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CHAPTER ONE

INTRODUCTION

1.1. Overview

The ability of robotic systems to couple information to physical action in complex ways has had a profound influence on our society. Applications include such fields as industrial production, inspection and quality control, laboratory automation, exploration, field service, rescue, surveillance, and medicine and health care. Historically, robots have often been first introduced to automate or improve discrete processes, such as painting a car or placing test probes on electronic circuits, but their greatest economic influence has often come indirectly as essential enablers of computer-integration of entire production or service processes.

As the world's population ages, and with an increasing shortage of physicians and other healthcare personnel, robots will be a growing presence in the healthcare system. At the same time, healthcare providers are attracted to robots due to their ability to reduce the cost of care, offload menial tasks from human personnel, improve the accuracy of repetitive tasks, and enable enhanced forms of therapy and rehabilitation, among other types of use cases. Healthcare robots include surgical robots, hospital logistics robots, disinfectant robots, nursing robots, exoskeleton robots used for rehabilitation, robotic prosthetic limbs, and many other potential robot types. More than 200 companies are already active in various aspects of the healthcare robotics market, creating highly specialized devices for a wide range of applications.

1.1.1. Possible Beneficiaries

Possible Beneficiaries are defined as people who have a vested interest in the use of robotics technology in healthcare.

Possible Beneficiaries can be people who directly use robots to provide assistance with daily living or wellness activities.

Primary beneficiaries: direct robot users, clinicians, and caregivers, all of whom are likely to use robotics technology on a regular basis.

Secondary beneficiaries: health administrators, robot makers, and environmental service workers, all of whom are involved in the use of robotics technology in healthcare settings but do not directly use the robots to use robots to support the health and wellness.

Tertiary beneficiaries: policy makers and advocacy groups, who have interest in the use of robots to provide care to their constituents, but are unlikely to use them directly. This article will focus on primary beneficiaries; however, it is important to note that all other stakeholder groups are critical to the successful end-deployment of robotics in health care, and should be included when possible in decision making.

The use of robots in healthcare represents an exciting opportunity to help a large number of people , Robots can be used to enable people with cognitive, sensory, and motor impairments , help people who are ill or injured , support caregivers , and aid the clinical workforce.

1.2.Research Motivation

While many types of research look at what people do, motivation research looks at why they do it. This information on the motives driving human behavior Is used in marketing, social sciences and a variety of fields where understanding behavior is important.

Understanding why people act in certain ways can be difficult, especially since many people don’t truly understand their own motives.

Research motivation attempts to identify the forces behind the behavior, especially consumer behavior. For instance, why do certain trends take off while others flop? Why do certain age groups spend money differently than others? Consumer behavior is affected by conscious and unconscious motives, economic needs, cultural factors and a variety of variables. Motivation research attempts to deconstruct complex behaviors so they can be understood and even influenced.

❖ What Sets Motivation Research Apart from Other Types of Research?

There are several factors that set motivation research apart from other types of research. Rather than occurring in a lab, motivation research is usually based on a focus group, interviews, and simple observation. In a focus group, a researcher leads a group of the people being studied in activities and discussions that reveal their feelings and motivations. In-depth interviews are similar but deal with each person individually.

Simple observation can also be a powerful tool as people may behave differently in real life than in a research setting.

Because people are often unaware of their own motivations, each study must be designed to extract truths and encourage reflection. It is very important for the research team to be empathetic, nonjudgmental and skilled at getting people to talk honestly.

After data is collected, researchers then must be able to look at it without bias and make inferences about the motivations behind the studied behaviors. This type of research requires a great deal of skill and understanding of human psychology.

❖ Research motivation techniques

There are four popular techniques used when it comes to motivation research, they include:

- Non-disguised Structured Techniques – This technique utilizes a standard questionnaire that collects data on belief and feelings. It's arranged beforehand and the researcher discloses the objective and purpose of the survey to the participant. This is the most widely used technique when it comes to market research.
- Non-disguised Non-Structured Techniques – This technique questions are not necessarily arranged in a strategic order, the questions are more free-flowing. The questions can be asked in any order that the research sees fit. The participant is aware of the purpose of the information being collected.
- Disguised Non-Structured Techniques – In the same way that the non-disguised non-structured techniques the questions are not in a strategic order and the questions are free

flowing. Unlike the non-disguised non-structured techniques the participant is not aware of the purpose of the information being collected.

- Disguised Structured Techniques – This technique uses questions in a pre-arranged order, much like the non-disguised structured technique, but using this method the participant is not aware of the purpose of the information being collected.

1.3.Scientific Background

Robotics is an interdisciplinary branch of engineering and science that includes mechanical engineering, electrical engineering, computer science, and others. Robotics deals with the design, construction, operation, and use of robots, as well as computer systems for their control, sensory feedback, and information processing.

These technologies are used to develop machines that can substitute for humans and replicate human actions. Robots can be used in any situation and for any purpose, but today many are used in dangerous environments (including bomb detection and de-activation), manufacturing processes, or where humans cannot survive. Robots can take on any form but some are made to resemble humans in appearance. This is said to help in the acceptance of a robot in certain replicative behaviors usually performed by people. Such robots attempt to replicate walking, lifting, speech, cognition, and basically anything a human can do. Many of today's robots are inspired by nature, contributing to the field of bio-inspired robotics.

The concept of creating machines that can operate autonomously dates back to classical times, but research into the functionality and potential uses of robots did not grow substantially until the 20th century.[1] Throughout history, it has been frequently assumed that robots will one day be able to mimic human behavior and manage tasks in a human-like fashion. Today, robotics is a rapidly growing field, as technological advances continue; researching, designing, and building new robots serve various practical purposes, whether domestically, commercially, or militarily. Many robots are built to do jobs that are hazardous to people such as defusing bombs, finding survivors in unstable ruins, and exploring mines and shipwrecks. Robotics is also used in STEM (Science, Technology, Engineering, and Mathematics) as a teaching aid.

Robotics is a branch of engineering that involves the conception, design, manufacture, and operation of robots. This field overlaps with electronics, computer science, artificial intelligence, mechatronics, nanotechnology and bio-engineering.

Science-fiction author Isaac Asimov is often given credit for being the first person to use the term robotics in a short story composed in the 1940s. In the story, Asimov suggested three principles to guide the behavior of robots and smart machines. Asimov's Three Laws of Robotics, as they are called, have survived to the present: 1. Robots must never harm human beings.

Robots must follow instructions from humans without violating rule : Robots must protect themselves without violating the other rules.

❖ Robotic aspects

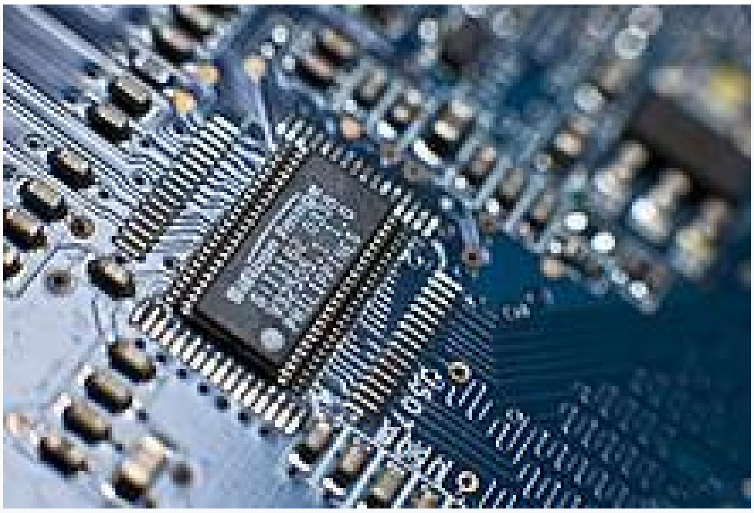
There are many types of robots; they are used in many different environments and for many different uses, although being very diverse in application and form they all share three basic similarities when it comes to their construction:

- Robots all have some kind of mechanical construction, a frame, form or shape designed to achieve a particular task. For example, a robot designed to travel across heavy dirt or mud, might use caterpillar tracks. The mechanical aspect is mostly the creator's solution to completing the assigned task and dealing with the physics of the environment around it. Form follows function.
- Robots have electrical components which power and control the machinery. For example, the robot with caterpillar tracks would need some kind of power to move the tracker treads. That power comes in the form of electricity, which will have to travel through a wire and originate from a battery, a basic electrical circuit. Even petrol powered machines that get their power mainly from petrol still require an electric current to start the combustion process which is why most petrol powered machines like cars, have batteries. The electrical aspect of robots is used for movement (through motors), sensing (where electrical signals are used to measure things like heat, sound, position, and energy status) and operation (robots need some level of electrical energy supplied to their motors and sensors in order to activate and perform basic operations)

- All robots contain some level of computer programming code. A program is how a robot decides when or how to do something. In the caterpillar track example, a robot that needs to move across a muddy road may have the correct mechanical construction and receive the correct amount of power from its battery, but would not go anywhere without a program telling it to move. Programs are the core essence of a robot, it could have excellent mechanical and electrical construction, but if its program is poorly constructed its performance will be very poor (or it may not perform at all). There are three different types of robotic programs: remote control, artificial intelligence and hybrid. A robot with remote control programing has a preexisting set of commands that it will only perform if and when it receives a signal from a control source, typically a human being with a remote control. It is perhaps more appropriate to view devices controlled primarily by human commands as falling in the discipline of automation rather than robotics. Robots that use artificial intelligence interact with their environment on their own without a control source, and can determine reactions to objects and problems they encounter using their preexisting programming. Hybrid is a form of programming that incorporates both AI and RC functions.

- Mechanical construction

❖ Electrical aspect



❖ A level of programming

❖ Applications

As more and more robots are designed for specific tasks this method of classification becomes more relevant. For example, many robots are designed for assembly work, which may not be readily adaptable for other applications. They are termed as "assembly robots". For seam welding, some suppliers provide complete welding systems with the robot i.e. the welding equipment along with other material handling facilities like turntables etc. as an integrated unit. Such an integrated robotic system is called a "welding robot" even though its discrete manipulator unit could be adapted to a variety of tasks. Some robots are specifically designed for heavy load manipulation, and are labeled as "heavy duty robots".

Current and potential applications include:

❖ Military robots

Military robots are autonomous robots or remote-controlled mobile robots designed for military applications, from transport to search & rescue and attack.

Some such systems are currently in use, and many are under development.

History:

Broadly defined, military robots date back to World War II and the Cold War in the form of the German Goliath tracked mines and the Soviet teletanks.

The MQB-1 Predator drone was when "CIA officers began to see the first practical returns on their decade-old fantasy of using aerial robots to collect intelligence".

The use of robots in warfare, although traditionally a topic for science fiction, is being researched as a possible future means of fighting wars. Already several military robots have been developed by various armies.

Some believe the future of modern warfare will be fought by automated weapons systems.

The U.S. Military is investing heavily in research and development towards testing and deploying increasingly automated systems. The most prominent system currently in use is the unmanned aerial vehicle (IAI Pioneer & RQ-1 Predator) which can be armed with Air-to-ground missiles and remotely operated from a command center in reconnaissance roles. DARPA has hosted competitions in 2004 & 2005 to involve private companies and universities to develop unmanned ground vehicles to navigate through rough terrain in the Mojave Desert for a final prize of 2 Million.

Artillery has seen promising research with an experimental weapons system named "Dragon Fire II" which automates loading and ballistics calculations required for accurate predicted fire, providing a 12-second response time to fire support requests. However, military weapons are prevented from being fully autonomous: they require human input at certain intervention points to ensure that targets are not within restricted fire areas as defined by Geneva Conventions for the laws of war.

There have been some developments towards developing autonomous fighter jets and bombers.[4] The use of autonomous fighters and bombers to destroy enemy targets is especially promising because of the lack of training required for robotic pilots, autonomous planes are capable of performing maneuvers which could not otherwise be done with human pilots (due to high amount of G-Force), plane designs do not require a life support system, and a loss of a plane does not mean a loss of a pilot. However, the largest draw back to robotics is their inability to accommodate for non-standard conditions. Advances in artificial intelligence in the near future may help to rectify this.

The Platform-M variant of the Multi-functional Utility/Combat support/Patrol. Serially produced by the Russian Army.

The Armed Robotic Vehicle variant

Agricultural robots

Agricultural robots:

It is a robot deployed for agricultural purposes. The main area of application of robots in agriculture today is at the harvesting stage. Emerging applications of robots or drones in agriculture include weed control, cloud seeding, planting seeds, harvesting, environmental monitoring and soil analysis.

Some Examples of Computer Vision Guided Farm Robots Include:

- Drones which can be fitted with the latest multi spectral, network-connected sensors in order to image crops or the environment, survey the landscape, and even analyses the fertility of certain areas of soil then send this data across the network to be analyzed and processed. Harvesting Robots which are not only able to pick the fruit but using their computer vision programs, can sort the produce based on size and ripeness. Weeding and Spraying Robots with computer based vision systems are being deployed on tractors to automate spraying for weed control. With the use of artificial intelligence and machine learning techniques to enhance the precision of processes such as weeding.

Fieldwork Robot

Domestic robots

A domestic robot is a type of service robot, an autonomous robot that is primarily used for household chores, but may also be used for education, entertainment or therapy. Thus far, there are only a few limited models, though speculators, such as Bill Gates, have suggested that they could become more common in the future.

Indoor robots:

This type of domestic robot does chores around and inside homes. Different kinds include:

- Robotic vacuum cleaners and floor-washing robots that clean floors with sweeping and wet mopping functions. Some use Swiffer or other disposable cleaning cloths to dry-sweep, or reusable microfiber cloths to wet-mop.
- Dressman is a robot to iron shirts using hot air.
- Cat litter robots are automatic self-cleaning litter boxes that filter clumps out into a built-in waste receptacle that can be lined with an ordinary plastic bag.
- Rotimatic is a kitchen robot that makes rotis, tortillas, puris out of flour in just few minutes.
- Security robots such as Knightscope have a night-vision-capable wide-angle camera that detects movements and intruders. It can patrol places and shoot video of suspicious activities, too, and send alerts via email or text message; the stored history of past alerts and videos are accessible via the Web. The robot can also be configured to go into action at any time of the day.

Outdoor robots:

Outdoor robots are domestic robots that perform different chores that exist outside of the house.

Robotic lawn mowers are one type of outdoor robot that cut grass on their own without the need for a driver. Some models can mow complicated and uneven lawns that are up to three-quarters of an acre in size. Others can mow a lawn as large as 40,000 square feet (3,700 m^2), can handle a hill inclined up to 27 degrees.

There are also automated pool cleaners that clean and maintain swimming pools autonomously by scrubbing in-ground pools from the floor to the waterline in 3 hours, cleaning and circulating more than 70 US gallons (260 l) of water per minute, and removing debris as small as 2 μm in size.

Gutter-cleaning robots such as Looj use brushes and rubber blades to remove debris from rain gutters; users operate the device using a remote.

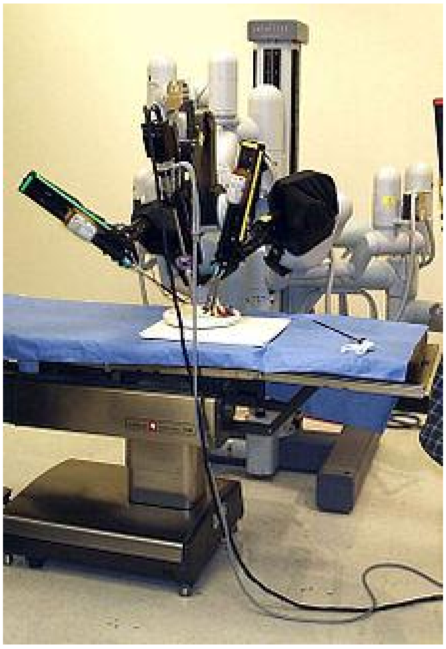
A window-washing robot commonly uses two magnetic modules to navigate windows as it sprays cleaning solution onto microfiber pads to wash them. It covers about 1,601 square feet (148.7 m^2) per charge.

First generation Roomba vacuumsthe carpets in a domestic environment:

Medical robots:

A medical robot is a robot used in the medical sciences. They include, but are not limited to, surgical robots. These are in most telemanipulators, which use the surgeon's actions on one side to control the "effector" on the other side.

A laparoscopic robotic surgery machine. Patient-side cart of the da Vinci surgical system.



Swarm robotics:

Swarm robotics is an approach to the coordination of multirobot systems which consist of large numbers of mostly simple physical robots. It is supposed that a desired collective behavior emerges from the interactions between the robots and interactions of robots with the environment. This approach emerged on the field of artificial swarm intelligence, as well as the biological studies of insects, ants and other fields in nature, where swarm behaviour occurs.

The research of swarm robotics is to study the design of robots, their physical body and their controlling behaviours. It is inspired but not limited by the emergent behaviour observed in social insects, called swarm intelligence. Relatively simple individual rules can produce a large set of complex swarm behaviours. A key-component is the communication between the members of the group that build a system of constant feedback. The swarm behavior involves constant change of individuals in cooperation with others, as well as the behavior of the whole group.

Unlike distributed robotic systems in general, swarm robotics emphasizes a large number of robots, and promotes scalability, for instance by using only local communication.

That local communication for example can be achieved by wireless transmission systems, like radio frequency or infrared.

A team of iRobot Create robots at the Georgia Institute of Technology

1.4.Healthcare Robots

1.4.1. Definition of Healthcare Robots

A Healthcare robot is a robot used in the medical sciences. They include, but are not limited to, surgical robots. These are in most telemanipulators, which use the surgeon's actions on one side to control the "effector" on the other side.

1.4.2. Challenges of Healthcare Robots

Healthcare Robots are facing similar challenges. The advent of new consumer technology is introducing even more challenges, or bringing older ones to the fore. This disruptive technology promotes greater patient power. The most agile and forward-thinking health economies have the opportunity to revolutionize the way care is delivered, and in doing so, to transform their societies. This paper outlines challenges with which we see our clients struggling, and some of the trends we think will impact healthcare for the better. Among the global challenges that will impact healthcare in the near future are:

◆Rising costs:

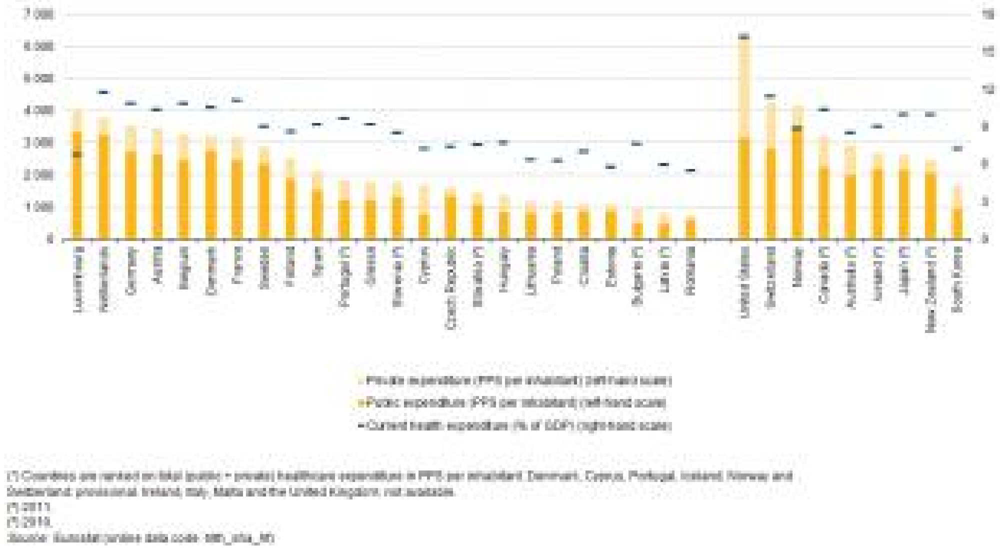
Spending on healthcare almost invariably grows faster than GDP. The rate of growth of healthcare spend has exceeded that of GDP since records began. Moreover, spending and economic recession are closely linked. We can expect to see the rate of growth of healthcare spend in Europe outstrip GDP growth significantly during the current economically difficult times. Macroeconomic factors like aging populations or insufficient public funding are challenging both receivers and providers of healthcare. Adoption and penetration rates of clinical information systems vary greatly. In fact, the number (and size) of buyers varies from country to country, and is not necessarily dependent on the size of the country but rather on the structure of the healthcare system. Additionally, purchasing behavior is shifting towards more coordinated, joint purchasing.

- Service is in demand:

There is increasing demand on the healthcare delivery organizations, and this is happening in every country. People live longer thanks to advances in understanding of the causes of diseases, and consequent improvements in diagnostic techniques and treatments. The average life expectancy in OECD countries has now reached 80 years and continues to lengthen. However, not only are people living longer, but increasingly people are living longer with chronic disease.

- Easy access

The graph below shows the distribution of hospital sizes. As demand and spending increase, health economies increasingly will need to balance ease of access to their services against the cost of operating smaller hospitals. For many countries, the rationalization of the healthcare system means the closure of small regional hospitals, which becomes a politically-charged issue. This rationalization also has to take into account the increasing specialization of tertiary hospitals, which is discussed later in this paper.



1.4.3. Solutions of Healthcare Robots

Governments and healthcare organizations need partners that can help them understand how the healthcare landscape is changing, and how to make the most of the emerging trends and technology, With deep experience in developing and integrating business, clinical and IT solutions for public and private sector health organizations across Europe and North America, CGI helps clients anticipate challenges and achieve real transformation. Additionally, our client proximity business model promotes understanding of local markets and political environments while leveraging CGI's global capabilities and delivery systems to provide best-fit solutions that are cost-effective and platform-agnostic. We offer focused expertise and innovative solutions for patient-centric care management, electronic medical records, healthcare administration, health information exchange, health insurance exchange, health analytics, enterprise content management, military health, public health, translational research and pharma and life sciences. We welcome the chance to be a part of a new enlightenment for each player in the healthcare ecosystem, from governments to enterprises to individuals.

1.5.Benefits and Drawbacks of Human Detection & Identification

1.5.1. Benefits

1.5.1.1. Increased efficiency

Industrial robots are able to complete certain tasks faster and better than people, as they are designed to perform these tasks with a higher accuracy level. This and the fact that they are used to automate processes which previously might have taken significantly more time and resources, means that you can often use industrial robots to increase the efficiency of your production line.

1.5.1.2. Higher Quality

Due to their high accuracy levels, robots can also be used to produce higher quality products which adhere to certain standards of quality, whilst also reducing the time needed for quality control.

1.5.1.3. Improved Working Environment

Industrial robots are often used for performing tasks which are deemed as dangerous for humans, as well as being able to perform highly laborious and repetitive tasks. Overall, by using industrial robots you can improve the working conditions and safety in your factory or production plant. Robots don't get tired and make dangerous mistakes, neither do they suffer from repetitive strain injury.

1.5.1.4. Increased Profitability

By increasing the efficiency of your production process, reducing the resource and time needed to complete it, and also achieving higher quality products, industrial robots can thus be used to achieve higher profitability levels overall, with lower cost per product.

1.5.1.5. Longer Working Hours

Typically people have to have breaks, get distracted and after time attention drops and pace slows. With a robot it can work 24/7, and keeps running at 100%. Typically if you replace one person on a key process in a production line with a robot the output increases by 40% in the same working hours just because a robot has more stamina and never stops. Robots also don't take holidays or have unexpected days off sick.

1.5.1.6. Prestige

You set yourself at the cutting edge of your industry and wow your customers when they come to see you. As a marketing tool robots are fantastic, boost your brand image, and have often been used simply for the PR even if they don't offer many benefits over a bespoke non-robotic system

1.5.2. Drawbacks

1.5.2.1. Capital Cost

Whilst industrial robots can prove highly effective and bring you a positive ROI, implementing them might require a fairly high capital cost. That's why, before making a decision we recommend considering both the investment needed and also the ROI you expect to achieve. Often the easiest way to get round this issue is to take out asset finance and the ROI of the robot more than pays for the interest on the asset finance.

1.5.2.2. Expertise

Whilst industrial robots are excellent for performing many tasks, as with any other type of technology, they require more training and expertise to initially set up. The expertise of a good automation company with a support package will be very important. To minimize your reliance on automation companies you can train some of your engineers on how to program robots, but you will still need the assistance of experienced automation companies for the original integration of the robot.

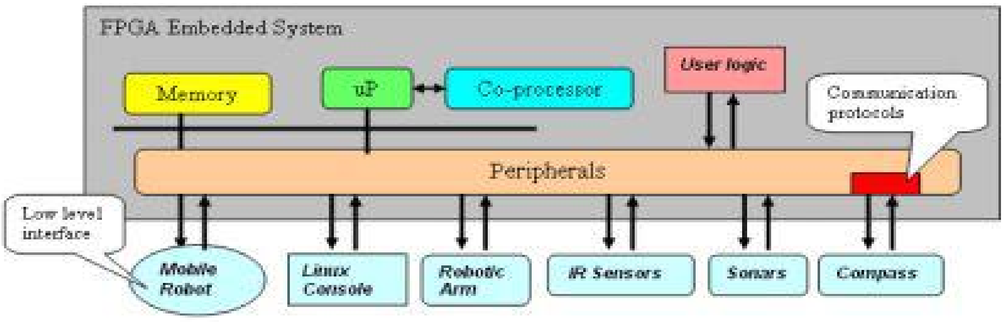
1.5.2.3. Limitations

In recent years the number of industrial robots and the applications they can be used for has increased significantly. However, there still are some limitations in terms of the type of tasks they can perform, which is why we suggest that an automation company looks at your requirement to assess the options first. Sometimes a bespoke automated system may give a better or faster result than a robot. Also, a robot does not have everything built into it, often the success or failure of an industrial robotic system depends on how well the surrounding systems are integrated e.g. grippers, vision systems, conveyor systems etc. Only use good trusted robot integrators to be sure of the optimum results if you do choose to use industrial robots.

1.6.System Requirements

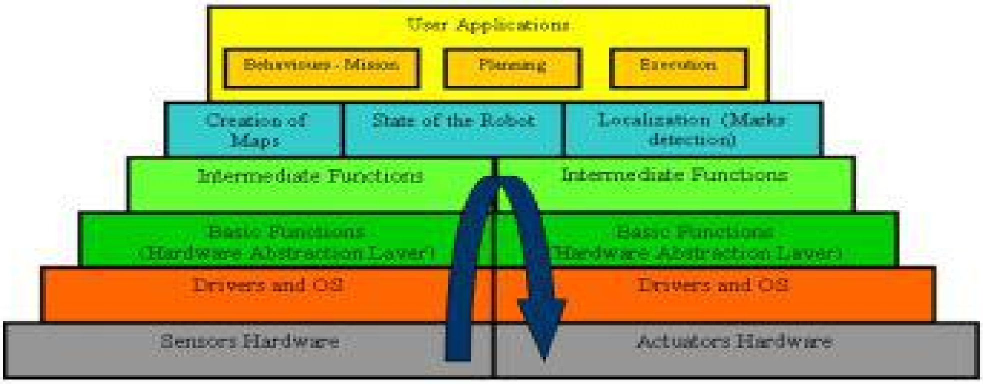
1.6.1. Hardware Tools

Like most ES, they are divided in two parts: Hardware and Software. Fig 1 shows functional diagram of hardware platform and all the components interconnected to form whole system. FPGA hardware platform proposed is designed to support any kind of mobile robot that has a low-level command interface, like serial protocol. Also hardware platform must support any additional element to increase its functionality, as sensors, robotics arms, cameras or a hardware component in general, regardless interface communication that they use; since any protocol can be implemented with FPGA logic. Other important feature of this hardware platform are co-processors, they can accelerate software execution of some specific task, taking advantage of parallelism in hardware. In this case, an image processing co-processor was added to perform convolution task. This core improves convolution processing through a series of parallel modules working in different places of image at the same time. In general, coprocessors can be used to implement any kind of hardware accelerator to improve performance of some algorithms. Custom logic are another feature that helps with data processing. For example in this work, it implements a hardware module that makes distance conversion of a sonar, this is done in hardware, letting processor free to execute another tasks. Also custom logic can be used to implement protocols, in this case an I2C protocol was implemented in FPGA to communicate with some sensors. In general, FPGA allows implementation of any kind of communication protocol.



1.6.2. Software Tools

To control and to manage all hardware elements a software platform is required, also microprocessor are used to run user programs. Fig. 2 shows software architecture proposed, this platform is organized in abstraction layers, at bottom layer there is sensors and actuators hardware. Upper Drivers and OS layer has all drivers needed to low-level communication with the hardware elements, also these drivers are working over a Linux OS that runs on FPGA.The General Case: Nontrivially. Next layer is Basic Functions, this layer converts peripheral language into robotic programmers language, e.g. for mobile robot, it has functions like move forward, move backwards, stop, turn, etc. They are functions that a robotic programmer understand, but their functionality is basic.



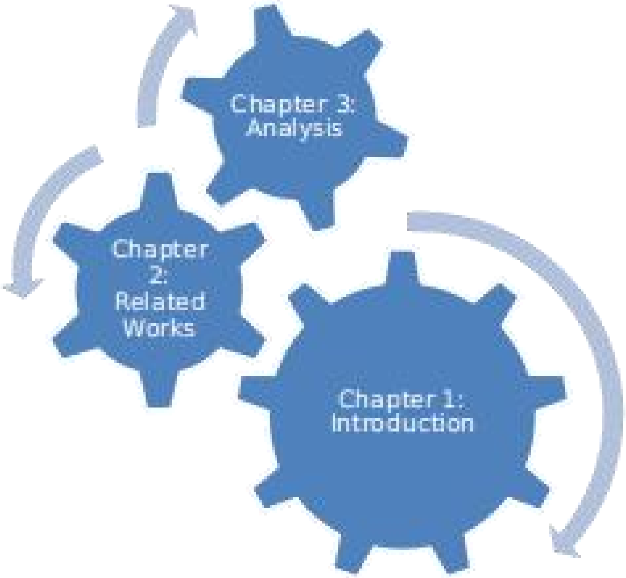
In Intermediate Functions layer, it has functions with a higher level of abstraction, functions that perform behaviors like avoiding obstacles, position movements for robotic arm, following a line, etc. Next two layers are more complex, they have specific functions that helps to creation of maps, localization, state of robot, vision algorithms, etc. In addition, in top layer, it has user applications, in this layer user can take basic and intermediate functions to develop his programs. This work focus only in first four low layers, but software platform are open to construct a more elaborated software architecture. The details of implementation are describe in next section, also it presents specific hardware components and software libraries used on FPGA platform.

1.7.Research Organization

This research consists of 3 chapters. First chapter presents introduction and background of the system development. Chapter one also consist of the research questions, system requirements.

Chapter two introduces a review on related change management literature focusing on strategies to ensure successful change. Moreover, research conducted clarifies change occurrences.

Chapter three was explained about the selection of appropriate methodology in the development of this system. It will explain the methodology done to develop the system.



Outline of the research

CHAPTER TWO

RELATED WORKS

2.1 History

Medical Robots. Nowadays, it is no longer surprising to learn that a hospital's top performing surgeon is not human. With unmatched precision and the ability to work without fatigue, medical robots are obviously one of the most useful applications of robotic technology. These robots are widely used in various medical practices, including difficult surgical procedures, and have completely revolutionized the speed and efficiency of health care services in several parts of the world.

2.2 Similar Studies

2.2.1 Telepresence Robot:

2.2.1.1 Overview

"Telemedicine" typically refers to clinical services that are offered from a remote location (telepresence) by doctors or other healthcare professionals. The term "telehealth" typically covers a broader scope of services offered via a remote presence. Telehealth often encompasses both clinical services and non-clinical services. Non-clinical services may include such tasks as meetings, training sessions, remote lectures, remote family visits, and similar usage. Telemedicine allowed physicians to access patient data from distance, interact with patient, diagnose and process treatment through virtual space. With the combination of robotic technology, telemedicine has step further to provide care for any patient from rural to urban area.

It is used to treat patients who are in remote locations, where a remote-control physician is in touch to ask questions to the patient, and high-resolution cameras in addition to complex equipment to help him to conduct the necessary detection and examination.

RP-VITA is the first remote presence solution for patient care that combines autonomous navigation and mobility from iRobot with telemedicine technology from InTouch Health.

The RP-VITA, which is a collaboration between iRobot and InTouch Health stands, and the screen (a pivoting touch tablet) can angle to look at patients and help navigate busy hallways. The new robot will allow doctors to interact with patients in other hospitals, and to monitor patients using otoscopes, ultrasound,stethoscopes and more.

The InTouch Vita, also known as the RP-Vita, is a remote presence robot developed by iRobot and InTouch Health, and is assisting medical professionals in the exchange of information in healthcare environments and enhanced service to patients. Already being used in several hospitals, the Vita robot is helping to revolutionize the healthcare industry by allowing medical staff to monitor and advise patients from remote locations.

Robot does not treat patients, it is a way for doctors and nurses to communicate with patients remotely and to know the patient's data and medical condition by communicating with his electronic medical records.

2.2.1.2 Methodology

The RP-VITA robot operates a Wi-Fi remote control system that can be controlled by the doctor from anywhere in the hospital and given orders to visit patients, talk to them and diagnose their condition, as well as roaming at night in the corridors of the hospital. The robot also replaces the role of an on-duty doctor with an HD camera, a screen, a microphone and a loudspeaker to communicate with the patient. The robot carries many diagnostic tools, including the earpiece, sonar and radiology, and the nurse has only to pull the speaker and put it on the patient's chest so that the doctor can hear his breathing or heart beats remotely.

2.2.1.3 Advantages

- RP-VITA shortens the distance between patients and their physician.
- RP-VITA is not only saving time and provides immediately aid for patient, but also giving physician more flexibility and convenience at work.

- It allows physician to save time spend on a patient and/or access to more than one patient at a time.
- This impact will eventually reduce the cost for hospital while maintaining the quality of service for patient.

2.2.1.4 Disadvantages

- RP-VITA can reduce the number of patients who visit doctor office because many the patients can sit at home and have diagnosis through telecommunication with their doctor. This may result in the decrease of staffs in that doctor office because they have become the extras, Leading to unemployment.

2.2.2 Surgical Assistants

2.2.2.1 Overview

With the advancement in technology, these robots really change the face of healthcare. It either allows surgical operations to be carried out with greater precision compared to the human surgeon or allow remote surgery where the physician is not present physically with the patient. While performing critical tasks or operations like open heart surgery, removal of fibroids, joint replacements, kidney surgeries etc. These robots prove to be an asset in the medical field. The main reason behind using these robots in medicine is to provide great diagnostic abilities, to do more precise interventions, more comfortable experience for the patient etc. The Da Vinci surgical system & Zeus robotic surgical system has been cleared by the FDA to assist surgeons.

The da Vinci System consists of a surgeon's console that is typically in the same room as the patient, and a patient-side cart with four interactive robotic arms controlled from the console. Three of the arms are for tools that hold objects, and can also act as scalpels, scissors, bevies, or graspers. The surgeon uses the console's master controls to maneuver the patient-side cart's three or four robotic arms (depending on the model). The instruments' jointed-wrist design exceeds the natural range of motion of the human hand; motion scaling and tremor reduction further interpret and refine the surgeon's hand movements.

The da Vinci System always requires a human operator, and incorporates multiple redundant safety features designed to minimize opportunities for human error when compared with traditional approaches.

The da Vinci System has been designed to improve upon conventional laparoscopy, in which the surgeon operates while standing, using hand-held, long-shafted instruments, which have no wrists. With conventional laparoscopy, the surgeon must look up and away from the instruments, to a nearby 2D video monitor to see an image of the target anatomy. The surgeon must also rely on a patient-side assistant to position the camera correctly. In contrast, the da Vinci System's design allows the surgeon to operate from a seated position at the console, with eyes and hands positioned in line with the instruments and using controls at the console to move the instruments and camera.

By providing surgeons with superior visualization, enhanced dexterity, greater precision and ergonomic comfort, the da Vinci Surgical System makes it possible for more surgeons to perform minimally invasive procedures involving complex dissection or reconstruction. For the patient, a da Vinci procedure can offer all the potential benefits of a minimally invasive procedure, including less pain, less blood loss and less need for blood transfusions. Moreover, the da Vinci System can enable a shorter hospital to stay, a quicker recovery and faster return to normal daily activities.

2.2.2.2 Methodology

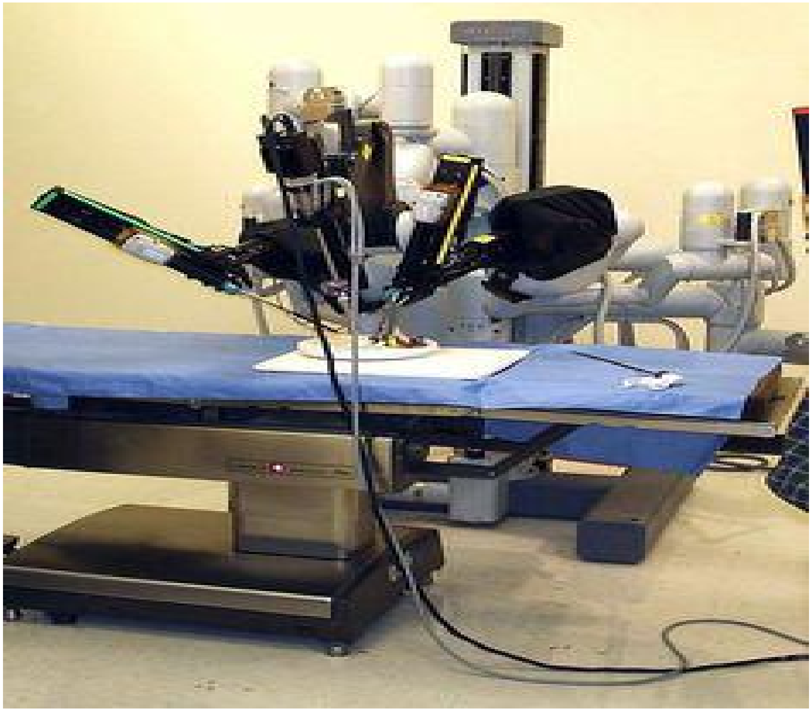
The da Vinci Si has two separate but connected sections:

The tower, which is positioned directly over the patient during surgery, contains the robot’s four arms—three that can hold a multitude of different surgical instruments, and a fourth that holds the system’s 3-D cameras. These arms are controlled by a computer that exactly replicates the movements of the operating surgeon.

The console is where the surgeon sits and operates the robot’s controls while looking into a stereoscopic monitor that provides a magnified, high definition 3-D view of the surgical site. The surgeon manipulates the robot’s four arms by maneuvering two master controls that provide fingertip precision of movement.

The surgeon also operates a footswitch that provides additional options, such as the ability to switch between two different energy sources. Touchpads allow the surgeon to easily adjust video, audio and system settings, while the ergonomic console and the alignment of the controls and monitor are designed to keep the surgeon in a relaxed, focused position at all times.

Finally, additional video screens link in the rest of the surgical team by providing a two-dimensional view of what the surgeon is looking at through the da Vinci's stereoptic monitor.



2.2.2.3 Advantages

- This surgery system provides patients with a significantly shorter recovery period.
- It is minimally invasive, which means that blood loss is reduced.
- There is also less scarring with this robotic surgery system.
- Patients are able to return to work and their other everyday activities faster.
- In many cases, this system provides better clinical results.

2.2.2.4 Disadvantages

- In the event of a defect during the operation by the Da Vinci robot, and the doctor to perform a traditional surgery, the patient then needs to overdose of the drug, and may cause a defect in the cells in the patient.

- In the event of an unwanted collision between the arms during the operation of surgery, does not stop its work and may cause a problem and errors may lead to the failure of the surgical operation.

- The high cost of this device.

2.2.3 ROBOT TO TREAT AUTISM:

2.2.3.1 Overview

This type is used to help autistic children to use robotics, such as the idea that a sick child canby interacting with the robot, improve his emotional, social and mental skills.

Millions of children in the world are suffering from autism, a disease that has yet to be treated, but the gentle robot Kasper is ready to help.

The studies have shown that Kasper can act as a safe and predictable learning tool for children with autism. It enables them to learn social interaction and communication skills and meet specific educational or therapeutic objectives in an enjoyable play context.

Kasper is controlled by a remote control, and Kasper interact with the children and teach them how to interact socially with others, and so far, Kasper has helped more than 300 children with autism.

2.2.3.2 Methodology

Kasper's design features a human-like complexion, which will give a better impression for children, as well as many programming and design features such as the ability to laugh, watch and wave.

Also sings song, imitates eating, plays the tambourine and combs his hair during their sessions aimed at helping children with his social interaction and communication.

2.2.3.3 Advantages

- Helps children get rid of autism and give them the ability to deal with normal life and people.

2.2.3.4 Disadvantages

- One disadvantage that comes along with social robots is the price to purchase one.
- Social robots take responsibilities away from therapists, which could lead to a decrease in pay for therapist or even result in therapists being let go. Therapists are not even needed at the same location as the robot during a therapy session.

2.2.4 Analytical Robots:

2.2.4.1 Overview

Blood donation or periodic analysis is a big problem for many, especially for the presence of several problems in obtaining the vein that does not appear easily enables the doctor to withdraw the blood sample required of the patient, causing more pain and wasting a lot of time, especially in critical cases.

VEEBOT has solved this complex problem because it has the unique ability to pull the required blood sample in a few seconds. It uses imaging technology to find the vein and then draw the blood and locate it to pull the sample faster and more safely.

2.2.4.2 Methodology

VEEBOT combines the latest in robotics and imaging technology to ultimately speed up the process of drawing blood or inserting IVs. The patient slides his or her arm into an inflatable cuff, which acts as a tourniquet. An infrared light illuminates the inner elbow for a camera that searches for a suitable vein using software that compares the camera's view against a model of an arm's veins. Next, ultrasound confirms that the chosen vein has sufficient blood flow for a successful blood draw. Finally, the robotic arm aligns itself with the chosen vein and inserts the needle.

The whole process takes about a minute, and tests of the VEEBOT show that it can correctly identify the best vein with approximately 83% accuracy, which is about as good as a human phlebotomist. And, all that the human phlebotomist, that still has a job, needs to do is load the test tube or IV bag, disinfect the arm and clean the puncture afterwards, and perhaps offer the "this is going to stick a little" warning to anxious patients.

VEEBOT should hopefully offer some reassurances to those with tricky veins.

2.2.4.3 Advantages

- ◆Reduce error and decrease venipuncture times.
- ◆This saves hospitals and clinics money.
- ◆Reduces the risk of injury to practitioners, and improves comfort and care for patients.

2.2.4.4 Disadvantages

- ◆The soles always need sterilization.
- ◆He needs the intervention of human beings.
- ◆The high cost of this device.

2.2.5 Medical Transportation Robots

2.2.5.1 Overview

Supplies, medications, and meals are delivered to patients and staff by these robots, thereby optimizing communication between doctors, hospital staff members, and patients. “Most of these machines have highly dedicated capabilities for self-navigation throughout the facility,” states ManojSahi, a research analyst with Tactical, a market intelligence firm that specializes in technology. “There is, however, a need for highly advanced and cost-effective indoor navigation systems based on sensor fusion location technology in order to make the navigational capabilities of transportation robots more robust.”

2.2.5.2 Helpmate Hospital Robot

Helpmate robot being used to carry patients' meals at a hospital. The robot navigates throughout the hospital, avoiding any obstacles by using a memorized map of the building together with sonar and vision systems. In addition to meals, the robot is used to deliver medicine, medical records & equipment to the wards, to transport specimens & packages to & from laboratories, and handle any internal mail. Helpmate robots became active in hospitals in the mid to late nineties but the technology research dates to the mid-eighties. In that span of time Transitions Research Corporation was funded by NASA and then went public and changed its name to Help Mate Robotics.

2.2.5.3 Methodology

The robot receives instructions through a human–machine interface. An installed knowledge base helps the robot to maneuver around the hospital. The robot is equipped to climb stairs, detect obstacles, move in lifts and call for opening or shutting doors.

The robot is loaded with supplies, given specific instructions through the human–machine interface and then it goes to its destination. It offloads the supplies, takes back anything else and moves on.

The robot navigates throughout the hospital, avoiding any obstacles by using a memorized map of the building together with sonar and vision systems.

2.2.5.4 Advantages

- ◆Medicines are delivered with a higher accountability via an integrated chain of custody systems.
- ◆Automated delivery enables pharmacy technicians to focus on performing high-value tasks such as mixing IVs without committing any mistake.
- ◆Delivery of medicines can be more frequent and nurses can concentrate on caring for patients rather than worry about missing medicines and supplies.
- ◆Automated delivery brings down costs and improves on-time reliability.
- ◆Waste can be collected more frequently, improving control of infection and maintaining a neat appearance in the facility.
- ◆Automated waste transport brings down the risk of injuries from the transport of heavy loads.
- ◆Lab test items can be delivered immediately, hence speeding the testing process.
- ◆Some of these systems have call functionality to deliver to departments behind locked doors.

- Accurate tracking of high-priced equipment and supplies ensure that the number of lost items is decreased

2.2.5.5 Disadvantages

- Although these robots can walk and automatically discover the path within the hospital, but this process (according to experts) is still in need of further development

- High cost of making robot cells safe, including collision sensors.

- Extremely expensive to purchase and install in automated manufacturing.

2.2.6 Sanitation and Disinfection Robots

2.2.6.1 Overview

With the increase in antibiotic-resistant bacteria and outbreaks of deadly infections like Ebola, more healthcare facilities are using robots to clean and disinfect surfaces. “Currently, the primary methods used for disinfection are UV light and hydrogen peroxide vapors,” says Sahi. “These robots can disinfect a room of any bacteria and viruses within minutes.”

2.2.6.2 Xanax Disinfection Robot:

With ultraviolet light technology, these robots disinfect the specific area within a minute and make it free of viruses, bacteria etc. These robots move anywhere inside the room & target a predefined area that you wish to disinfect. With the help of ultraviolet lamps, it zaps the nucleic acid within the bacteria & disrupts their DNA and make it impossible for them to reproduce again.

For healthcare & production sector it has been considered as the flexible & user-friendly disinfection tool. These are very cost efficient and kills 99% of bacteria within ten minutes of exposure

2.2.6.3 Methodology

High intensity ultraviolet light is produced by our xenon flash lamps across the entire disinfecting spectrum known as UV-C. This UV-C energy passes through the cell walls of bacteria, viruses and bacterial spores. The DNA, RNA and proteins inside the microorganism absorb this intense UV-C energy. Xanax Full Spectrum UV-C provides four mechanisms of damage against pathogens.

2.2.6.4 Advantages

- In use in more hospitals than any other UV disinfection device, Xenex offers the only Pulsed Xenon UV disinfection system on the market.
- XenexLightStrike Germ-Zapping Robots are developed and designed to be highly effective, efficient and portable, allowing for the proven and systematic disinfection of any space within a healthcare facility.
- Provides a fast, safe and effective method of disinfection.
- Preserves the health of healthcare workers and hospital employees by providing thorough disinfection of all surfaces.
- Environmentally-friendly disinfection technology that uses no chemicals and does not contain toxic mercury. No safety or disposal issues associated with mercury bulbs.

2.2.6.5 Disadvantages

- Low dosages may not effectively inactivate some viruses, spores, and cysts.
- Organisms can sometimes repair and reverse the destructive effects of UV through a “repair mechanism,” known as photoreactivation, or in the absence of light known as “dark repair.”

- A preventive maintenance program is necessary to control fouling of tubes.

- Turbidity and total suspended solids (TSS) in the wastewater can render UV disinfection ineffective. UV disinfection with low-pressure lamps is not as effective for secondary effluent with TSS levels above 30 mg/L.

- UV disinfection is not as cost-effective as chlorination, but costs are competitive when chlorination-dichlorination is used and fire codes are met.

- There is no measurable residual to indicate the efficacy of UV disinfection.

2.2.7 Rebilitional Robot:

2.2.7.1 Overview

Rehabilitation robotics can be considered a specific focus of biomedical engineering, and a part of human-robot interaction. In this field, clinicians, therapists, and engineers collaborate to help rehabilitate patients.

Prominent goals in the field include: developing implementable technologies that can be easily used by patients, therapists, and clinicians; enhancing the efficacy of clinician's therapies; and increasing the ease of activities in the daily lives of patients.

There are different types of robots that can be used in the results of a stroke. The InMotion can be used, it allows participates to practice reaching movement in horizontal plane with a reduction of gravity. The motions that are performed require shoulder flexion and extension and external rotation. It is very easy to set up the usage of this robot. The procedure of using this robot is the following. The participant sits down at a desk and places her or his into a trough. Then the participants' looks at a computer screen and try to reach out for the target. As you are reaching out for the target the device gives guidance so that your therapy can be successful.

Another example of rehabilitation robot is called Hipbot. The Hipbot is a robot used in patients with limited mobility. The hip is an important joint in the human body, it supports our weight and allows the movement and statically position. When people suffer a fracture by an accident or have problems in this location, need to improve a rehabilitation process. This robot helps in this cases, because it combines movements of abduction/adduction and flexion/extension that help the patients to restore their mobility. The robot has 5 degree of freedom mechanism necessary to all positions for the rehab, it is controlled by a PID controller and can be used for both legs (separately).

2.2.7.2 Methodology

Design an upper arm movement rehabilitation task that requires cognitive processing as well as could contribute to a variety of functional daily living activities.

Design a controller to provide robotic assistance to help participants to perform the above movement rehabilitation task. In what follows we present the basic design of the task and the assistive controller.

2.2.7.3 Advantages

- Reduce or eliminate pain.
- Avoid surgery.
- Improve mobility.
- Recover from a stroke.
- Recover from a sports injury.
- Improve balance and prevent falls.

2.2.7.4 Disadvantages

- It still needs developments to cope with the tasks it is doing with a natural arm.

◆It should be accurate so that no complications occur.

2.2.8 Pharmacy automation

2.2.8.1 Overview

Pharmacy automation involves the mechanical processes of handling and distributing medications. Any pharmacy task may be involved, including counting small objects (e.g., tablets, capsules); measuring and mixing powders and liquids for compounding; tracking and updating customer information in databases (e.g., personally identifiable information (PII), medical history, drug interaction risk detection); and inventory management.

2.2.8.2 Methodology

The robots tower over humans, both in size and ability to deliver medications accurately. Housed in a tightly secured, sterile environment, the automated system prepares oral and injectable medicines, including toxic chemotherapy drugs. In addition to providing a safer environment for pharmacy employees, the automation also frees UCSF pharmacists and nurses to focus more of their expertise on direct patient care.

2.2.8.3 Advantages

- Speed. One of the biggest benefits of these machines is faster service. Customers do not have to wait as long to receive medication, and the machine can fill a prescription much faster than a human can.
- Safety. Pills that look alike may be easily confused or miscounted by pharmacy staff, while the automated machine does not have this problem. In addition, the pills and medications are kept in a sterile environment, making the common occurrence of medication contamination much less likely.
- Customer service. Allowing robots to fill prescriptions allows pharmacists to devote more time to patient care. Pharmacists may be free to talk to patients about their medications, address possible interactions, and answer questions to improve the quality of a patient’s life. Pharmacists may also be able to devote more time to provide basic preventive care, such as administering immunizations and performing health screening.
- Security. Medications are securely locked in automated dispensing machines, and all dispensed pills are tracked by the machine’s software. Only certain pharmacy staff members are trained on how to use, open, and restock the machines, reducing the potential of medication theft or human error.

2.2.8.4 Disadvantages

- Variety. There are many different kinds of automated dispensing machines, each with its own specific operating procedures. Older machines may be less reliable, while newer ones may have a complicated interface that is difficult to use.
- Mistakes. Unfortunately, automated pharmacy dispensing machines can still make mistakes—and if the wrong drug is loaded into the machine, many customers can receive the wrong medication before the problem is identified.
- Breakdowns. To reduce human error, only a few staff members may be trained to use the machine at each location. This can cause delays if the machine needs service, is malfunctioning, or needs reloading of vials and medications.
- Software problems. These machines are run by computer programs, which can fail without warning. Installing software updates and hooking the machine to the pharmacy’s own record management system can take time, and must be done properly to avoid errors in the future.

2.2.9 Health care system:

2.2.9.1 Overview

To provide a balanced and well healthcare for human in hospitals that improves the traditional manual monitoring system so, design an automatic wireless health monitoring for patients; to avoid the late diagnosis due to the number of medical team compared to the number of patients, the delay in dealing with different cases specially the critical ones.

The system works as multiple devices in one by measuring and monitoring the vital parameters for patients as the temperature, heat beat, ECG and EMG then sending all those results through GSM in a form of SMS message to the doctor concerning that there is a critical case exceeded the basic diagnosis standards in the measurements taken. this wireless commination done by receiving the sensors data and resent it to the microcontroller for displaying them on the GLCD.

In this system we present a mobile device based wireless healthcare monitoring system that can provide real time online information about physiological conditions of a patient. system is designed to measure and monitor important physiological data of a patient to accurately describe the status of her/his health and fitness. In addition, system can send alarming message about the patient’s critical health data by text messages or by SMS report. It operates wirelessly using ZigBee network. By using the information contained in the text message the healthcare professional can provide necessary medical advising. The system mainly consists of nine sensors, the data acquisition unit, microcontroller, GSM module and ZigBee modules. The patent’s temperature, heart beat rate, blood pressure, blood glucose level, ECG, EMG, and patient position are monitored, displayed, and stored by system.

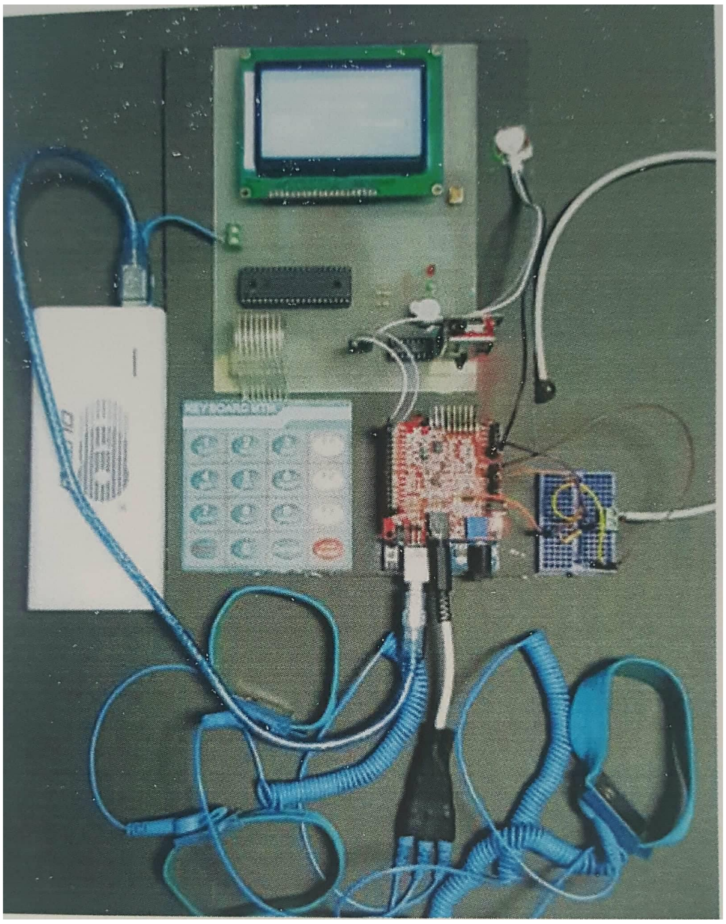
2.2.9.2 Methodology

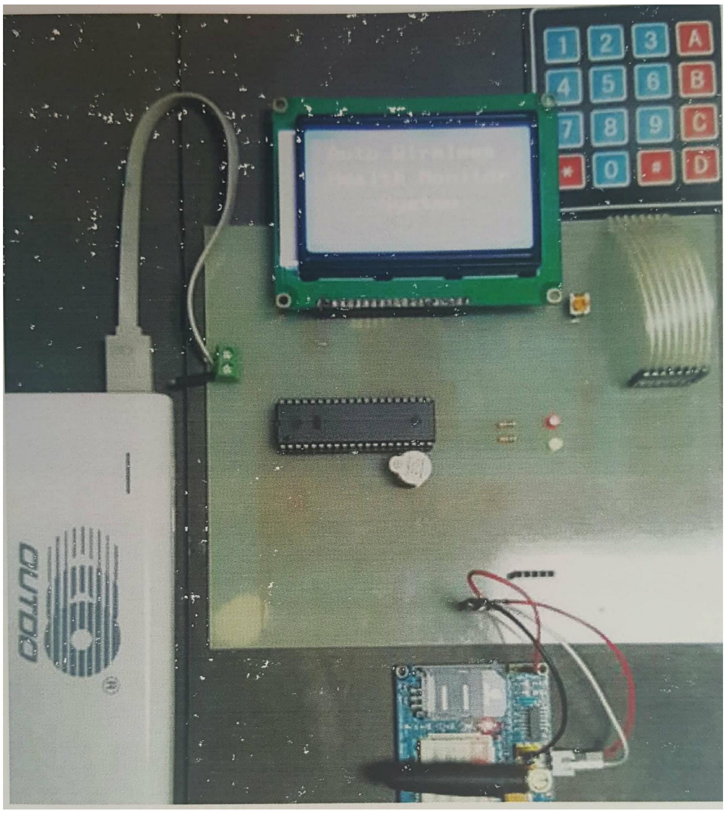
In this system, some of modern wireless technologies are used such as GSM and ZigBee. In addition to the wireless, some of recent existing sensors are utilized for measuring different parameters of the patient.

In this system, a wireless network is created for remotely monitoring of patient's health parameters like Temperature, Blood Pressure, Glucose, ECG, Heartbeat, and skin conductance. All these parameters are continuously measured using appropriate efficient low-cost modules, which are designed for each parameter.

The measured data from the patients are transferred to a central monitoring station via a ZigBee. In this a GLCD is used for monitoring the parameters. The monitoring system automatically transmits the information to the doctor's hand phone on the mobile network as a SMS message via a GSM device / SMS gateway ant at the same time the system will update the hospital database periodically. The system was successful as a prototype to send SMS regarding the patient info to the doctors.

This system transmitting module continuously reads patient's body statistics through seven different sensors, sensor sent data to the microcontroller which displays it on the GLCD screen and transmits encoded serial data over the air by ZigBee in critical case. Receiver is used to receive data using another ZigBee, decode it and feed it to another microcontroller which is then displayed on anther GLCD screen for staff, and send text massage to doctor by GSM module.





2.2.9.3 Advantages

- Wireless.
- Real time measurement.
- Physiologic information (temperature, heart rate, heart sound, weight) are dynamically analyzed.

2.2.9.4 Disadvantages

- ZigBee will deal with each other only 90 meters away, making him a certain distance.

2.3 Comparative Study

Title	Methodology	Advantages	Disadvantages
Telepresence Robot	The RP-VITA robot operates a Wi-Fi remote control system that can be controlled by the doctor from anywhere in the hospital and given orders to visit patients, talk to them and diagnose their condition, as well as roaming at night in the corridors of the hospital. The robot also replaces the role of an on-duty doctor with an HD camera, a screen, a microphone and a loudspeaker to communicate with the patient. The robot carries many diagnostic tools, including the earpiece, sonar and radiology, and the nurse has only to pull the speaker and put it on the patient's chest so that the doctor can hear his breathing or heart beats remotely.	•RP-VITA shortens the distance between patients and their physician. •RP-VITA is not only saving time and provides immediately aid for patient, but also giving physician more flexibility and convenience at work. •It allows physician to save time spend on a patient and/or access to more than one patient at a time. This impact will eventually reduce the cost for hospital while maintaining the quality of service for patient.	•RP-VITA can reduce the number of patients who visit doctor office because many the patients can sit at home and have diagnosis through telecommunication with their doctor. This may result in the decrease of staffs in that doctor office because they have become the extras, Leading to unemployment.

Surgical Assistants	Throughout the robotic surgery the surgeon sits at a special consol. A very small 3D camera and dime-sized surgical instruments are placed inside the patient through tiny incisions. The camera gives the surgeon a magnified 360 degree view of the operative field. Using the console's hand and foot controls, the surgeon remotely moves robotic arms attached to surgical instruments. A second surgeon is positioned at the operating table to confirm the correct placement of the surgical instruments	•This surgery system provides patients with a significantly shorter recovery period. •It is minimally invasive, which means that blood loss is reduced. •There is also less scarring with this robotic surgery system.	•In the event of a defect during the operation by the DaVinci robot, and the doctor to perform a traditional surgery, the patient then needs to overdose of the drug, and may cause a defect in the cells in the patient. • In the event of an unwanted collision between the arms during the operation of surgery, does not stop its work and may cause a problem and errors may lead to the failure of the surgical operation. • The high cost of this device
Robot to Treat Autism	This type is used to help autistic children to use robotics, such as the idea that a sick child can by interacting with the robot, improve his emotional, social and mental skills. Kasper's design features a human-like complexion, which will give a better impression for children, as	•Helps children get rid of autism and give them the ability to deal with normal life and people.	•One disadvantage that comes along with social robots is the price to purchase one. •Social robots take responsibilities away from therapists, which could lead to a decrease in pay for therapist or even

	well as many programming and design features such as the ability to laugh, watch and wave. also sings song, imitates eating, plays the tambourine and combs his hair during their sessions aimed at helping children with his social interaction and communication.		result in therapists being let go. Therapists are not even needed at the same location as the robot during a therapy session.
Analytical Robots	There are problems in getting the vein that does not seem to easily enable the doctor to pull the required blood sample from the patient, causing more pain and wasting a lot of time, especially in critical cases. VEEBOT combines the latest in robotics and imaging technology to ultimately speed up the process of drawing blood or inserting IVs. The patient slides his or her arm into an inflatable cuff, which acts as a tourniquet. An infrared light illuminates the inner elbow for a camera that searches for a suitable vein using software that compares the camera's view against a model of an arm's veins. Next, ultrasound confirms that the chosen vein has sufficient blood flow for a	•Reduce error and decrease venipuncture times. •This saves hospitals and clinics money. • reduces the risk of injury to practitioners, and improves comfort and care for patients.	

	successful blood draw. Finally, the robotic arm aligns itself with the chosen vein and inserts the needle.		
Medical Transportation Robots	The robot receives instructions through a human–machine interface. An installed knowledge base helps the robot to maneuver around the hospital. The robot is equipped to climb stairs, detect obstacles, move in lifts and call for opening or shutting doors. The robot is loaded with supplies, given specific instructions through the human–machine interface and then it goes to its destination. It offloads the supplies, takes back anything else and moves on. The robot navigates throughout the hospital, avoiding any obstacles by using a memorized map of the building together with sonar and vision systems.	•Medicines are delivered with a higher accountability via an integrated chain of custody systems •Automated delivery brings down costs and improves on-time reliability. •Waste can be collected more frequently, improving control of infection and maintaining a neat appearance in the facility. •Accurate tracking of high-priced equipment and supplies ensure that the number of lost items is decreased	•Although these robots can walk and automatically discover the path within the hospital, but this process (according to experts) is still in need of further development •High cost of making robot cells safe, including collision sensors. •is extremely expensive to purchase and install in automated manufacturing. •Accurate imaging is required for the hospital to avoid any obstacles and needs to receive instructions through a human–machine interface
Sanitation and Disinfection Robots	High intensity ultraviolet light is produced by our xenon flash lamps across the entire disinfecting spectrum known as UV-C. This UV-C energy passes through the cell walls of	•Provides a fast, safe and effective method of disinfection. •Preserves the health of healthcare workers and hospital employees by	•Low dosages may not effectively inactivate some viruses, spores, and cysts. •Organisms can sometimes repair and reverse the

	bacteria, viruses and bacterial spores. The DNA, RNA and proteins inside the microorganism absorb this intense UV-C energy. Xanax Full Spectrum UV-C provides four mechanisms of damage against pathogens	providing thorough disinfection of all surfaces. •Environmentally-friendly disinfection technology that uses no chemicals and does not contain toxic mercury. No safety or disposal issues associated with mercury bulbs.	destructive effects of UV through a “repair mechanism,” known as photoreactivation, or in the absence of light known as “dark repair.” •A preventive maintenance program is necessary to control fouling of tubes. •Turbidity and total suspended solids (TSS) in the wastewater can render UV disinfection ineffective. UV disinfection with low-pressure lamps is not as effective for secondary effluent with TSS levels above 30 mg/L. •UV disinfection is not as cost-effective as chlorination, but costs are competitive when chlorination-dichlorination is used and fire codes are met. •There is no measurable residual to indicate the efficacy of UV disinfection.

Rehabilitation Robot	design an upper arm movement rehabilitation task that requires cognitive processing as well as could contribute to a variety of functional daily living activities. design a controller to provide robotic assistance to help participants to perform the above movement rehabilitation task. In what follows we present the basic design of the task and the assistive controller.	Reduce or eliminate pain. Avoid surgery. Recover from a stroke. Improve balance and prevent falls.	It still needs developments to cope with the tasks it is doing with a natural arm. It should be accurate so that no complications occur.
Pharmacy Automation	The robots best over humans, both in size and ability to deliver medications accurately. Housed in a tightly secured, sterile environment, the automated system prepares oral and injectable medicines, including toxic chemotherapy drugs. In addition to providing a safer environment for pharmacy employees, the automation also frees UCSF pharmacists and nurses to focus more of	Speed. One of the biggest benefits of these machines is faster service. Customers do not have to wait as long to receive medication, and the machine can fill a prescription much faster than a human can. Safety. Pills that look alike may be easily confused or miscounted by	Variety. There are many different kinds of automated dispensing machines, each with its own specific operating procedures. Older machines may be less reliable, while newer ones may have a complicated interface that is difficult to use. Mistakes. Unfortunately, automated pharmacy

	their expertise on direct patient care.	pharmacy staff, while the automated machine does not have this problem. In addition, the pills and medications are kept in a sterile environment, making the common occurrence of medication contamination much less likely. Security. Medications are securely locked in automated dispensing machines, and all dispensed pills are tracked by the machine's software. Only certain pharmacy staff members are trained on how to use, open, and restock the machines, reducing the potential of medication theft or human error.	dispensing machines can still make mistakes and if the wrong drug is loaded into the machine, many customers can receive the wrong medication before the problem is identified. Breakdowns. To reduce human error, only a few staff members may be trained to use the machine at each location. This can cause delays if the machine needs service, is malfunctioning, or needs reloading of vials and medications. Software problems. These machines are run by computer programs, which can fail without warning. Installing software updates and hooking the machine to the pharmacy's own record management system can take time, and must be done properly to avoid errors in the future.
Healthcare	to provide a balanced and well healthcare for human	•Wireless. •Real time	•ZigBee will deal with each other only 90

System	in hospitals that improves the traditional manual monitoring system so, design an automatic wireless health monitoring for patients; to avoid the late diagnosis due to the number of medical team compared to the number of patients, the delay in dealing with different cases specially the critical ones. The system works as multiple devices in one by measuring and monitoring the vital parameters for patients as the temperature, heartbeat, ECG and blood pressure. This system transmitting module continuously reads patient's body statistics through seven different sensors, sensor sent data to the microcontroller which displays it on the GLCD screen and transmits encoded serial data over the air by ZigBee in critical case. Receiver is used to receive data using another ZigBee, decode it and feed it to another microcontroller which is then displayed on anther GLCD screen for staff, and send text massage to doctor by GSM module.	measurement. •Physiologic information (temperature, heart rate, heart sound, weight) are dynamically analyzed.	meters away, making him a certain distance.

2.4 Problem Definition

Although robotics have evolved rapidly and effectively to help patients and critical situations in most areas of medicine, there are still some problems and missing links that always need them to developed .For example, in surgical procedures, the patient's pressure, temperature, and heartbeat should be measured periodically before and during the operation of the patient's maximum insulin In the remote sensing robots, despite the speed of access to the doctor to help the patient and reduce the distance, but lacks the partial speed of intervention and diagnosis of the patient's condition, which enables the patient and the doctor to act more accurately and knowledge. In health care system that it works accurately in the measurement of pressure and temperature and heart beat continuously and identify the critical cases and to inform the doctor as soon as it works only after a certain distance It is important to have a medical robot capable of performing the necessary tasks necessary to contribute to raising the level of medicine and upgrading to the highest level appropriate to the health of the patient by helping to measure the pressure and temperature and heart beat more accurately and faster and can also do work CT scan more precisely.

2.5 Research Questions

- What are robots?
- What about robots in healthcare system?
- What is the categories of robots in healthcare?
- How can robots in each department work?
- What is advantages and disadvantages of each robot?
- What benefits have we taken from the health robots that have helped humans?

2.6 Research Objectives

Robots are about to reach beyond their traditional well-structured factory floors to become companions for humans in complex, unpredictable environments. As a companion, the robot must still be able to safely navigate and manipulate objects, but it must also be able to robustly and naturally cooperate and interact with people to match human intuition. Therefore, the traditional robotic research paradigm aiming at studying physical interactions (between robots and objects), needs to be complemented with the investigation of cognitive interactions between robots and humans. Human-robot interaction (HRI) can only be effective on the premise that perception, e.g., seeing and hearing, and perception-action cycles are properly addressed. In comparison to the well-established vision-based HRI methodologies, auditory HRI has been much less investigated. Ideally, HRI would use voice communication as much as humans do it among each other, but current limitations in robot audition do not allow for effective, natural, untethered acoustic communication between robots and humans in real-world environments. This is mainly due to the fact that the human communication partners and other sound sources of interest will be at some distance and the microphone signals as picked-up by the robot are strongly impaired by additional noise and reverberation. Aggravating the problem even further, the robot itself produces significant 'ego noise', due to its mechanical drives and electronics. Compared to other hands-free human-machine audio interfaces, e.g., in cars, the human-robot distance is usually larger and the environment more adverse, and as a consequence, speech recognition and sound classification performance is far inferior. This implies that robot-embodied cognition cannot use the according inputs from the acoustic domain and exploit its potential for HRI, as robot audition (i) cannot beneficially be combined with other sensorial modalities, e.g., vision, and hence (ii) it cannot interact with the large repertoire of multimodal behaviours that are instinctively used for human-to-human casual communication and interaction, such as speech and prosodic sounds accompanied by hand gestures and head motions.

While the human auditory system has a sophisticated hearing mechanism and unique cognitive capabilities to extract the desired auditory information, the corresponding auditory signal processing for robots is still in its infancy.

CHAPTER THREE
SYSTEM ANALYSIS & DESIGN

3.1 Overview

Systems development is systematic process which includes phases such as planning, analysis, design, deployment, and maintenance. We will primarily focus on system analysis and system design.

System analysis is a process of collecting and interpreting facts, identifying the problems, and decomposition of a system into its components. It is conducted for the purpose of studying a system or its parts in order to identify its objectives. It is also a problem solving technique that improves the system and ensures that all the components of the system work efficiently to accomplish their purpose. It specifies what the system should do.

System design is a process of planning a new business system or replacing an existing system by defining its components or modules to satisfy the specific requirements. Before planning, you need to understand the old system thoroughly and determine how computers can best be used in order to operate efficiently. It focuses on how to accomplish the objective of the system.

3.2 System Study

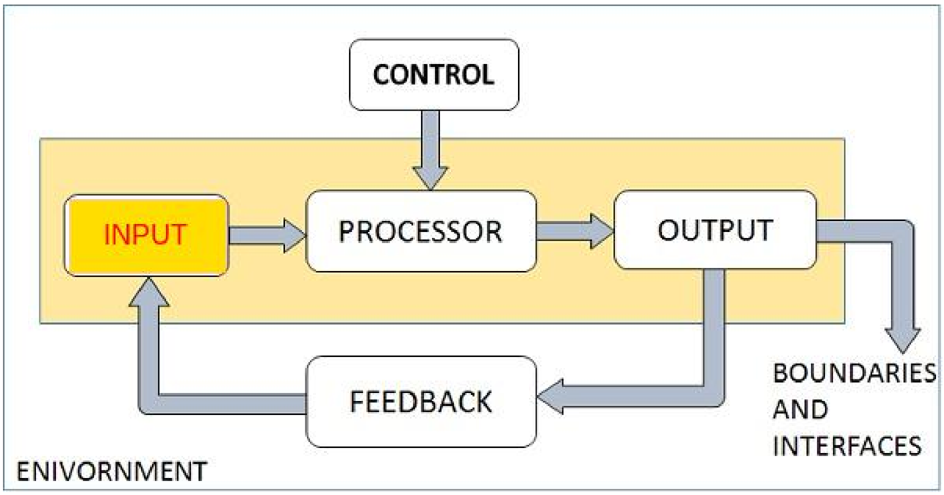
3.2.1 What is System?

A system is a regularly interacting or interdependent group of items forming a unified whole. Every system is delineated by its spatial and temporal boundaries, surrounded and influenced by its environment, described by its structure and purpose and expressed in its functioning.

Each system may contain several subsystems. A subsystem is a set of elements, which is a system itself, and a component of a larger system. It is also a system object that contains information defining the characteristics of an operating environment controlled by the system.

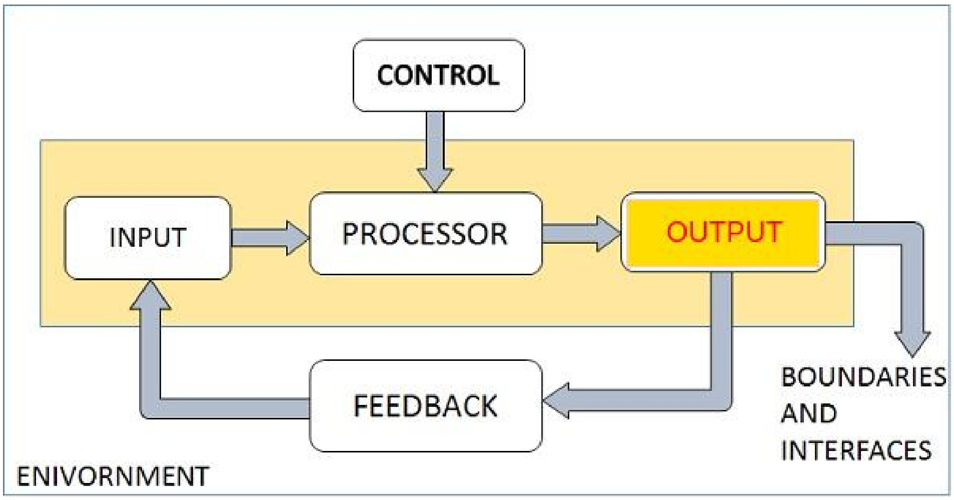
3.2.1.1 Input

Inputs are the information that enters into the system for processing. For example, voice commands are considered an input in our project.



3.2.1.2 Output

Output is the outcome of processing. The main aim of a system is to produce an output which is useful for its user. For example, the outputs for this Medical Robot may be the movements resulted from the voice commands (from the input process), and results shown on the Robot's screen.



3.2.1.3 Embedded Processor

Processor is the heart of an embedded system. It is the basic unit that takes inputs and produces an output after processing the data.

Embedded processors are generally smaller, use a floor mount form factor and eat much less energy. An embedded processor is a microprocessor this is used in an embedded system. An embedded processor is a microprocessor designed especially for coping with the wishes of an embedded gadget. A normal microprocessor best comes with the processor in the chip. The peripherals are separate from the main chip, ensuring in extra strength intake. Embedded processors have many real life examples.

3.2.1.4 Control system

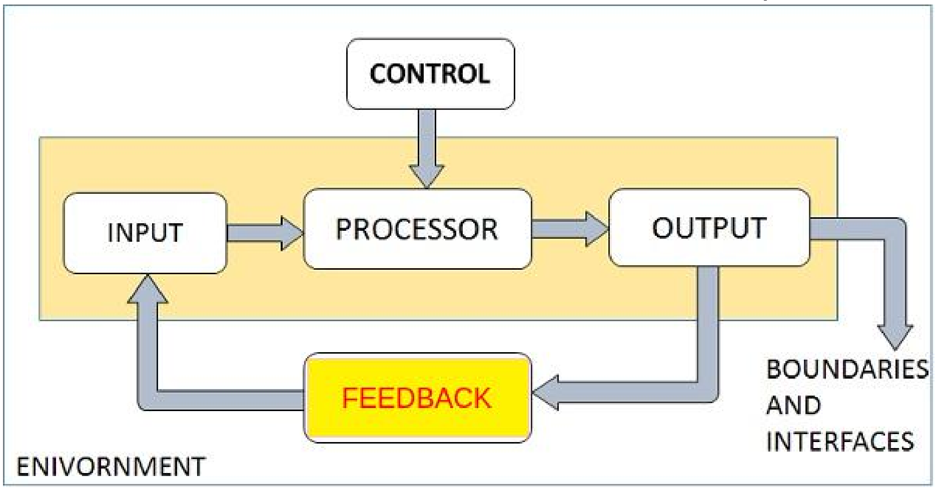
A control system is a set of mechanical or electronic devices that regulates other devices or systems by way of control loops. Typically, control systems are computerized. Control systems are used to enhance production, efficiency and safety in many areas.

Control systems are a central part of industry and of automation. The types of control loops that regulate these processes include industrial control systems (ICS) such as supervisory control and data acquisition (SCADA) and distributed control systems (DCS).

3.2.1.5 Feedback

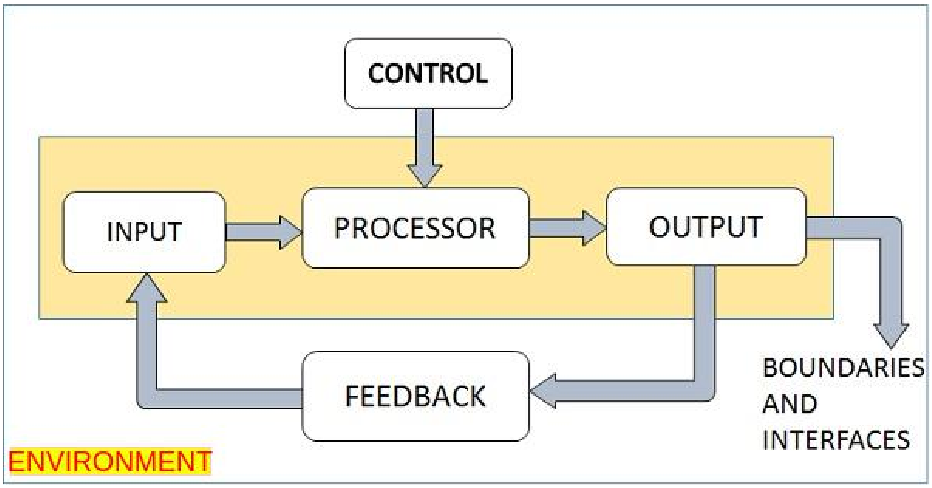
Feedback occurs when outputs of a system are routed back as inputs as part of a chain of cause-and-effect that forms a circuit or loop. The system can then be said to feed back into itself. The notion of cause-and-effect has to be handled carefully when applied to feedback systems:

Simple reasoning about a feedback system is difficult because the first system influences the second and second system influences the first, leading to a circular argument. This makes reasoning based upon cause and effect tricky, and it is necessary to analyze the system as a whole.



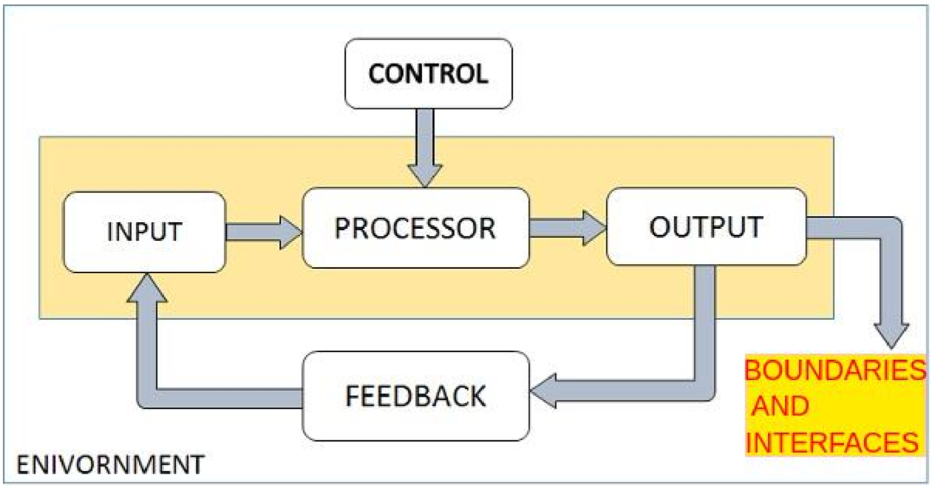
3.2.1.6 Environment

A system is the part of the universe that is being studied, while the environment is the remainder of the universe that lies outside the boundaries of the system. It is also known as the surroundings or neighborhood. Depending on the type of system, it may interact with the environment by exchanging mass, energy, linear momentum, angular momentum, electric charge, or other conserved properties. In some disciplines, such as information theory, information may also be exchanged. The environment is ignored in analysis of the system, except in regard to these interactions.



3.2.1.7 Boundaries and Interface

A system should be defined by its boundaries. Boundaries are the limits that identify its components, processes, and interrelationship when it interfaces with another system. Each system has boundaries that determine its sphere of influence and control. So, the knowledge of the boundaries of a given system is crucial in determining the nature of its interface with other systems for successful design.



3.3 Preliminary Investigation

Preliminary investigation is the first phase of the SDLC. In this phase, the system is investigated. The objective of this phase is to conduct an initial analysis and findings of the system.

By the end of Preliminary Investigation phase, the development team should furnish a document that holds different specific recommendations for the candidate system.

3.4 Feasibility Study

A feasibility study is conducted to find out whether the proposed system is possible, affordable and acceptable for organization. The financial, political, social and time constraints must be considered during this study.

It is important to be reasonably sure of the success of proposed system before initiating work on it. A feasibility study is a study to find out whether the proposed system is possible, affordable, or acceptable.

3.4.1 Technical Feasibility

This assessment is based on an outline design of system requirements, to determine whether the company has the technical expertise to handle completion of the project. When writing a feasibility report, the following should be taken to consideration:

- A brief description of the business to assess more possible factors which could affect the study.
- The part of the business being examined.
- The human and economic factor.
- The possible solutions to the problem.

The technical feasibility assessment is focused on gaining an understanding of the present technical resources of the organization and their applicability to the expected needs of the proposed system. It is an evaluation of the hardware and software and how it meets the need of the proposed system.

3.4.2 Economic Feasibility

The purpose of an economic feasibility study is to demonstrate the net benefit of a proposed project for accepting or disbursing electronic funds/benefits, taking into consideration the benefits and costs to the agency, other state agencies, and the general public as a whole. The economic feasibility study is composed of two required forms: Business Case, and Cost Benefit Analysis.

3.4.3 Operational Feasibility

Operational feasibility is the measure of how well a proposed system solves the problems, and takes advantage of the opportunities identified during scope definition and how it satisfies the requirements identified in the requirements analysis phase of system development.

The operational feasibility assessment focuses on the degree to which the proposed development project fits in with the existing business environment and objectives with regard to development schedule, delivery date, corporate culture and existing business processes.

To ensure success, desired operational outcomes must be imparted during design and development. These include such design-dependent parameters as reliability, maintainability, supportability, usability, producibility, disposability, sustainability, affordability and others. These parameters are required to be considered at the early stages of design if desired operational behaviours are to be realized. A system design and development requires appropriate and timely application of engineering and management efforts to meet the previously mentioned parameters. A system may serve its intended purpose most effectively when its technical and operating characteristics are engineered into the design. Therefore, operational feasibility is a critical aspect of systems engineering that needs to be an integral part of the early design phases.

3.5 System Requirements Specification

A system requirements specification is a description of a software system to be developed. It lays out functional and non-functional requirements, and may include a set of use cases that describe user interactions that the system must provide.

System requirements specification establishes the basis for an agreement between customers and contractors or suppliers (in market-driven projects, these roles may be played by the marketing and development divisions) on what the system product is to do as well as what it is not expected to do. System requirements specification permits a rigorous assessment of requirements before design can begin and reduces later redesign. It should also provide a realistic basis for estimating product costs, risks, and schedules.Used appropriately, system requirements specifications can help prevent system project failure.

The system requirements specification document enlists enough and necessary requirements that are required for the project development. To derive the requirements, the developer needs to have clear and thorough understanding of the products to be developed or being developed. This is achieved and refined with detailed and continuous communications with the project team and customer till the completion of the system.

3.5.1 Software Requirements:

Software requirements deal with defining software resource requirements and prerequisites that need to be installed on a computer to provide optimal functioning of an application. These requirements or prerequisites are generally not included in the software installation package and need to be installed separately before the software is installed.

3.5.1.1 Operating System

Raspbian is the recommended operating system for normal use on a Raspberry Pi. It's a free operating system based on Debian, optimized for the Raspberry Pi hardware. It comes with over 35,000 packages: precompiled software bundled in a nice format for easy installation on your Raspberry Pi. Raspbian is a community project under active development, with an emphasis on improving the stability and performance of as many Debian packages as possible.

3.5.1.2 Programming Language

While The Python Language Reference describes the exact syntax and semantics of the Python language, this library reference manual describes the standard library that is distributed with Python. It also describes some of the optional components that are commonly included in Python distributions. Python's standard library is very extensive, offering a wide range of facilities as indicated by the long table of contents listed below. The library contains built-in modules (written in C) that provide access to system functionality such as file I/O that would otherwise be inaccessible to Python programmers, as well as modules written in Python that provide standardized solutions for many problems that occur in everyday programming. Some of these modules are explicitly designed to encourage and enhance the portability of Python programs by abstracting away platform-specifics into platform-neutral APIs.

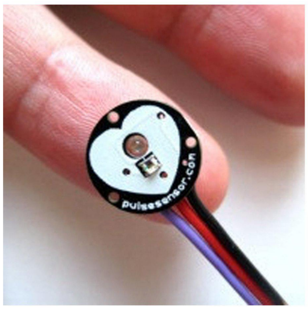
3.5.1.3 Voice Recognition

Google Cloud Speech API enables developers to convert audio to text by applying powerful neural network models in an easy to use API. The API recognizes over 110 languages and variants, to support your global user base. You can transcribe the text of users dictating to an application's microphone, enable command-and-control through voice, or transcribe audio files, among many other use cases. Recognize audio uploaded in the request, and integrate with your audio storage on Google Cloud Storage, by using the same technology Google uses to power its own products.

3.5.2 Hardware Requirements

3.5.2.1 Pulse Sensor

The Pulse Sensor is a plug-and-play heart-rate sensor for micro controllers and micro computers. It essentially combines a simple optical heart rate sensor with amplification and noise cancellation circuitry making it fast and easy to get reliable pulse readings.



3.5.2.2 Blood Pressure Sensor

Automated blood pressure measurements can be a valuable tool in collecting and documenting this critical information. The blood pressure sensor have many applications for scientist and engineers. It can be used for science (engineering) experiments or activity which involves blood pressure measurements such as in the field of exercise science, biology, physiology, medical engineering, blood pressure anomalies, athletes comparison and human health.

3.5.2.3 Body Temperature Sensor

This is human body temperature sensor. It can be applied to skin surface and indicate the body temperature after reaching steady state. The sensor is accurate and stable and comply with medical certification. It can be used in many applications such as child incubators, patient monitoring and medical research labs.

3.5.3 User requirements

User requirements are high-level statements of what the system should do. They should describe functional and non-functional requirements in such a way that they are understandable by system users who don’t have detailed technical knowledge. User requirements are defined using natural language, tables and diagrams as these can be understood by all users.

3.5.3.1 Functional Requirements

A functional requirement document defines the functionality of a system or one of its subsystems. It also depends upon the type of software, expected users and the type of system where the software is used.

Functional user requirements may be high-level statements of what the system should do but functional system requirements should also describe clearly about the system services in detail.

Functional Requirements in project are:

- Mobility: It possesses some form of mobility.
- Programmability: It can be programmed to accomplish a large variety of tasks , After being programmed , it operates automatically.
- Sensors: Be able to sense the environment and give the useful feedback to the device.
- Mechanical Capability: Enabling it to act on its environment rather than merely functions as a data processing or computational device.
- Flexibility: It can operate using a range of programs and transports material in a variety of ways.
- Addressing Cognitive Decline: For example, reminding patient to drink , take medicine or of an appointment.
- Enabling Patients and Caregivers: To interact thereby reducing the frequency of personal visits.
- Collecting Data and Monitoring Patients: Emergencies such as heart failure and high blood sugar level , could be avoided.
- Assisting People with Domestic Tasks: Many give up independent living because of arthritis.
- Accuracy: Robot once instructed can perform a task without fatigue with accuracy , even after long hour of operation.

3.5.3.2 Non-functional Requirements

Requirements that specifies criteria that can be used to judge the operation of a system, rather than specific behaviors. They are contrasted with functional requirements that define specific behavior or functions.

The plan for implementing non-functional requirements is detailed in the system architecture, because they are usually Architecturally Significant Requirements.

Non-functional Requirements in project are:

- Serve as a communication tool: Technology is changing at record speeds, if an older adult can't or doesn't want to learn to use the latest machine, they can simply ask the robot to serve that function.
- Promote independence: A robot that helped with basic chores might delay or diminish the need for unwanted human help.
- The Medial Robot, however, is not supposed to apply any medical treatment to the patient. The workplace of such a robot would be usually confined to one room, either in a hospital or in the patient's room.
- They could help the elderly and chronically ill to remain independent, reducing the need for careers and the demand for care homes.
- Improved patient satisfaction.
- Increased patient referrals.
- Caregiver robot could make sure that heart, blood and body functions are working just fine.

3.5.4 System Requirement

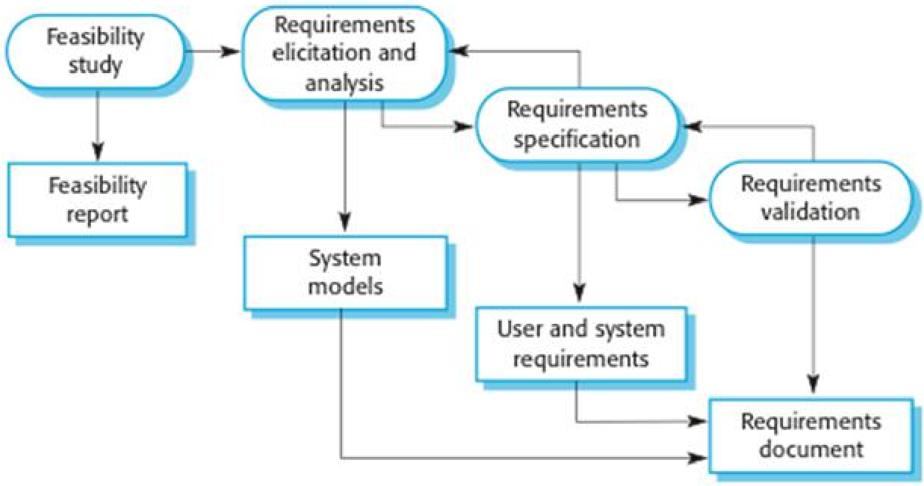
A System Requirement is a document or set of documentation that describes the features and behavior of a system or software application. It includes a variety of elements that attempts to define the intended functionality required by the customer to satisfy their different users. In addition to specifying how the system should behave, the specification also defines at a high-level the main business processes that will be supported, what simplifying assumptions have been made and what key performance parameters will need to be met by the system.

In this project:

- Electric wires should be matched to avoid any drop in the robot functionalities.
- Spare parts to be used if any damage infects the main parts.
- High performance computer (Raspberry Pi).
- The body of the machine should be solid to handle the robot functions.
- The appropriate sensors to match with the used board.

3.5.5 Requirements Engineering Process

The process of defining, documenting and maintaining requirements in the engineering design process. It is a common role in systems engineering and software engineering.



3.5.5.1 Feasibility Study

A feasibility study decides whether or not the proposed system is worthwhile. It's a short focused study that checks if the system contributed to organizational objectives, can be engineered using current technology and within budget, or can be integrated with other systems that are used.

3.5.5.2 Requirements Elicitation

Requirements elicitation is the practice of collecting the requirements of a system from users, customers and other stakeholders. The practice is also sometimes referred to as "requirement gathering".

3.5.5.3 Requirements Analysis

Requirements analysis encompasses those tasks that go into determining the needs or conditions to meet for a new or altered product or project, taking account of the possibly conflicting requirementsof the various stakeholders, analyzing, documenting, validating and managing software or system requirements.

Requirements analysis is critical to the success or failure of a systems or software project. The requirements should be documented, actionable, measurable, testable, traceable, related to identified business needs or opportunities, and defined to a level of detail sufficient for system design.

3.5.5.4 Requirements Specification

Requirements specification in engineering refers to specific design requirement(s). In software engineering, it is a result of a requirements analysis and can refer to Software requirements specification, Hardware requirements specification, or both.

3.5.5.5 Requirements Verification

The evaluation of whether or not a product, service, or system complies with a regulation, requirement, specification, or imposed condition. It is often an internal process. Contrast with validation.

3.5.5.6 Requirements management

Requirements management is the process of documenting, analyzing, tracing, prioritizing and agreeing on requirements and then controlling change and communicating to relevant stakeholders. It is a continuous process throughout a project. A requirement is a capability to which a project outcome (product or service) should conform.

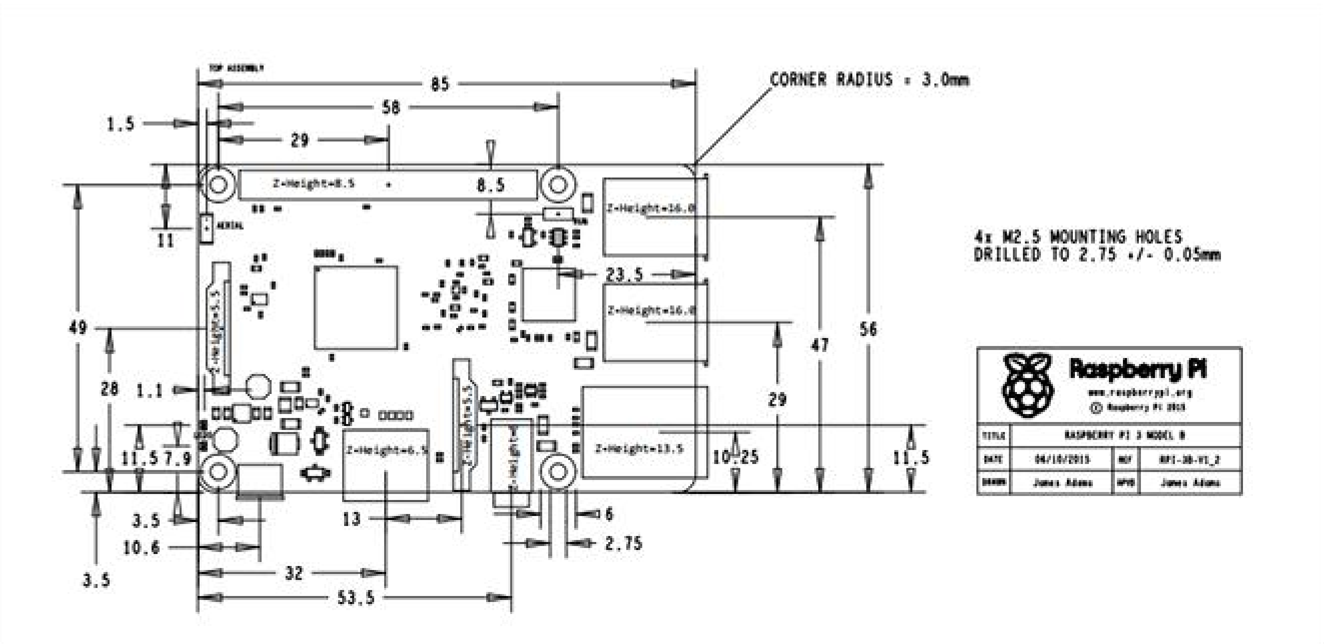
3.5.6 System Architecture

3.5.6.1 Raspberry Pi 3

The Raspberry Pi is a series of small single-board computers developed in the United Kingdom by the Raspberry Pi Foundationto promote the teaching of basic computer science in schools and in developing countries. The original model became far more popular than anticipated, selling outside its target market for uses such as robotics. It does not include peripherals (such as keyboards, mice and cases). However, some accessories have been included in several official and unofficial bundles.

The Raspberry Pi hardware has evolved through several versions that feature variations in memory capacity and peripheral-device support. This block diagram depicts Models A, B, A+, and B+. Model A, A+, and the Pi Zero lack the Ethernet and USB hub components. The Ethernet adapter is internally connected to an additional USB port. In Model A, A+, and the Pi Zero, the USB port is connected directly to the system on a chip (SoC). On the Pi 1 Model B+ and later models the USB/Ethernet chip contains a five-point USB hub, of which four ports are available, while the Pi 1 Model B only provides two. On the Pi Zero, the USB port is also connected directly to the SoC, but it uses a micro USB (OTG) port.

The Raspberry Pi 3, with a quad-core ARM Cortex-A53 processor, is described as 10 times the performance of a Raspberry Pi 1. This was suggested to be highly dependent upon task threading and instruction set use. Benchmarks showed the Raspberry Pi 3 to be approximately 80% faster than the Raspberry Pi 2 in parallelized tasks.



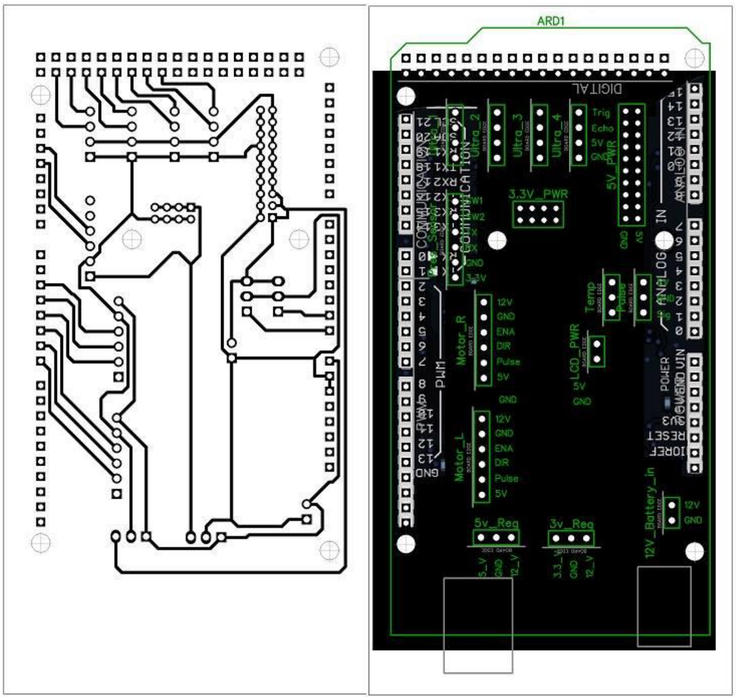
Raspberry Pi 3 Mechanical Drawing

3.5.6.2 Printed Circuit Board (PCB)

A printed circuit board (PCB) mechanically supports and electrically connects electronic components or electrical components using conductive tracks, pads and other features etched from one or more sheet layers of copper laminated onto and/or between sheet layers of a non-conductive substrate. Components are generally soldered onto the PCB to both electrically connect and mechanically fasten them to it.

Printed circuit boards are used in all but the simplest electronic products. They are also used in some electrical products, such as passive switch boxes.

PCBs can be single-sided (one copper layer), double-sided (two copper layers on both sides of one substrate layer), or multi-layer (outer and inner layers of copper, alternating with layers of substrate). Multi-layer PCBs allow for much higher component density, because circuit traces on the inner layers would otherwise take up surface space between components. The rise in popularity of multi-layer PCBs with more than two, and especially with more than four, copper planes was concurrent with the adoption of surface mount technology. However, multilayer PCBs make repair, analysis, and field modification of circuits much more difficult and usually impractical.



PCB for Raspberry Pi 3

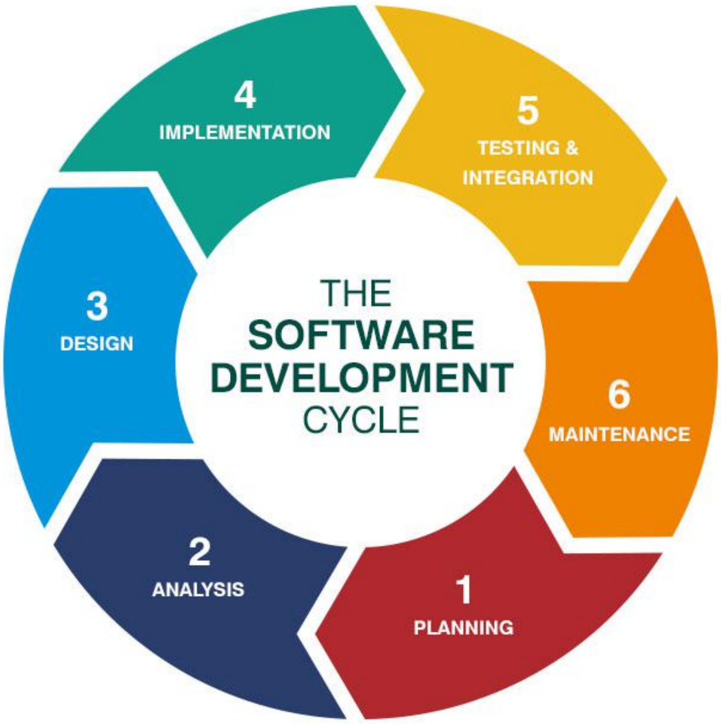
3.6 Proposed Project

There are many crises and problems in nurses requiring US nurses: 67.5% of nurses intend to quit their jobs and since nursing personnel are 90% of the task of communicating directly with the patient, the shortage of their numbers will have serious consequences for the provision of health care, but the medical robot will protect and prevent the crisis of nurses in the world and the person may feel tired or stressed.

3.7 Methodology

3.7.1 What is SDLC?

The software development life cycle is a term used in systems engineering, information systems and software engineering to describe a process for planning, creating, testing, and deploying an information system. The software development life cycle concept applies to a range of hardware and software configurations, as a system can be composed of hardware only, software only, or a combination of both. In consists of the following:



3.7.1.1 Planning and Requirement Analysis

Requirement analysis is the most important and fundamental stage in SDLC. It is performed by the senior members of the team with inputs from the customer, the sales department, market surveys and domain experts in the industry. This information is then used to plan the basic project approach and to conduct product feasibility study in the economical, operational and technical areas.

Planning for the quality assurance requirements and identification of the risks associated with the project is also done in the planning stage. The outcome of the technical feasibility study is to define the various technical approaches that can be followed to implement the project successfully with minimum risks.

3.7.1.2 Defining Requirements

Once the requirement analysis is done the next step is to clearly define and document the product requirements and get them approved from the customer or the market analysts. This is done through an SRS (Software Requirement Specification) document which consists of all the product requirements to be designed and developed during the project life cycle.

3.7.1.3 Designing the product architecture

SRS is the reference for product architects to come out with the best architecture for the product to be developed. Based on the requirements specified in SRS, usually more than one design approach for the product architecture is proposed and documented in a DDS - Design Document Specification.

This DDS is reviewed by all the important stakeholders and based on various parameters as risk assessment, product robustness, design modularity, budget and time constraints, the best design approach is selected for the product.

A design approach clearly defines all the architectural modules of the product along with its communication and data flow representation with the external and third party modules (if any). The internal design of all the modules of the proposed architecture should be clearly defined with the minutest of the details in DDS.

3.7.1.4 Building or Developing the Product

In this stage of SDLC the actual development starts and the product is built. The programming code is generated as per DDS during this stage. If the design is performed in a detailed and organized manner, code generation can be accomplished without much hassle.

Developers must follow the coding guidelines defined by their organization and programming tools like compilers, interpreters, debuggers, etc. are used to generate the code. Different high level programming languages such as C, C++, Pascal, Java and PHP are used for coding. The programming language is chosen with respect to the type of software being developed.

3.7.1.5 Testing the Product

This stage is usually a subset of all the stages as in the modern SDLC models, the testing activities are mostly involved in all the stages of SDLC. However, this stage refers to the testing only stage of the product where product defects are reported, tracked, fixed and retested, until the product reaches the quality standards defined in the SRS.

3.7.1.6 Deployment in the Market and Maintenance

Once the product is tested and ready to be deployed it is released formally in the appropriate market. Sometimes product deployment happens in stages as per the business strategy of that organization. The product may first be released in a limited segment and tested in the real business environment (UAT- User acceptance testing).

Then based on the feedback, the product may be released as it is or with suggested enhancements in the targeting market segment. After the product is released in the market, its maintenance is done for the existing customer base.

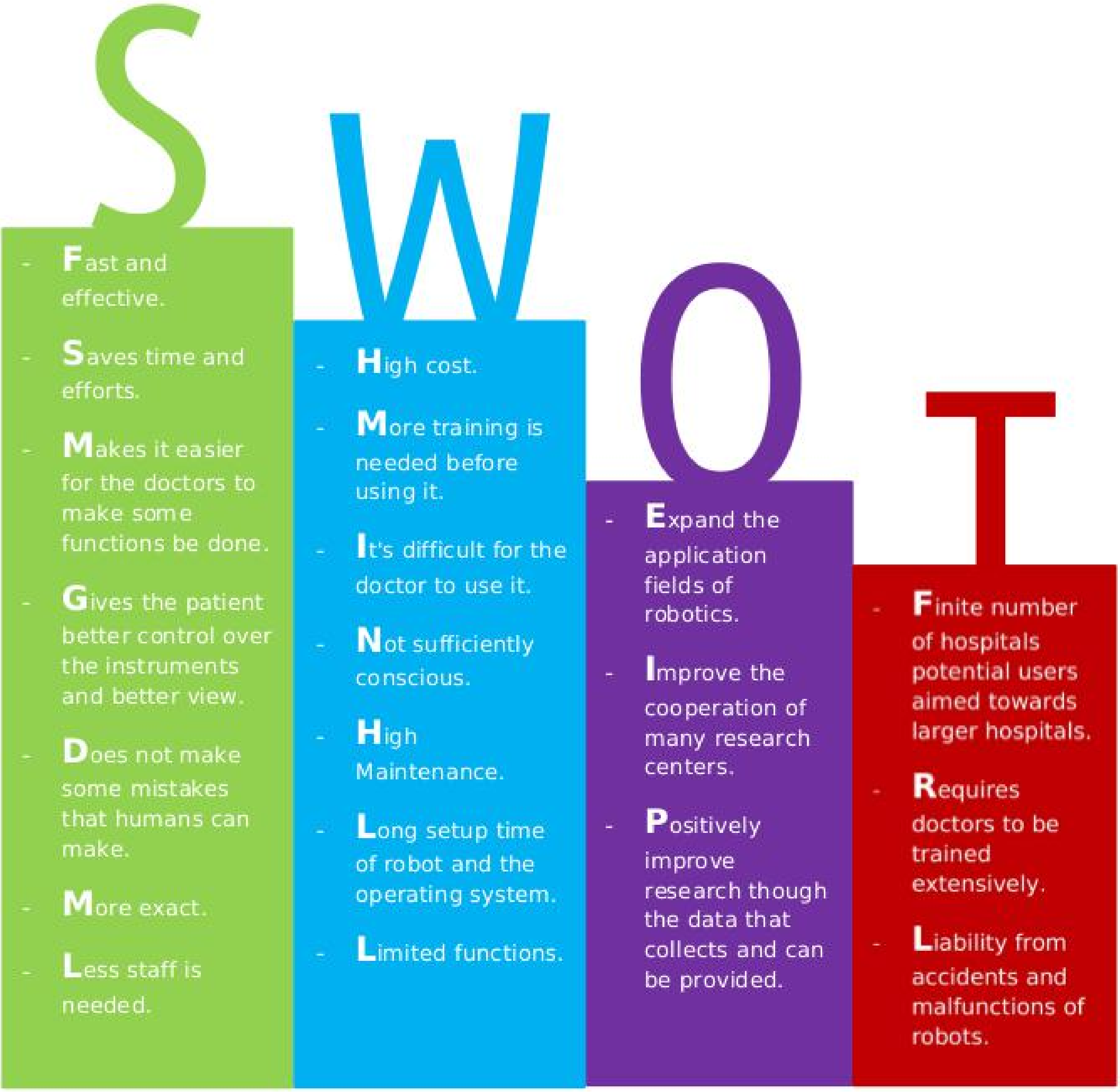
3.8 Analysis

Systems analysis is the process of observing systems for troubleshooting or development purposes. It is applied to information technology, where computer-based systems require defined analysis according to their makeup and design.

Systems analysis can include looking at end-user implementation of a software package or product; looking in-depth at source code to define the methodologies used in building software; or taking feasibility studies and other types of research to support the use and production of a software product, among other things.

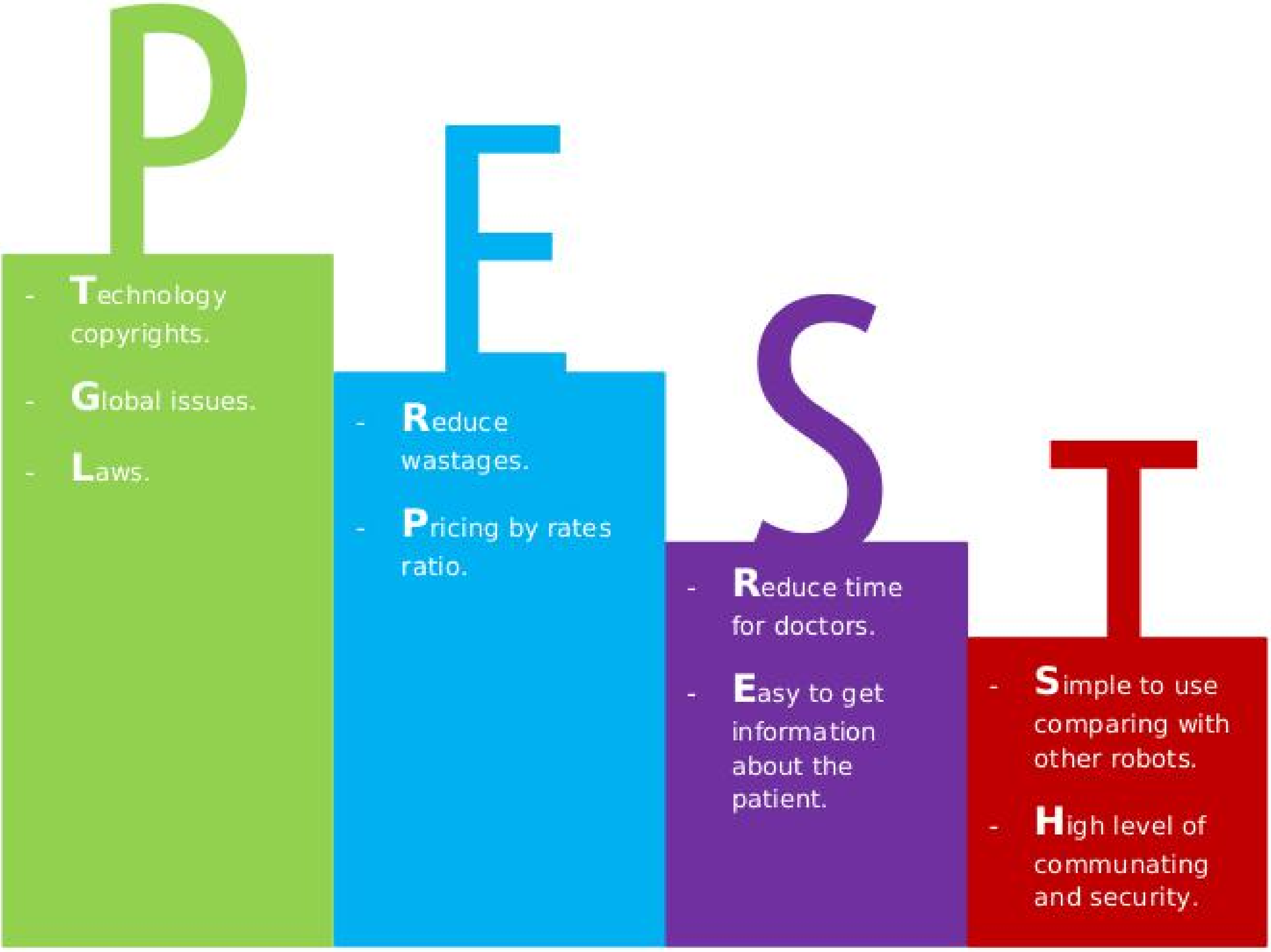
3.8.1 SWOT Analysis:

SWOT analysis is an acronym for strengths, weaknesses, opportunities, and threats and is a structured planningmethod that evaluates those four elements of an organization, project or business venture. A SWOT analysis can be carried out for a company, product, place, industry, or person. It involves specifying the objectives of the business venture or project and identifying the internal and external factors that are favorable and unfavorable to achieve that objective.



3.8.2 PEST Analysis:

PEST analysis (political, economic, socio-cultural and technological) describes a framework of macro-environmental factors used in the environmental scanning component of strategic management. It is part of an external analysis when conducting a strategic analysis or doing market research, and gives an overview of the different macro-environmental factors to be taken into consideration. It is a strategic tool for understanding market growth or decline, business position, potential and direction for operations.



3.9 Design

Systems design is the process of defining the architecture, modules, interfaces, and data for a system to satisfy specified requirements. Systems design could be seen as the application of systems theory to product development. There is some overlap with the disciplines of systems analysis, systems architecture and systems engineering.

3.9.1 Use Case Diagram

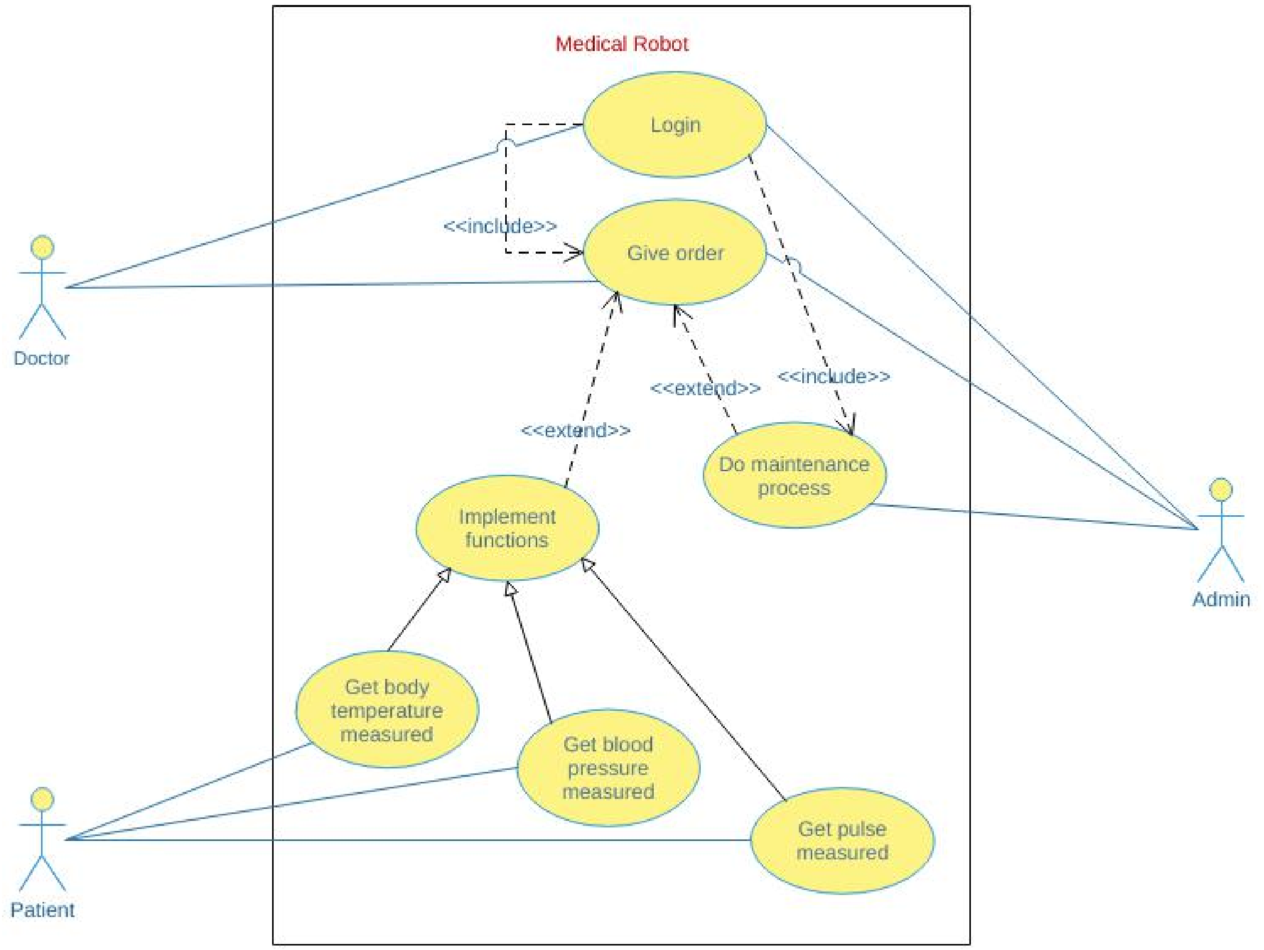
A use case diagram at its simplest is a representation of a user's interaction with the system that shows the relationship between the user and the different use cases in which the user is involved. A use case diagram can identify the different types of users of a system and the different use cases and will often be accompanied by other types of diagrams as well.

Use case diagrams are usually referred to as behavior diagrams used to describe a set of actions (use cases) that some system or systems (subject) should or can perform in collaboration with one or more external users of the system (actors). Each use case should provide some observable and valuable result to the actors or other stakeholders of the system.

Use case diagrams are in fact twofold - they are both behavior diagrams, because they describe behavior of the system, and they are also structure diagrams - as a special case of class diagrams where classifiers are restricted to be either actors or use cases related to each other with associations.

Actors:

- Doctor.
- Patient.
- Admin.



Use Case Diagram

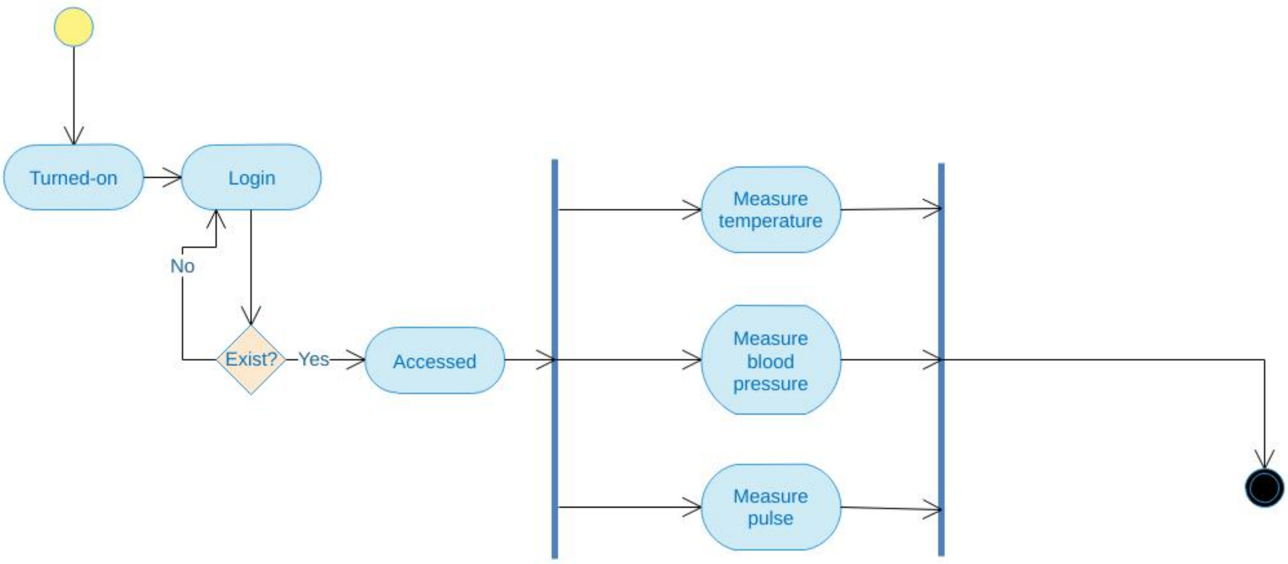
3.9.2 Activity Diagram

Activity diagram is an important diagram in UML to describe the dynamic aspects of the system. It's basically a flowchart to represent the flow from one activity to another activity. The activity can be described as an operation of the system. The control flow is drawn from one operation to another. This flow can be sequential, branched, or concurrent. Activity diagrams deal with all type of flow control by using different elements such as fork, join, etc.

The basic purposes of activity diagrams is that it captures the dynamic behavior of the system. Other UML diagrams are used to show the message flow from one object to another but activity diagram is used to show message flow from one activity to another.

Activity is a particular operation of the system. Activity diagrams are not only used for visualizing the dynamic nature of a system, but they are also used to construct the executable system by using forward and reverse engineering techniques. The only missing thing in the activity diagram is the message part.

It does not show any message flow from one activity to another. Activity diagram is sometimes considered as the flowchart. Although the diagrams look like a flowchart, they are not. It shows different flows such as parallel, branched, concurrent, and single.



Activity Diagram

3.9.3 Sequence Diagram

Sequence diagrams are a popular dynamic modeling solution in UML because they specifically focus on the "lifelines" of an object and how they communicate with other objects to perform a function before the lifeline ends. Use this guide to learn everything there is to know about sequence diagrams in UML.

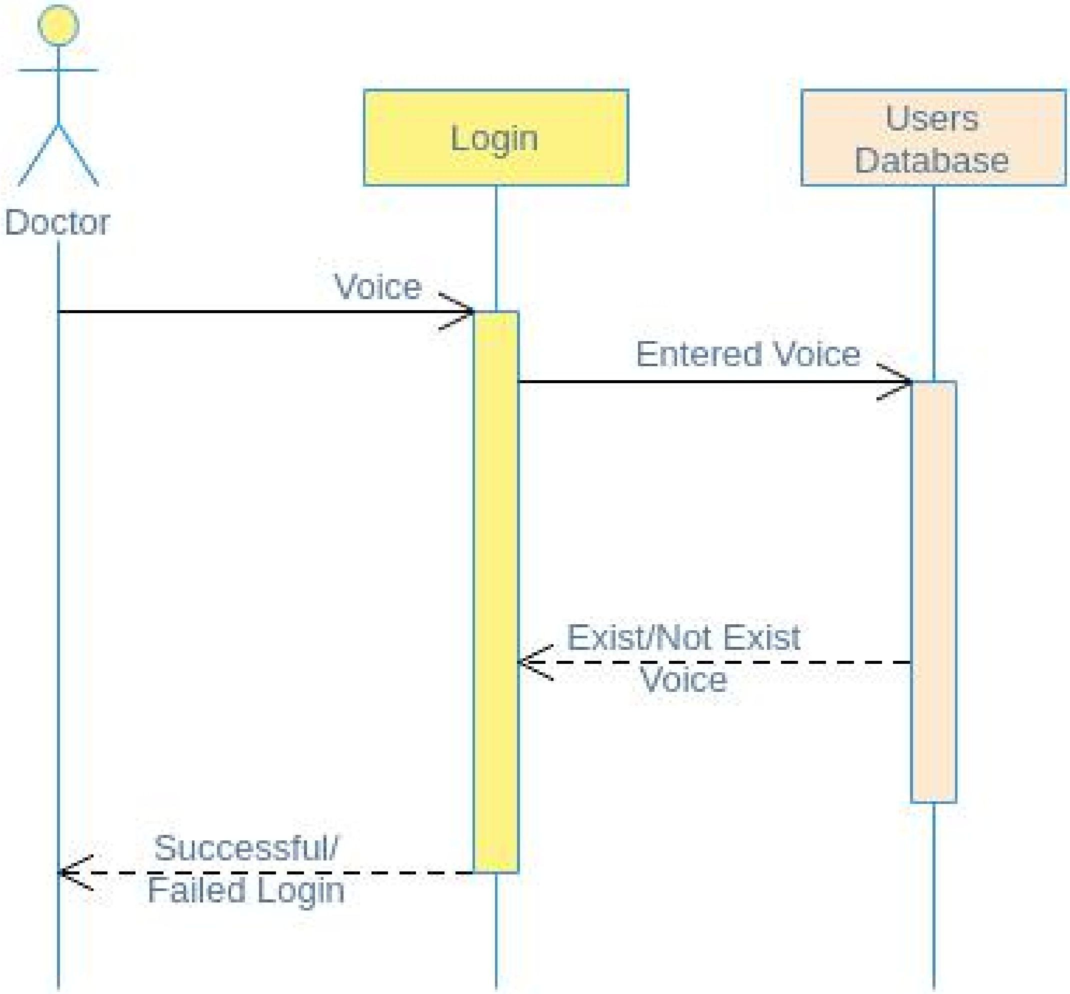
Sequence diagrams can be useful reference diagrams for businesses and other organizations. Try drawing a sequence diagram to:

◆Represent the details of a UML use case.

◆Model the logic of a sophisticated procedure, function, or operation.

◆See how tasks are moved between objects or components of a process.

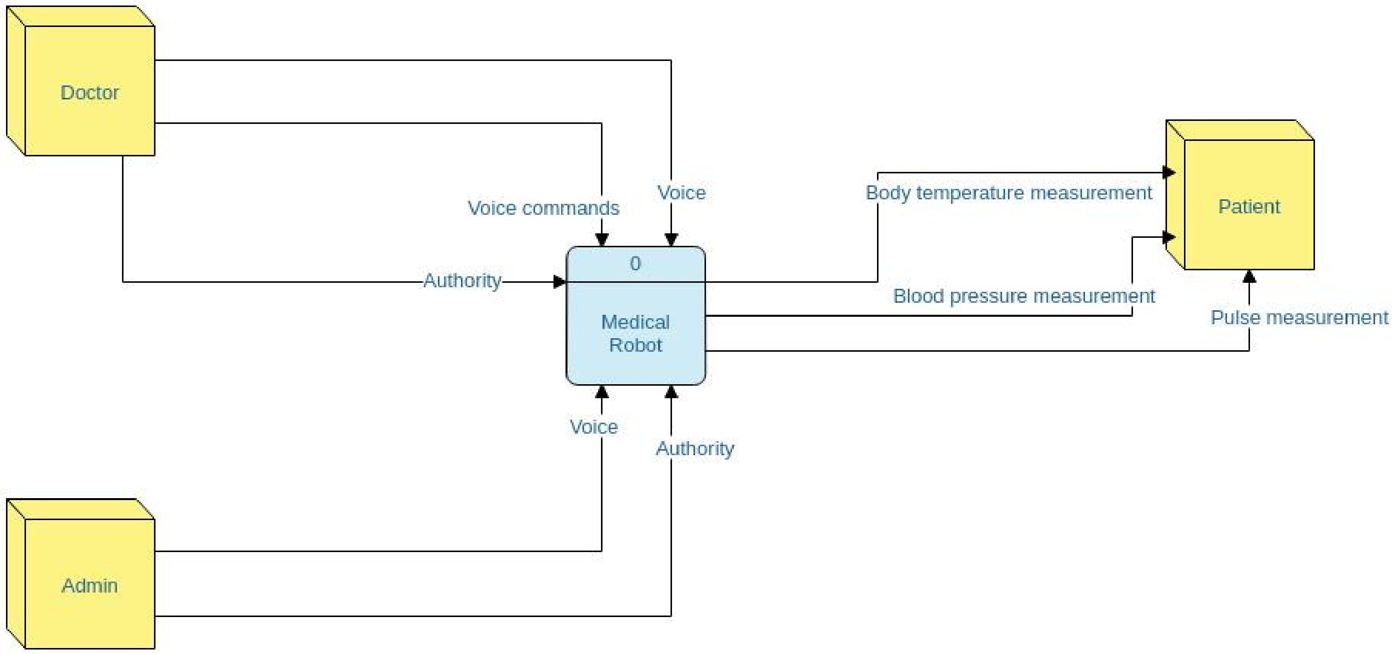
◆ Plan and understand the detailed functionality of an existing or future scenario.



Login Sequence Diagram

3.9.4 Context Diagram

A context diagram is a diagram that defines the boundary between the system, or part of a system, and its environment, showing the entities that interact with it. This diagram is a high level view of a system. It is similar to a block diagram. It shows a system, as a whole and its inputs and outputs from/to external factors.



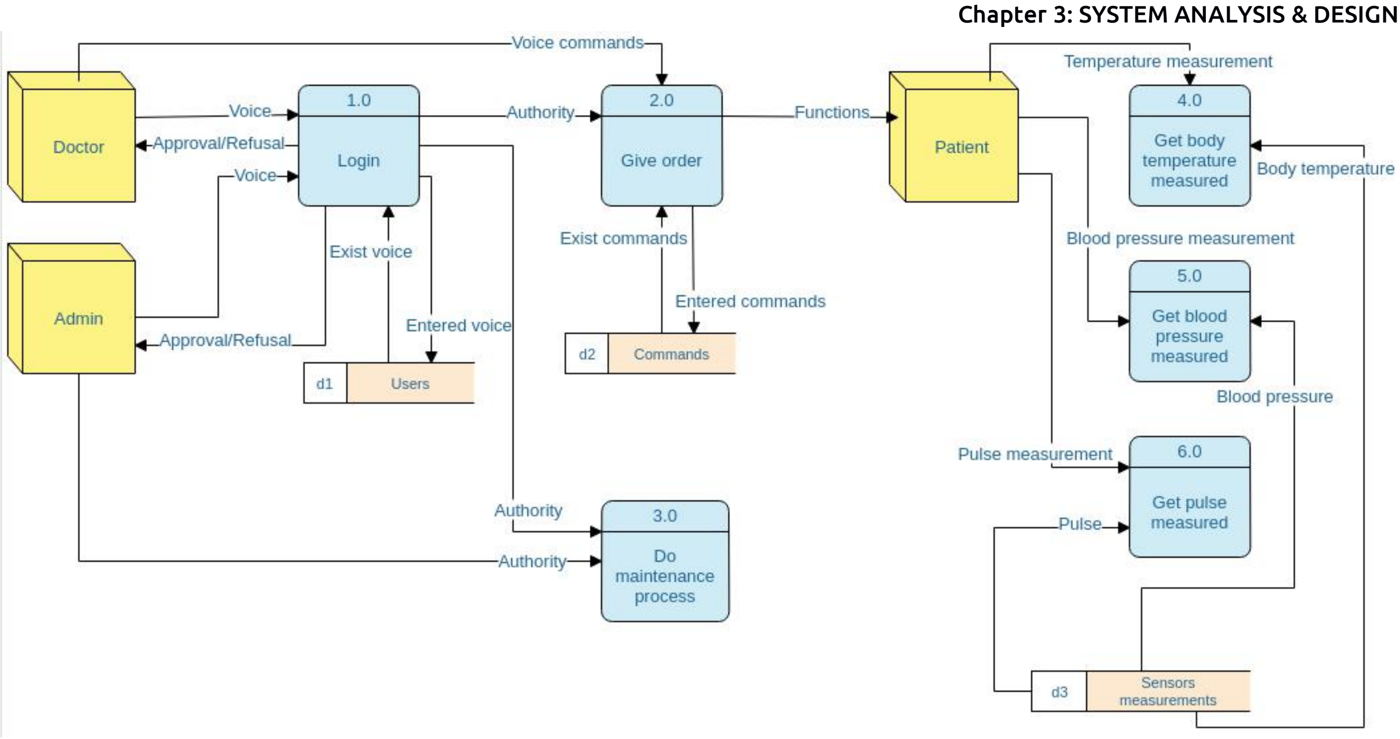
Context Diagram

3.9.5 Data Flow Diagram (Level 0)

A Data Flow Diagram is traditional visual representation of the information flows within a system. A neat and clear DFD can depict a good amount of the system requirements graphically. It can be manual, automated, or combination of both.

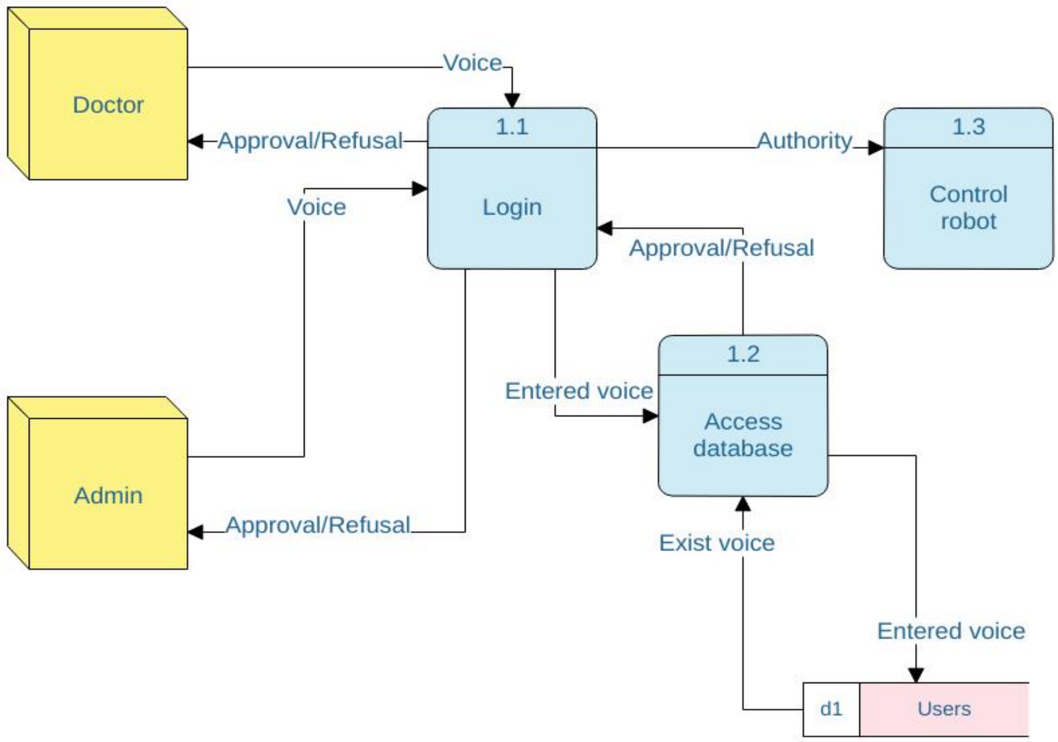
It shows how information enters and leaves the system, what changes the information and where information is stored. The purpose of a DFD is to show the scope and boundaries of a system as a whole. It may be used as a communications tool between a systems analyst and any person who plays a part in the system that acts as the starting point for redesigning a system.

It is usually beginning with a context diagram as the level 0 of DFD diagram, a simple representation of the whole system. To elaborate further from that, we drill down to a level 1 diagram with lower level functions decomposed from the major functions of the system. This could continue to evolve to become a level 2 diagram when further analysis is required. Progression to level 3, 4 and so on is possible but anything beyond level 3 is not very common. Please bear in mind that the level of details for decomposing particular function really depending on the complexity that function.



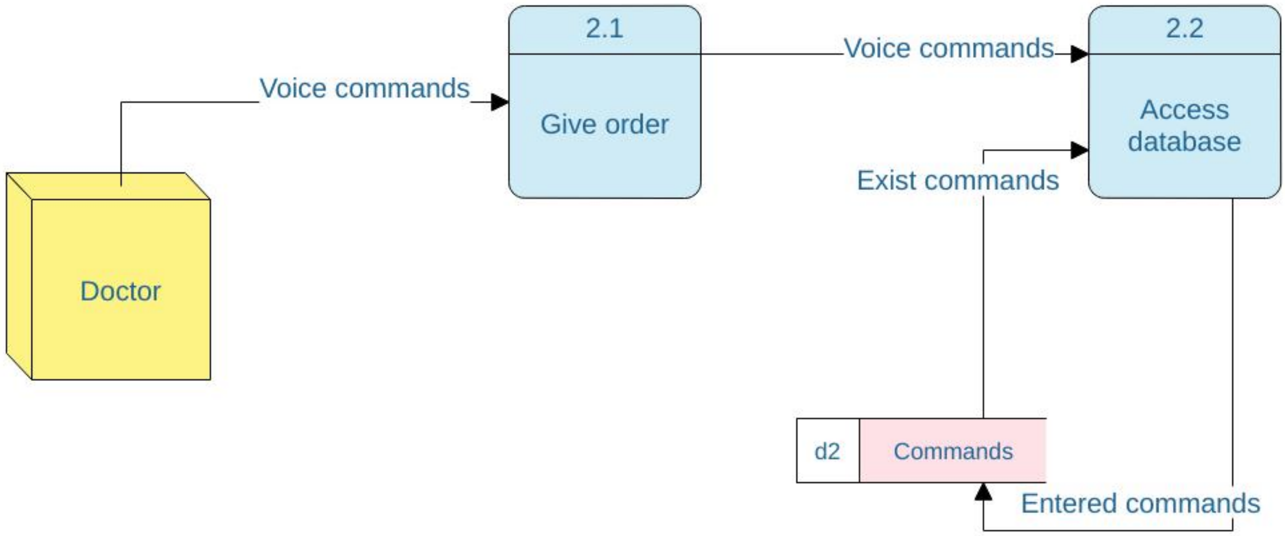
Data Flow Diagram (Level 0)

3.9.6 Data Flow Diagrams (Level 1) (1 of 2)



Data Flow Diagram (Level 1)

3.9.7 Data Flow Diagrams (Level 1) (2 of 2)



Data Flow Diagram (Level 1)

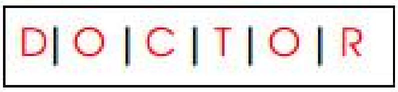
3.9.8 Data Dictionary

A Data Dictionary provides detailed information about the business data, such as standard definitions of data elements, their meanings, and allowable values. While a conceptual or logical Entity Relationship Diagram will focus on the high-level business concepts, a Data Dictionary will provide more detail about each attribute of a business concept.

Essentially, a data dictionary provides a tool that enables you to communicate business stakeholder requirements in such a way that your technical team can more easily design a relational database or data structure to meet those requirements. It helps avoid project mishaps such as requiring information in a field that a business stakeholder can't reasonably be expected to provide, or expecting the wrong type of information in a field

3.9.8.1 Context Diagram

3.9.8.1.1 External Entities



Description: The person who will order and use the robot to make it be ablo to finish its functions.

A | D | M | I | N

Description: The person who will to edit, update, and control the whole robot

P | A | T | I | E | N | T

Description: The person on whom the robot will do its functions.

3.9.8.1.2 Data Flows

V | O | I | C | E

Description: The doctor/admin sends an authentication with his voice, and waited untill the robot regonizes him.

V | O | I | C | E | - | C | O | M | M | A | N | D | S

Description: The special words said to the robot by the doctor to implement its function.

3.9.8.2 Data Flow Diagram (Level 0)

3.9.8.2.1 Data Flows

V | O | I | C | E

Description: The doctor/admin sends an authentication with his voice, and waited untill the robot regonizes him.

V | O | I | C | E | - | C | O | M | M | A | N | D | S

Description: The special words said to the robot by the doctor to implement its function.

A	P	P	R	O	V	A	L	-	R	E	F	U	S	A	L

Description: Approval: The case in which the authentication of the doctor/admin is succeed.
Refusal: The case in which the authentication of the doctor/admin is failed

A	U	T	H	O	R	I	T	Y

Description: The authority is given to the doctor after authenticating to access the robot and give it orders.

E	N	T	E	R	E	D	-	V	O	I	C	E

Description: The voice of the doctor/admin is send to the data store to check the authority of this voice in order to access the robot.

E	X	I	S	T	-	V	O	I	C	E

Description: The voices exist in the data store are checked when a voice tries to access the robot, and returns an approval in existence case, and refusal in the negative case.

E	N	T	E	R	E	D	-	C	O	M	M	A	N	D	S

Description: The voice commands said by the doctor to make the robot do a specific function.

E	X	I	S	T	-	C	O	M	M	A	N	D	S

Description: The voice commands exist in the data store are checked when a voice command is said by the doctor to give an order to the robot.

F | U | N | C | T | I | O | N | S

Description: The orders given to the robot is done as functions performed on the patients

B | O | D | Y | - | T | E | M | P | E | R | A | T | U | R | E

Description: A function done by the robot and performed on the patient to get the body temperature measurement.

B | L | O | O | D | - | P | R | E | S | S | U | R | E

Description: A function done by the robot and performed on the patient to get the blood pressure measurement.

P | U | L | S | E

Description: A function done by the robot and performed on the patient to get the pulse measurement.

3.9.8.2.2 Processes

L | O | G | I | N

Description: This process is responsible for logging in and access the robot.

Inputs	Logic Summary	Outputs
-The voices of the people who are trying to access the robot. -The exist voices in the data store.	-It checks if the voices of people who are trying to access the robot is exist in the data store or not.	-The approval/refusal of the voices tried to access the robot depending on the voices stored in the data store. -An authority for the person who is trying to access the robot in case of existing voice.

G | I | V | E | - | O | R | D | E | R

Description: This process is responsible for giving orders to the robot.

Inputs	Logic Summary	Outputs
-Voice commands said by the doctor to order the robot to do a specific function. -An authority to control the robots by giving orders.	-It takes voice commands make the robot do some functions performed on the patients.	-Functions to be done and performed on patients.

D | O | - | M | A | I | N | T | E | N | A | N | C | E | - | P | R | O | C | E | S | S

Description: This process is only done by admins, it's responsible for editing, updating, and do any other adminstrative thing on the robot.

Inputs	Logic Summary	Outputs
-An authority to control the robot.	-It can be only done by the admins.	-Upgrades and edits done on the robot by admins.

CHAPTER TWO References

- https://en.wikipedia.org/wiki/Rehabilitation_robotics#References
- https://www.digitaltrends.com/cool-tech/senhance-system-robotic/
- https://www.transenterix.com/overview/
- https://www.sages.org/publications/tavac/senhance-surgical-robotic-system/
- http://citeseerx.ist.psu.edu/viewdoc/download;jsessionid=B6533B52BB2760994E62
- https://www.reuters.com/article/us-stroke-robots/stroke-patients-maintain-benefits-o
- https://www.feiretail.com/10-benefits-physical-therapy/
- http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.551.4188&rep=rep1&typ
- https://www.pharmaceutical-journal.com/opinion/comment/pharmacy-robots-in-uk-h
- https://en.wikipedia.org/wiki/Pharmacy_automation
- http://www.pharmacyerrorlawfirm.com/blog/advantages-and-disadvantages-of-phar
- https://www.sciencedirect.com/science/article/pii/S0929664612000873
- https://l.facebook.com/l.php?u=http%3A%2F%2Frpvitatelemedicine.blogspot.com.e
- https://l.facebook.com/l.php?u=https%3A%2F%2Ftelepresencerobots.com%2Frobot

- http://www.robots-and-androids.com/medical-robots.html
- http://desertwestsurgery.com/robotic-surgery-benefits/
- http://triotree.com/blog/types-medical-robots-healthcare/https://fromfiction.com/davinci-method/
- http://support.technicaldr.com/?&tag=Medical+Transportation+Robots
- https://www.azorobotics.com/Article.aspx?ArticleID=111
- https://www.sciencesource.com/archive/-SS2783838.html
- https://www.sciencedaily.com/releases/2013/06/130621121003.htm
- https://www.robotics.org/blog-article.cfm/Medical-Robots-Top-4-Applications-in-Use-
- https://www.xenex.com/how-uv-disinfection-works
- https://www.researchgate.net/profile/Karol_Niechwiadowicz/publication/255575768_
- https://l.facebook.com/l.php?u=http%3A%2F%2Fwww.alanba.com.kw%2Far%2Flast
- https://l.facebook.com/l.php?u=https%3A%2F%2Fwww.medgadget.com%2F2013%2
- https://l.facebook.com/l.php?u=http%3A%2F%2Fwww.syr-res.com%2Farticle%2F12
- https://l.facebook.com/l.php?u=http%3A%2F%2Ftwahodvoice.com%2FAutismNews
- https://l.facebook.com/l.php?u=https%3A%2F%2Fwww.reuters.com%2Farticle%2Fu

CHAPTER THREE References:

- Control system:

http://whatis.techtarget.com/

- Embedded processor:

http://microcontrollerslab.com/

- Input/output:

https://www.tutorialspoint.com/

- What is system:

https://en.wikipedia.org/

- Overview:

https://www.tutorialspoint.com/

- Feedback:

https://en.wikipedia.org/

https://www.tutorialspoint.com/

- Environment:

https://en.wikipedia.org/

https://www.tutorialspoint.com/

- Boundaries & interfaces:

https://www.tutorialspoint.com/

- **Preliminary Investigation:**

http://it-alteration.blogspot.com.eg/

- **Reaibiity study:**

http://it-alteration.blogspot.com.eg/

- **Technical Feasibility:**

https://en.wikipedia.org/

- **Economic Feasibility:**

https://www.ofm.wa.gov/

- **Operational Feasibility:**

https://en.wikipedia.org/

- **System Requirements Specification:**

https://en.wikipedia.org/

- **Software requirements:**

https://en.wikipedia.org/

- **User requirements:**

https://softwareengineering.stackexchange.com/

- **Funtional requirements:**

https://www.tutorialspoint.com/

- **Non-functional requirements:**

https://en.wikipedia.org/

- **System requirement:**

https://www.inflectra.com/

◆ Requirements Engineering Process:

https://en.wikipedia.org/

◆ SDLC:

https://en.wikipedia.org/

◆ SDLC Processes:

https://www.tutorialspoint.com/

◆ Analysis:

https://www.techopedia.com/

◆ SWOT Analysis:

https://www.researchgate.net/

http://medicaldesign.com/

https://en.wikipedia.org/

◆ PEST Analysis:

https://en.wikipedia.org/

◆ Design:

https://en.wikipedia.org/

◆ System architecture:

https://en.wikipedia.org/