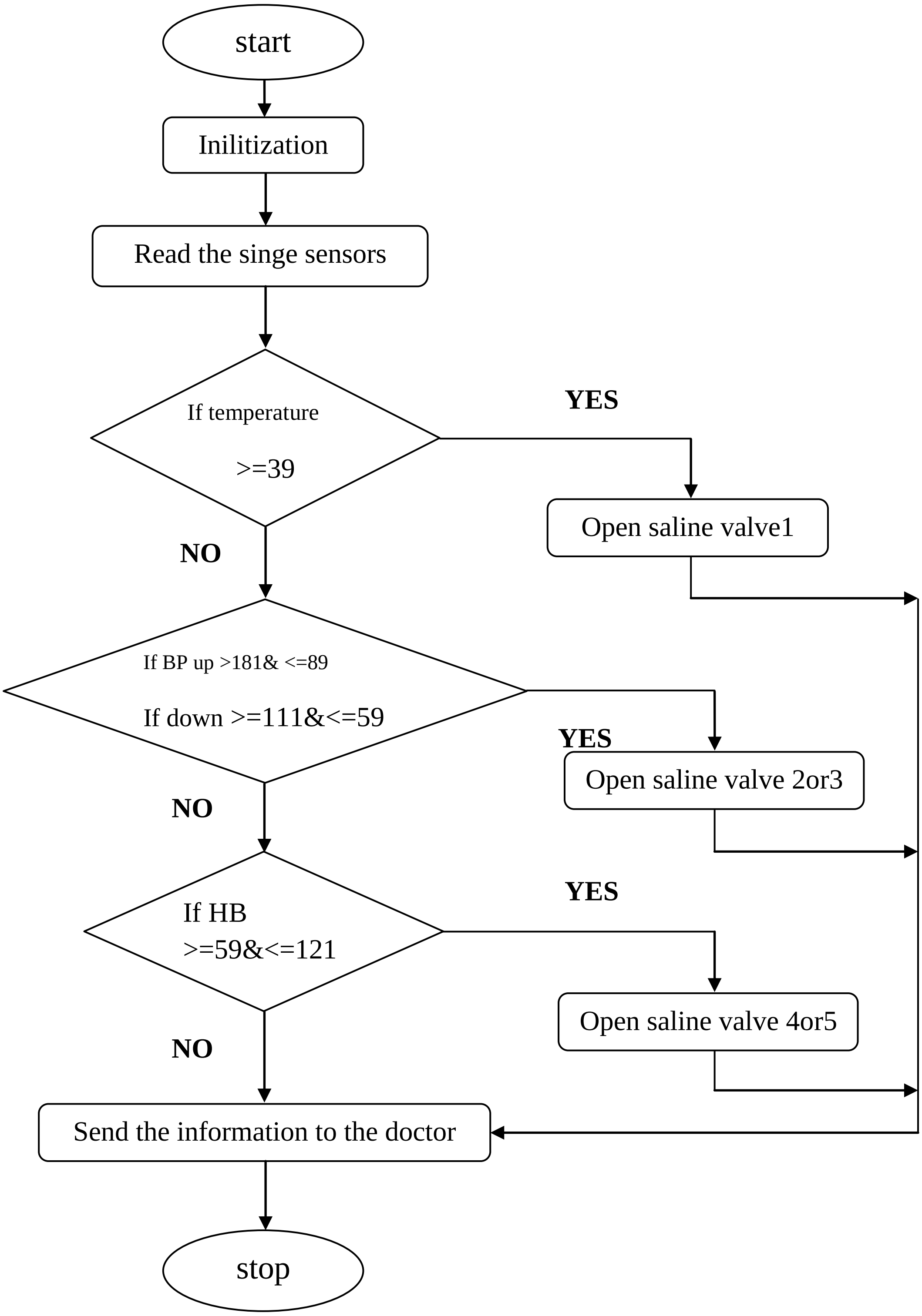


Figure 3.24: Flow chart

Chapter four

Simulation & results

Chapter Four

Simulation and Result

4.1 Introduction

In this chapter the simulation results will be illustrated along with the screen shots of the system, the system is simulated using Proteus simulation program.

4.2 Simulation result

In order to verify the effectiveness of the system, a simulation model has been developed in Proteus plateform, under different operation condition.

4.2.1 The normal situation

While running the system, the sensors reading are displayed simultaneously when they are displayed on the screen if they are in the normal situation as shown in figure(4.1)

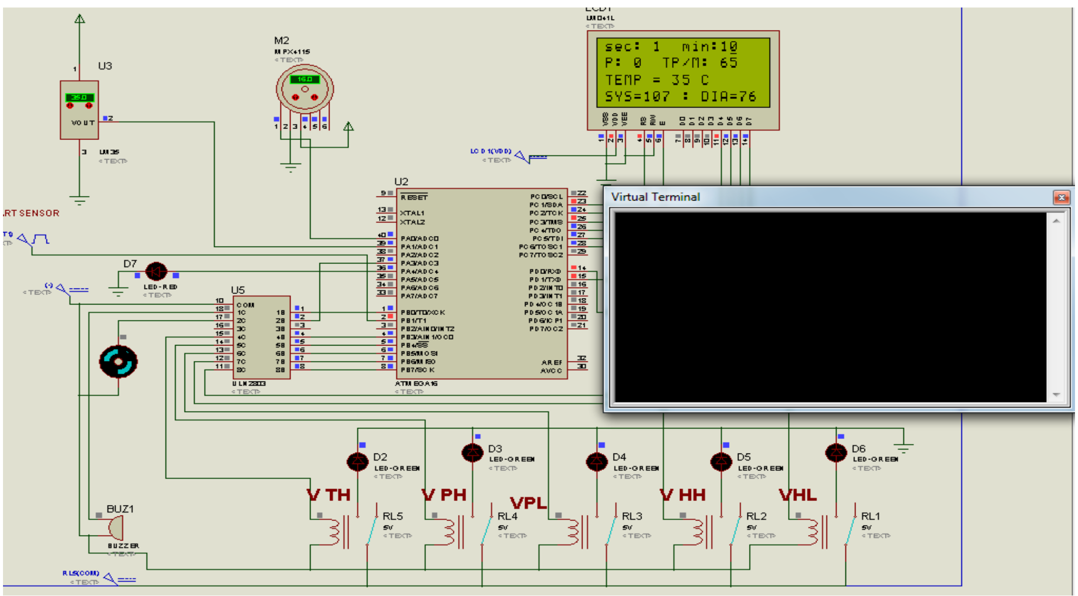


Figure 4.1: read sensors signals on screen LCD

4.2.2 The temperature situation

While the running system with an increasing in patient temperature more than 40°C the system display the number of temperature on the screen LCD as shown figure (4.2) and its 40 ,here the buzzer works and sends the signal to the doctor's through GSM which appears in the simulation in form of screen virtual terminal where the number of the treating doctor and the situation of emergency is determined by the patient and the same time the microcontroller give direct treatment through the vein of the patient who is in the form of solution consist a drug barastmol 50 ml by cannula here in the simulation the microcontroller gives order of the relay to open the indictor to give treatment for the patient , until the treatment of the patient's body is reduce to the normal situation . This is shown in the simulation in LED that leads to green light in the case of injecting the patient with the solution of treatment and in the case of low temperature is turn off the LED indicative of return to normal .

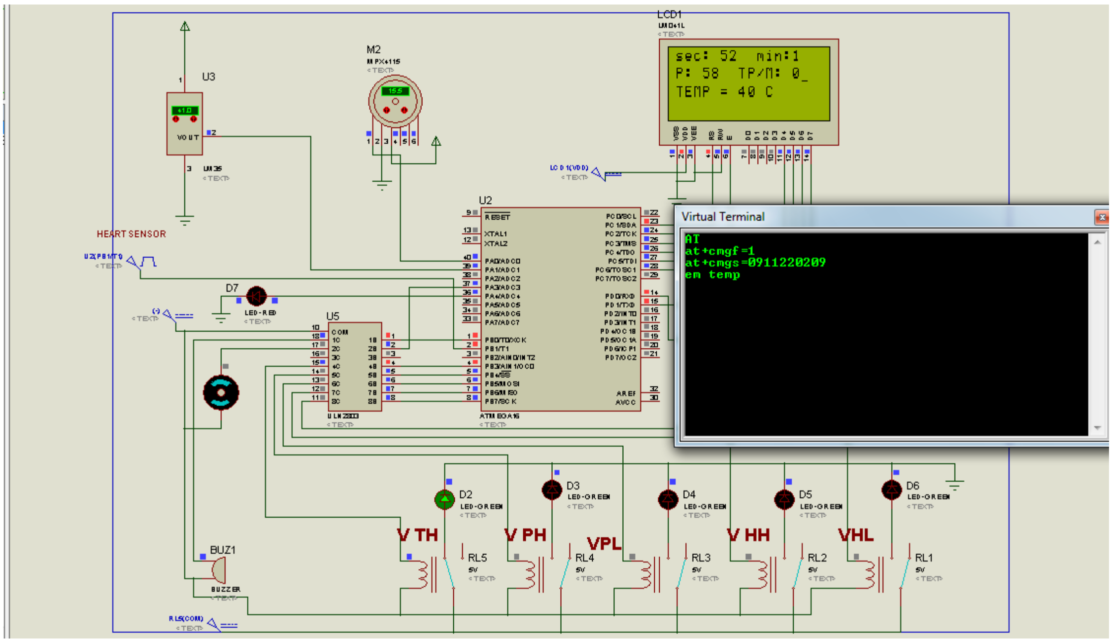


Figure 4.2: the signal temperature on LCD

4.2.3 The blood pressure situation

While the running system with an increasing in patient blood pressure more than 180/110 mmgh the system display up normal for blood pressure on the screen LCD as shown Figure (4.3) , here the buzzer works and sends the signal to the doctor's through GSM which appears in the simulation in form of screen virtual terminal where the number of the treating doctor and the situation of emergency is determined by the patient and the same time the microcontroller give direct treatment through the vein of the patient who is in the form of solution contain a drug 5 mg of Amlodipine every 24 hour by cannula here in the simulation the microcontroller gives order of the relay to open the indictor to give treatment for the patient , until the treatment of the patient's body is reduce to the normal situation . this is shown in the simulation in LED that leads to green light in the case of injecting the patient with the solution of treatment and in the case of low blood pressure is turn off the LED indicative of return to normal .

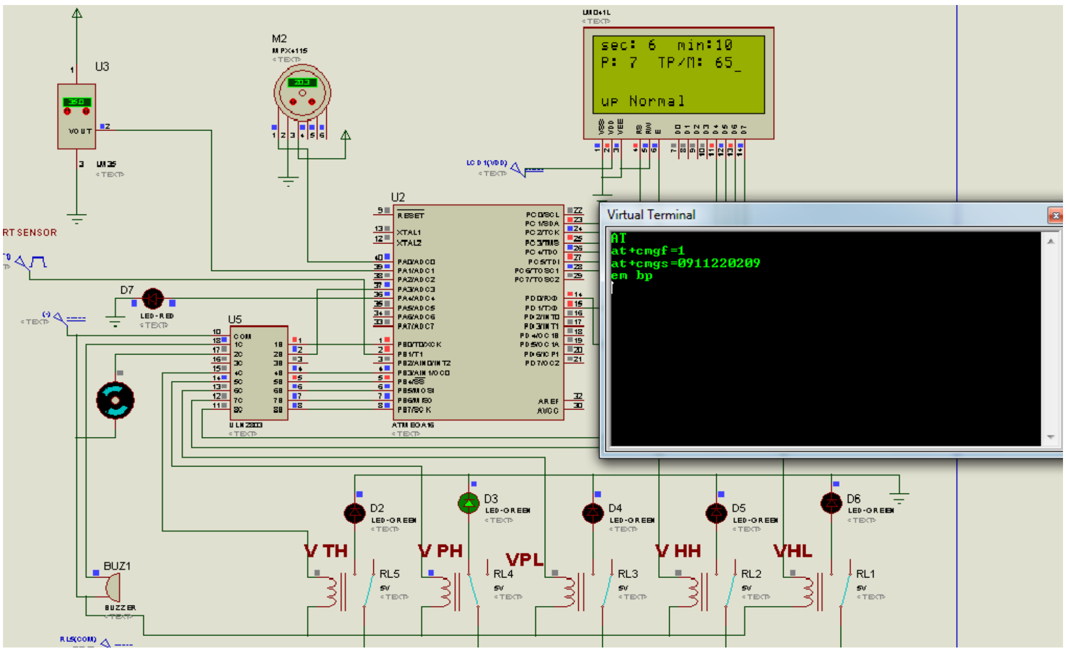


Figure 4.3: high blood pressure on LCD

While the running system with an decreasing in patient blood pressure less than 90/60 mmgh the system display down normal of blood pressure on the screen LCD as shown figure (4.4) ,here the alarm bell works and sends the signal to the doctor's through GSM which appears in the simulation in form of screen virtual terminal where the number of the treating doctor and the situation of emergency is determined by the patient and the same time the microcontroller give direct treatment through the vein of the patient who is in the form of solution contain a drug 5 mg of Amlodipine every 24 hour by cannula here in the simulation the microcontroller gives order of the relay to open the indictor to give treatment for the patient , until the treatment of the patient's body is reduce to the normal situation . this is shown in the simulation in LED that leads to green light in the case of injecting the patient with the solution of treatment and in the case of high blood pressure is turn off the LED indicative of return to normal .

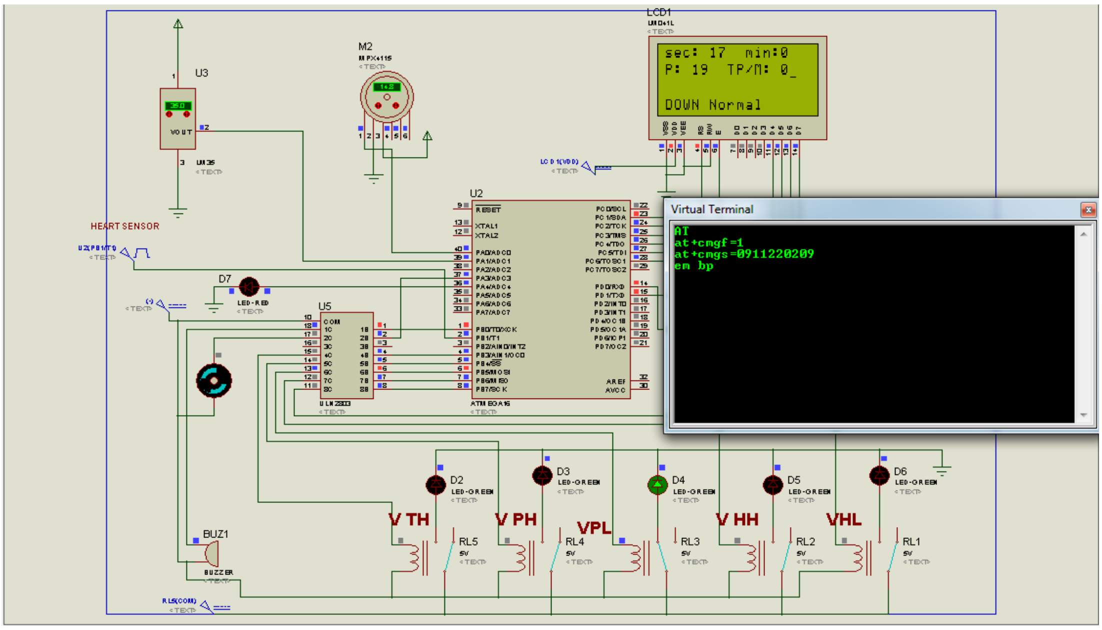


Figure 4.4: low blood pressure on LCD

4.2.4 The heart beat situation

While the running system with an increasing in patient heart beat more than 120 per pulse minutes the system display the number for heart beat on the screen LCD as shown figure (4.5) , here the alarm bell works and sends the signal to the doctor's through GSM which appears in the simulation in form of screen virtual terminal where the number of the treating doctor and the situation of emergency is determined by the patient and the same time the microcontroller give direct treatment through the vein of the patient who is in the form of solution contain a 10 mg propranolol by cannula here in the simulation the microcontroller gives order of the relay to open the indictor to give treatment for the patient , until the treatment of the patient's body is reduce to the normal situation . this is shown in the simulation in LED that leads to green light in the case of injecting the patient with the solution of treatment and in the case of low heart beat is turn off the LED indicative of return to normal .

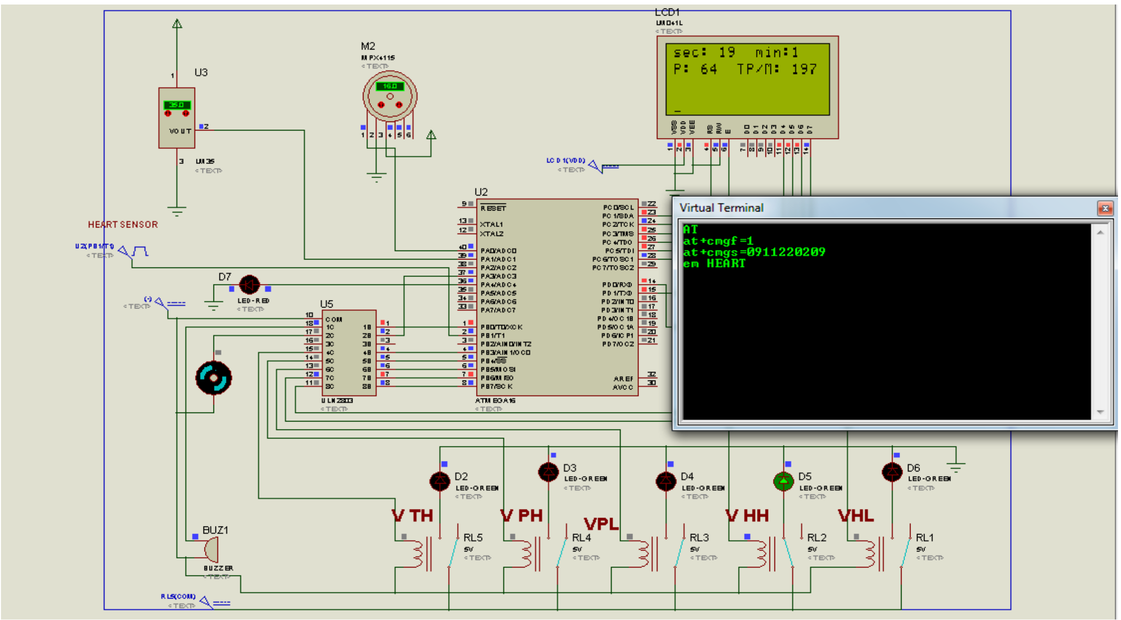


Figure 4.5: high heart beat on LCD

While the running system with an increasing in patient heart beat less than 60 per pulse minutes the system display the number for heart beat on the screen LCD as shown figure (4.6) , here the buzzer works and sends the signal to the doctor's through GSM which appears in the simulation in form of screen virtual terminal where the number of the treating doctor and the situation of emergency is determined by the patient and the same time the microcontroller give direct treatment through the vein of the patient who is in the form of solution contain a 10 mg adrenaline by cannula here in the simulation the microcontroller gives order of the relay to open the indictor to give treatment for the patient , until the treatment of the patient's body is reduce to the normal situation . This is shown in the simulation in LED that leads to green light in the case of injecting the patient with the solution of treatment and in the case of low heart beat is turn off the LED indicative of return to normal.

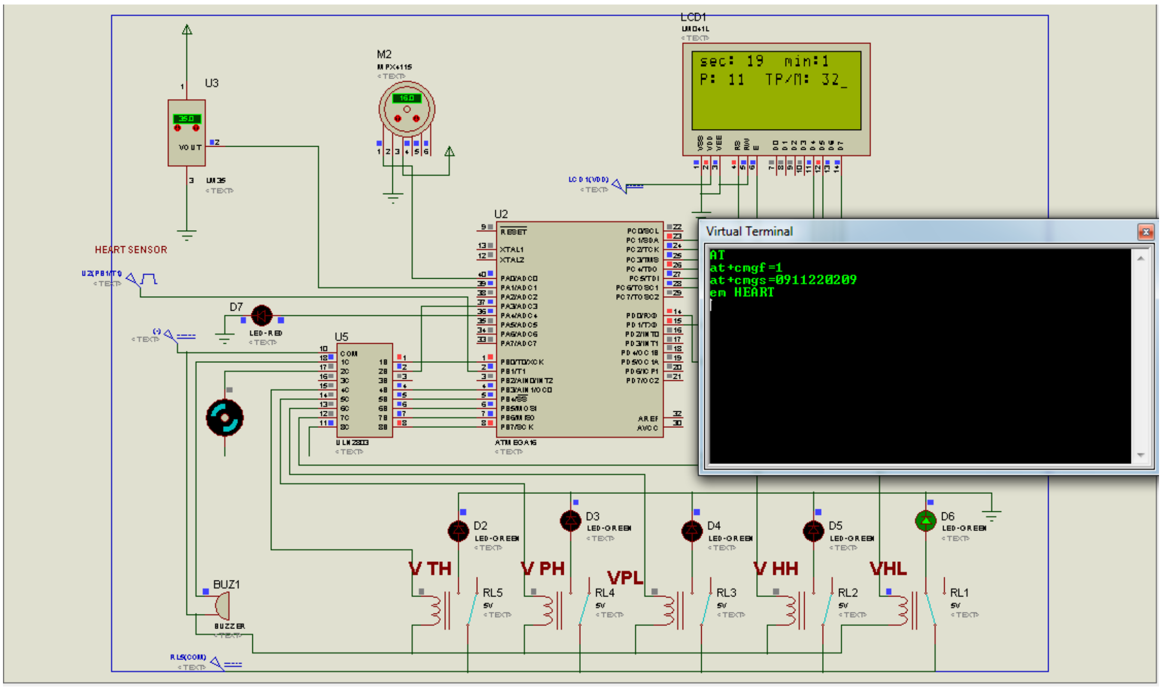


Figure 4.6 : low heart beat on LCD

4.2.5 The emergency situation (increase blood pressure and heart beat)

Blood pressure and heart rate are correlated components of the cardiovascular system, where doctors points to direct relationship between the blood pressure and heart beat and its positive relationship . here in the search there are emergency situation , they high blood pressure and heart beat at the same time, in this case microcontroller gives order of the relay to open the indicator to give treatment of blood pressure to the patient, until the treatment of the patient's body is reduce to the normal situation and the same time the buzzer works and sends the signal to the doctor's through GSM which appears in the simulation in form of screen virtual terminal where the number of the treating doctor and the situation of emergency is determined by the patient as shown in the figure (4.7) . This is shown in the simulation in LED that leads to green light in the case of injecting the patient with the solution of treatment and in the case of low heart beat is turn off the LED indicative of return to normal.

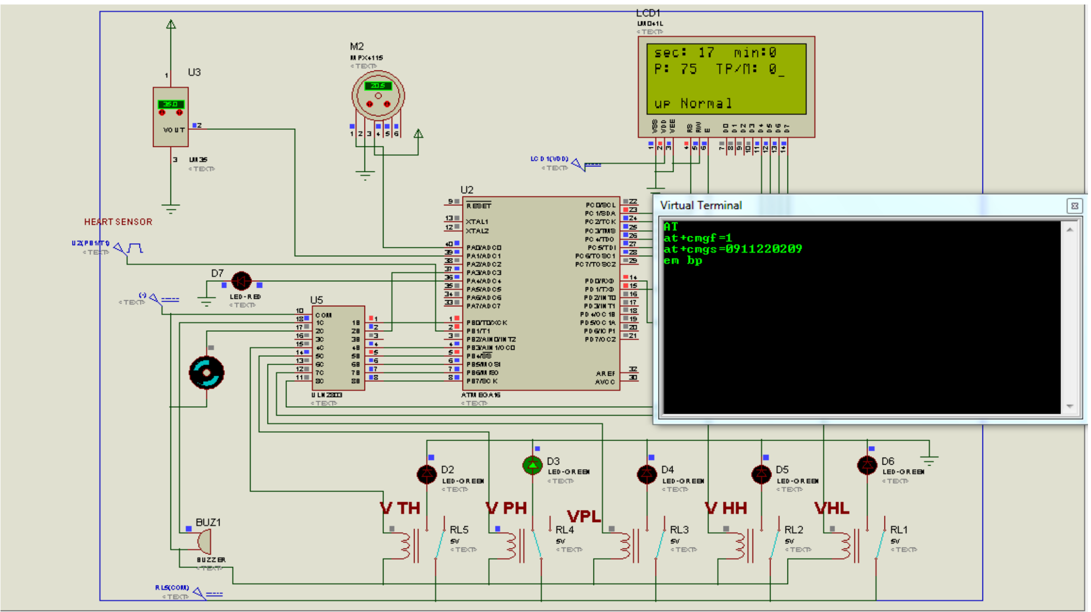


Figure 4.7: the emergency situation (increase blood pressure and heart beat)

Chapter five

Conclusion & recommendations

Chapter Five

Conclusion Recommendation

5.1 Conclusions

This thesis presented design and developed of integrated system for monitoring heart beat, blood pressure and temperature to improve estimating them.

the goal of this thesis design low cost device which measures the heart beat ,blood pressure and temperature and then displaying the result on a text based LCD , the simulation was successfully done and tested , with high accuracy of the system ,it has been developed by integrating fractures of all the hard ware components used.

5.2 RecommendationS

According to availability of sensors or development in biomedical trend more parameters can sense and monitor which will drastically improve the efficiency of the wireless monitoring system in biomedical field by adding:

- Sensors like (ECG, saline, oxygen saturation, ect) that can be measured more accurately , faster and more efficiently .
- GPS to specify exact location of the patient .
- Implementation of the proposed system in real time.

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Appendix

```
$regfile = "m16def.dat"                    'def type of micro
$crystal = 8000000                          'set frqunсy
$baud = 9600
Config Com1 = Dummy , Synchrone = 0 , Parity = None , Stopbits = 1 ,
Databits = 8 , Clockpol = 0        'set serialport
Config Lcd = 16 * 4
Config Lcdpin = Pin , Db4 = Portc.3 , Db5 = Portc.4 , Db6 = Portc.5 ,
Db7 = Portc.6 , E = Portc.2 , Rs = Portc.1
Config Portb.1 = Input                          'def input
Config Portb.0 = Output
Config Portb.3 = Output
Config Portb.4 = Output
Config Portb.5 = Output
Config Portb.6 = Output
Config Portb.7 = Output
Config Porta.3 = Output
Config Porta.4 = Output
Cls
Dim Count As Integer
Dim A As Integer
Dim S As Integer
Dim M As Integer
Dim D As Integer
```

```
Dim L As Integer

Config Timer1 = Counter , Edge = Rising

Config Timer0 = Timer , Prescale = 1024

On Ovf1 Pulse_counter

On Ovf0 Displays

Start Timer0

Enable Interrupts

'Enable Int0                                 'enable the interrupt

Enable Timer0

Enable Timer1

Start Timer1

On Int0 Label2

Dim Ss As String * 200

Dim Sr As String * 20

Config Adc = Single , Prescaler = Auto , Reference = Internal

Start Adc

----------------------'

Dim Te As Word

Dim Ve As Word

Dim P As Word

Dim Pr As Word

----------------------'

Do

 'Cls

 Te = Getadc(1(
```

```
Ve = Te / 4
Locate 3 , 1 : Lcd "TEMP = " ; Ve ; " C"
If Ve >= 39 Then
Portb.3 = 1
Portb.0 = 1
Cls
Locate 3 , 1 : Lcd "TEMP = " ; Ve ; " C"
Print "AT"
Print "at+cmgf=1"
Print "at+cmgs=" ; "0911220209"
Print "em temp"
Waitms 15000
End If
 If Ve <= 38 Then
 Portb.0 = 0
Portb.3 = 0
End If
Porta.3 = 1
Waitms 3000
Porta.3 = 0
Waitms 300
Porta.3 = 1
Waitms 300
Porta.3 = 0
Waitms 300
```

```
Porta.4 = 1
Waitms 1000
 Porta.4 = 0
P = Getadc(0(
P = P - 18
Pr = P / 9
Pr = Pr + 65
Cls
Locate 4 , 1 : Lcd "SYS=" ; P ; " : DIA=" ; Pr;
Waitms 3000
If P > 90 And P <= 180 And Pr > 60 And Pr <= 110 Then
Portb.4 = 0
Portb.5 = 0
End If
If P > 181 Then
Portb.0 = 1
Portb.4 = 1
Cls
Print "AT"
Waitms 2000
Print "at+cmgf=1"
Waitms 2000
Print "at+cmgs=" ; "0911220209"
Waitms 2000
Print "em bp"
```

```
Waitms 2000
Locate 4 , 1 : Lcd "up Normal"
Waitms 3000
End If
If P <= 89 Then
Portb.0 = 1
Portb.5 = 1
Cls
Print "AT"
Waitms 2000
Print "at+cmgf=1"
Waitms 2000
Print "at+cmgs=" ; "0911220209"
Waitms 2000
Print "em bp"
Waitms 2000
Locate 4 , 1 : Lcd "DOWN Normal"
Waitms 3000
End If
If Pr >= 111 Then
Portb.0 = 1
Portb.4 = 1
Cls
Print "AT"
Waitms 2000
```

```
Print "at+cmgf=1"
Waitms 2000
Print "at+cmgs=" ; "0911220209"
Waitms 2000
Print "em bp"
Waitms 2000
Locate 4 , 1 : Lcd "up Normal"
Waitms 3000
End If
If Pr <= 59 Then
Portb.0 = 1
Portb.4 = 1
Cls
Print "AT"
Waitms 2000
Print "at+cmgf=1"
Waitms 2000
Print "at+cmgs=" ; "0911220209"
Waitms 2000
Print "em bp"
Waitms 2000
Locate 4 , 1 : Lcd "DOWN Normal"
Waitms 3000
End If
If L >= 121 Then
```

```
Portb.0 = 1

Portb.6 = 1

Cls

Wait 1

Print "AT"

Wait 4

Print "at+cmgf=1"

Wait 4

Print "at+cmgs=" ; "0911220209"

Wait 4

Print "em HEART"

Wait 4

Locate 4 , 1 : Lcd "em HEART"

Waitms 3000

L = 0

End If

If L >= 60 And L <= 120 Then

Portb.0 = 0

Portb.6 = 0

Portb.7 = 0

L = 0

End If

If L >= 12 And L <= 59 Then

Portb.0 = 1

Portb.7 = 1
```

```
Cls
Wait 1
Print "AT"
Wait 4
Print "at+cmgf=1"
Wait 4
Print "at+cmgs=" ; "0911220209"
Wait 4
Print "em HEART"
Wait 4
Locate 4 , 1 : Lcd "em HEART"
Waitms 3000
L = 0
End If
If P > 181 And L => 121 Then
Portb.0 = 1
Portb.4 = 1
Portb.6 = 0
Portb.7 = 0
Cls
Print "AT"
Waitms 2000
Print "at+cmgf=1"
Waitms 2000
Print "at+cmgs=" ; "0911220209"
```

```
Waitms 2000

Print "em bp"

Waitms 2000

Locate 4 , 1 : Lcd "up Normal"

Waitms 3000

End If

Loop

End

Label2:

Incr Count

Waitms 20

Return                                  'generates a RETI because it is
the first RETURN

Displays:

Incr A

If A = 30 Then

Incr S

If S = 60 Then

S = 0

Incr M

Timer1 = 0

L = D

End If

If M = 60 Then

M = 0
```

```
End If

D = Timer1

"Cls

Locate 1 , 1

Lcd "sec: " ; S ; "  min:" ; M

Locate 2 , 1

Lcd "P: " ; D ; "  TP/M: " ; L

Waitms 100

A = 0

End If

Return
```