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Sudan University of Sciences and Technology
College of Engineering

Electrical Engineering Department

LAPAROSCOPIC TRAINING BOX

صندوق تدريب عملية المناظير

A Project submitted In Partial Fulfillment for the Requirements of The Degree of B.Sc. (Honor) In Electrical Engineering

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الآية

قال تعالى:

﴿ فَتَعَالَى اللَّهُ الْمَلِكُ الْحَقُّ وَلا تَعْجَلْ بِالْقُرْآنِ مِنْ قَبْلِ أَنْ يُقْضَى إِلَيْكَ وَحْيُهُ وَقُلْ رَبِّ زِدْنِي عِلْماً ﴾

صدق الله العظيم

سورة طه الآية ﴿114﴾

الإهداء

إلي من سكنت في القلب مكانا ورسخت في القلب عنوانا

أمي الغالية

. . . .

إلى من له في العمر بصمات

أبي العزيز

. . . .

إلى من لهم في النفس ما لا تكفيهم يد كاتب ولا يتصوره عقل انسان

أخواني وأخواتي

. . . .

إلى كل من كانو لنا نورا في ظلمات الطريق الطويل

أساتذتي الأجلاء

. . . .

إلى رفقاء الدرب و زملاء الدراسة

شكر وعرفان

الشكر من قبل ومن بعد لله الذي لا تأخذه سنة ولا نوم

ومن ثم إلى الأستاذ **الفاضل جلال عبدالرحمن محمد**

وإلى جميع اساتذة قسم هندسة الكهرباء الذين لم يبخلوا علينا بوقتهم ولا بمعلوماتهم الثرة سائلين الله لهم الصحة والعافية

والشكر أيضا موصول إلى جميع كوادر مستشفى ابن سينا التخصصي

وإلى المدير العام لشركة ليمتلس العالمية للمعدات الطبية

م/محمد عبد الله جمعه

والى م / عمر موسى بابكر

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ABSTRACT

This project works with the advanced technologies to help and develop the medical staff through training with modern facilities. This system depends on Arduino controller to control and process the hardware such as camera which is displaying the work field to make doctors able to do training by looking of the screen, In addition to that, it consisting of several sensors to monitor vital factors for the doctor (pressure and heart rate) to determine his state during the training Also this system has ability to test the doctor to determine the doctor is qualified to do a real surgery or not.

مستخلص

يعمل هذا المشروع بالتقنيات المتطورة لمساعدة وتطوير الكادر الطبى عن طريق تدريبهم بالوسائل الحديثة . هذا النظام يعتمد على المتحكم أردوينو الذي يعمل على المعالجة والتحكم في الاجهزة مثل الكاميرا التي تقوم بعرض بيئة العمل وتمكن المتدرب من إجراء العملية عبر النظر الي الشاشة , بالإضافة لذلك فانه يتكون من عدة حساسات لمراقبة العوامل الحيوية للطبيب(الضغط ومعدل نبضات القلب) لتحديد حالته أثناء التدريب . أيضا هذا النظام له القدرة على إختبار الطبيب وتقييمه لتحديد هذا الطبيب مؤهل إجراء عملية حقيقية أم لا.

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LIST OF ABREVIATIONS

ADC	Analog to Digital Converter
C	COMPUTER PROGRAMMING LANGUAGE
CLI	COMMAND LINE INTERFACE
CPU	Central Processing Unit
DAC	Analog to Digital Converter
DC	Direct Current
GND	Ground
LCD	LIQUID-CRYSTAL DISPLAY
LED	Light Emitting Diode
MIMO	multiple-input and multiple-output
NET	NETWORK
NC	Normally CLOSE
NO	Normally OPEN
OR	operating room
PID	Proportional-Integral-Derivative
RAM	Random Access Memory
ROM	Read Only Memory
SISO	single- input and single-output
USB	Universal Serial Bus
VCC	COLLECTOR SUPPLY

VDD	DRAIN SUPPLY
VR	virtual reality

CHAPTER ONE

INTRODUCTION

1.1 INTRODUCTION

1In the hospital they are two types of surgery, open surgery and laparoscope surgery is a recent surgical technique in which abdominal surgery is performed by a very small incision (usually .5_1.5 cm) compared with the cracks in the traditional surgery laparoscope surgery is performed in the abdominal area and laparoscope surgery is performed in the chest area called. the first surgery for laparoscope gallbladder in 1987 in Europe and America led to an unprecedented revolution in the field of surgery prior to that date medical perspectives were limited to diagnosis and some minor gynecological operations a few surgeons used it to surgery specialized units and independent sections and multiple references and research and international conferences to discuss the development and renewal and extended to include many surgeries such as hysterectomy and hernia etc.one of the most successful operations of laparoscope cholecystectomy has been the availability of most of the features that make it superior to open surgery in terms of healing speed scarring etc. this does not mean that laparoscope surgery has been limited to gallbladder removal but has been extended to include many surgeries and continues to expand with the growth of experience and the development of tools for these operation .this surgery has many features that are not available in open surgery such as the speed of recovery short stay in the hospital and quick return to work which saves on costs and work capacity besides providing avoidance of injuries and the consequent cost of care and the possibility of some complication such as inflammation and surgical hernia not to mention the cosmetic aspect of the abdominal wall especially in women there are several other factors that have played a role in the spread of this surgery in this exciting way and these factors necessary for this surgery of special devices such as binoculars camera and gas propulsion devices and others and so some of the manufacture of these devices motivated marketing to imagine this surgery as the only alternative to all roads and other surgeries resulting in some of these excesses such as competition in the field of private medicine and the resulting exaggeration in praising this surgery for commercial reasons in order to attract patients eager to dispense with wounds and dispense with stay in the hospital and so on of open surgery requirement the result of these factors led to the lack of sufficient experience in conducting such delicate operations and the lack of careful selection of appropriate cases which actually benefit from these operations resulting in some problems and complications of surgery importance of establishing controls to the limits of experience and clarifying the real need for these operations during medical conferences and scientific research centers as well as the remarkable and continuous development in the manufacture of cameras surgical instruments and other devices necessary for such surgeries has led to a lot of correction in the concepts and practical application of this nascent surgery.

1.2 Problem Statement

The shortage of sufficient experience in conducting such delicate operations and the lack of careful selection of appropriate cases which actually benefit from these operations resulting in some problems and complications of surgery.

1.3 Objectives

Ameliorate and develop medical staff and thus reduce medical errors, also reduce financial costs due to training of doctors outside the country.

1.4 Methodology

To design this project first visit to hospitals and study surgery environment and laparoscopy surgery, and study about vital changes are accompanied by tension then determined the components of project .After that simulator of project. Finally reach to final shape of project

1.5 Project Layout

The project consist of five chapters:-

Chapter one introduction present an introduction of the laparoscopy surgery and the Problems of the laparoscopy surgery and Objective and methodology of the project and layout of the project. Chapter Two general background present of introduction and control system and micro controller and sensor. Chapter Three model design present the introduction external system part and the main components and block diagram. Chapter Four simulation & practical present introduction and software program and simulator and operation. Chapter five conclusion and recommendations present conclusion and recommendations and reference and appendix.

CHAPTER TWO

General Background

2.1 Introduction

There Are Two Types first type Telescopic rod lens system that is usually connects t1o video camera. And second type digital laparoscopy where the charge coupled device is placed at the end of the laparoscopy actually the most popular gas used for laparoscopy is carbon dioxide. Other gases that are used for insufflation are nitrous oxide, argentum, helium, xenon, and also room air. It appears that there are significant differences between these, not only in physical matter many reports show the different effect on tumor biology during the laparoscopic procedure, and the helium and especially the xenon seem to decrease tumor volume. The helium and the argentum are also found to be safer for the cardio-circulatory system laparoscopy are a device used for introduction of the gas under specified volume and pressure into peritoneal cavity. First, old devices were set manually; nowadays mainly automatic electronically controlled insufflators are used. These allow setting a precise flow of the introduced gas (in l/min), and at a constant pressure (12-14 mmHg). Some of the sets are equipped with bacteriological filters, and an endothermic system (to maintain adequate Temperature of insufflated gas). In some cases a controlled desolation is also used to remove a surgical smoke. Advantage of laparoscopy(less pain less wound complications not need antibiotic less scar after surgery psychologically better than openness stay in hospital go quickly to normal life and work

2.1.1 Laparoscopic Surgery Tools

There are many tools used in laparoscopy to complete laparoscopy surgery such as:-

- Needle Driver a needle holder is used by laparoscopic surgeons to hold suturing needles when closing wounds. Forming slip-knots to close wounds and surgical incisions requires precise skills. Suturing can often be tricky to use owing to the property of "memory" which causes tissue to resist deformation. Needle holders have three parts – the jaws, joints, and handles. The instrument is classified as straight or curved depending upon the shape of the jaws
- Trocar along with the probe, scalpel, and cannula the trocar is one of the oldest implements used by medical practitioners. A trocar is shaped like a pen and has a sharp triangular point. Trocars are typically placed inside hollow cannulas and introduced inside body cavities to assist in draining fluids. Trocars are now referred to as both the initial entry device as well as the hollow cannula used during the operation. These instruments play an important role in laparoscopic surgery. Instruments such as scissors and graspers are introduced using surgical trocars
- Bowel Grasper a bowel grasper is used during minimally invasive bowel surgery. The graspers are maneuvered through incisions that are usually no larger than 5 mm. The advantage with using laparoscopic graspers is that they enable the surgeon to grasp and manipulate abdomen tissue with precision without having to cut open the abdomen. The graspers facilitate observation, excision, and biopsy procedures.

2.1.2 Laparoscopic Cholecystectomy

Laparoscopic cholecystectomy has now replaced open cholecystectomy as the first-choice of treatment for gallstones and inflammation of the gallbladder unless there are contraindications to the laparoscopic approach. This is because open surgery leaves the patient more prone to infection. Sometimes, a laparoscopic cholecystectomy will be converted to an open cholecystectomy for technical reasons or safety.

Laparoscopic cholecystectomy requires several (usually 4) small incisions in the abdomen to allow the insertion of operating ports, small cylindrical tubes approximately 5 to 10 mm in diameter, through which surgical instruments and a video camera are placed into the abdominal cavity. The camera illuminates the surgical field and sends a magnified image from inside the body to a video monitor, giving the surgeon a close-up view of the organs and tissues. The surgeon watches the monitor and performs the operation by manipulating the surgical instruments through the operating ports. To begin the operation; the patient is placed in the supine position on the operating table and anesthetized. A scalpel issued to make a small incision at the umbilicus. Using either needle or has son technique, the abdominal cavity is entered. The surgeon inflates the abdominal cavity with carbon dioxide to create a working space. The camera is placed through the umbilical port and the abdominal cavity is inspected. Additional ports are opened inferior to the ribs at the epigastria, and anterior axillary positions. The gallbladder fundus is identified, grasped, and retracted superiorly. With a second grasper, the gallbladder infundibulum is retracted laterally to expose and open Clot's Triangle (cystic artery, cystic duct, and common hepatic duct). The triangle is gently dissected to clear the peritoneal covering and obtain a view of the underlying structures. The cystic duct and the cystic artery are identified, clipped with tiny titanium clips and cut. Then the gallbladder is dissected away from the liver bed and removed through one of the ports. This type of surgery requires meticulous surgical skill, but in straightforward cases, it can be done in about an hour.

2.1.3Training Box

Laparoscopic procedures are performed on a regular basis in the areas of general surgery, urology, and gynecology. The performance requires development of specific psychomotor skills. Therefore, laparoscopic training methods have been the subject for innovation for the past 20 years. Training for basic laparoscopic skills can be done in the operating room (OR), but this is time-consuming and can be in conflict with patient safety and OR efficacy. As an alternative, box (video) trainers and/or virtual reality (VR) simulators can be used. VR training programs have proven to be of great value in acquiring laparoscopic skills outside of the OR because they demonstrate good predictive validity. Limiting factors of VR simulators are that they are so expensive so it is not available to the require extent , and can only be used in the skills lab of the hospital , this was the main focus on training using the box(video),Effective box (video) simulation training improves hand-eye coordination, manipulation of long instruments in a limited space, ambidexterity, and adjustment for tremor, and efficiency and accuracy of movements as well as getting used to reduce haptic feedback and depth perception through a camera .These elements can be implemented into simple and essential exercises, which can be validated and performed on any box (video) trainer. It has been shown that VR training and box training are equally effective in acquiring basic laparoscopic skills and that laparoscopic skills taught in box trainers are reproducible in a VR environment and vice versa. To ensure validated laparoscopic training, validated exercises with a proper training goal should be performed. Box training is of additional value to VR training programs because residents feel that they have too little time to train in a skill lab. Having the possibility to train at home could be a way to ensure more time and space for laparoscopic training

2.2 Control System

A system is a combination of components that act together and perform a certain objective. A system is not limited to physical ones. The concept of the system can be applied to abstract, dynamic phenomena such as those encountered in economics there are two major divisions in control theory, namely, classical and modern, which have direct implications over the control engineering applications. The scope of classical control theory is limited to single-input and single-output (SISO) system design, except when analyzing for disturbance rejection using a second input. The system analysis is carried out in the time domain using differential equations, in the complex-s domain with the Laplace transform, or in the frequency domain by transforming from the complex-s domain. Many systems may be assumed to have a second order and single variable system response in the time domain. A controller designed using classical theory often requires on-site tuning due to incorrect design approximations. Yet, due to the easier physical implementation of classical controller designs as compared to systems designed using modern control theory, these controllers are preferred in most industrial applications. The most common controllers designed using classical control theory is Proportional-Integral-Derivative controllers (PID). A less common implementation may include either or both a Lead and Lag filter. Ultimate the end goal is to meet requirements set typically provided in the time-domain called the Step response, or at times in the frequency domain called the Open-Loop response. The Step response characteristics applied in a specification are typically percent overshoot, settling time, etc. The Open-Loop response characteristics applied in a specification are typically Gain and Phase margin and bandwidth. These characteristics may be evaluated through simulation including a dynamic model of the system under control coupled with the compensation model. In contrast, modern control theory is carried out in the state space, and can deal with multiple-input and multiple-output (MIMO) systems. This overcomes the limitations of classical control theory in more sophisticated design problems, such as fighter aircraft control, with the limitation that no frequency domain analysis is possible. In modern design, a system is represented to the greatest advantage as a set of decoupled first order differential equations defined using state variables. Nonlinear, multivariable, adaptive and robust control theories come under this division. Matrix methods are significantly limited for MIMO systems where linear independence cannot be assured in the relationship between inputs and outputs.

2.2.1 Engineering techniques in the medical field

The application of engineering principles and techniques in the medical field. It aims to bridge the gap between engineering and medicine. It combines design and problem-solving skills with medical and biology sciences to improve medical treatment and diagnosis. After the doctor alone performs all the tasks of diagnosis, treatment and even the manufacture of medicine, the medical device became a basic part of the doctor in the diagnosis and treatment and control of patients, and in view of the urgent need to develop medical devices and equipment to serve patients health and speed of hospitalization, It was necessary to intervene specialists from other fields other than medicine to design these devices, such as engineers from the competence of electricity, mechanics, electronic and computer . These engineers also had to know the medical sciences from the anatomy and physiology of the human body and so on to understand the mechanism of work of each system in it and to harness their knowledge and competence in developing these devices, Examples include

Medical imaging, medical image processing, biometrics, bioremediation, industrial organ design such as artificial heart, industrial kidney, heart valves and other organs

2.3 Microcontroller

A microcontroller is a small processor which is equipped with memory, timers, (parallel) I/O pins and other on-chip peripherals. The driving element behind all this is cost:

Integrating all elements on one chip saves space and leads to both lower manufacturing costs and shorter development times. This saves both time and money, which are key factors in embedded systems. Additional advantages of the integration are easy upgradability, lower power consumption, and higher reliability, which are also very important aspects in embedded systems. On the downside, using a microcontroller to solve a task in software that could also be solved with a hardware solution will not give you the same speed that the hardware solution could achieve. Hence, applications which require very short reaction times might still call for a hardware solution. Most applications, however, and in particular those that require some sort of human interaction do not need such fast reaction times, so for these applications microcontrollers are a good choice. The microcontrollers are integrated into many appliances we have grown used to, like:

- Household appliances (microwave, washing machine, coffee machine)
- Telecommunication (mobile phones)
- Automotive industry (fuel injection, ABS)
- Aerospace industry

- ❖ Industrial automation A microcontroller basically contains one or more following components:
- ❖ Central processing unit

Central Processing Unit is the brain of a microcontroller. CPU is responsible for fetching the instruction, decodes it, and then finally executed. CPU connects every part of a microcontroller into a single system. The primary function of CPU is fetching and decoding instructions. Instruction fetched from program memory must be decoded by the CPU.

- ❖ Memory in a microcontroller is same as microprocessor. It is used to store data and program. A microcontroller usually has a certain amount of RAM and ROM (EEPROM, EPROM, etc.) or flash memories for storing program source codes.

- ➢ Parallel input/output ports

Parallel input/output ports are mainly used to drive/interface various devices such as LCD’S, LED’S, printers, memories, etc. to a microcontroller.

➢ Serial interfacing ports Serial ports provide various serial interfaces between microcontroller and other peripherals like parallel ports.

➢ Timers and counters this is the one of the useful function of a microcontroller. A microcontroller may have more than one timer and counters. The timers and counters provide all timing and counting functions inside the microcontroller. The major operations of this section are perform clock functions, modulations, pulse generations, frequency measuring, making oscillations, etc. This also can be used for counting external pulses.

- ➢ Analog to digital converter

Analog to Digital Converter (ADC) converters are used for converting the analog signal to digital form. The input signal in this converter should be in analog form (e.g. sensor output) and the output from this unit is in digital form. The digital output can be used for various digital app

- Digital to analog converter

Digital to Analog Converter (DAC) perform reversal operation of ADC conversion. DAC convert the digital signal into analog format. It usually used for controlling analog devices like DC motors, various drives, etc.

- Interrupt control the interrupt control used for providing interrupt (delay) for a working program. The interrupt may be external (activated by using interrupt pin) or internal (by using interrupt instruction during programming).
- Special functioning block some microcontrollers used only for some special applications (e.g. space systems and robotics) these controllers containing additional ports to perform such special operations. This considered as special functioning block.

2.4 Sensors

Sensors are devices that detect physical, chemical, and biological signals and provide a way for those signals to be measured and recorded.

Physical properties that can be sensed include temperature, pressure, vibration, sound level, light intensity, load or weight, flow rate of gases and liquids, amplitude of magnetic and electronic fields, and concentrations of many substances in gaseous, liquid, or solid form.

2.4.1 Need for Sensor

Sensors have played an important role in many industries, providing the mechanical “vision” used for counting, sorting, reading, and robotic guidance. Tactile sensors, typically piezoelectric materials, generate voltage when touched, squeezed, or bent, or when their temperature is changed. Other sensors can detect specific chemical pressures and fluid levels. Cars, homes, and offices are loaded with sensors. In the short term, sensors used in medical applications will emit a signal that can be read at the point of determination or transferred by wire or wireless transmission to remote locations.

2.4.2 Sensor Types

Sensors are classified in a number of ways; one common classification is contact or noncontact. Another way to classify sensors is as digital or analog.

- Contact & Noncontact the use of a noncontact sensor, also called proximity sensor, is a simple way to identify a sensor. If the device must contact a part to sense it, the device is a contact sensor. A simple limit switch on a conveyor is an example. When the part moves the lever on the switch, the switch changes state. The contact of the part and the switch creates a change in state that the PLC can monitor. Noncontact sensors can detect the part without touching it physically, which avoids slowing down or interfering with the process. Noncontact sensors (electronic) do not operate mechanically (i.e., they have no moving parts) and are more reliable and less likely to fail than mechanical ones. Electronic devices are also much faster than mechanical devices, so noncontact devices can perform at very high production rates. The remainder of the chapter examines noncontact sensors.
- Digital Sensors another way to classify sensors is as digital or analog. Industrial applications need both digital and analog sensors. . A digital sensor has two states: on or off Most applications involve presence / absence and counting, which a digital sensor does perfectly and inexpensively. Digital sensors are simpler and easier to use than analog ones, which is a factor in their wide use.

Computers are digital devices that actually work with only is or so (on or off). They generally have transistor outputs if the sensor senses an object, the transistor turns on and allows current to flow. The output from the sensor is typically connected to input module sensors are available with either normally closed or normally open output contacts. Normally open contact sensors are off until they sense an object and turn on. Normally closed contact sensors are on until they sense an object, when they turn off. When photo sensors are involved.

- Analog sensor also called linear output sensor, Analog sensors provide much more information about process than digital sensors .Their output varies depending on the condition being measured many types of analog sensors are available. Many of the types are available with digital and analog output "photo sensors and field sensors are available with analog output"

2.4.3 Sensor in Medicine

Sensors are used in electronics-based medical equipment to convert various forms of stimuli into electrical signals for analysis. Sensors can increase the intelligence of medical equipment, such as life-supporting implants, and can enable bedside and remote monitoring of vital signs and other health factors. An aging and expanding population is accelerating the development of new and different types of medical equipment, including various sensors used inside both equipment and patients' bodies. Healthcare organizations want real-time, reliable, and Accurate diagnostic results provided by devices that can be monitored remotely, whether the patient is in a hospital, clinic, or at home.

2.4.4Key Sensors and Applications in medicine

- Pressure sensors are used in anesthesia delivery machines, oxygen concentrators, sleep apnea machines, ventilators, kidney dialysis machines, infusion and insulin pumps, blood analyzers, respiratory monitoring and blood pressure monitoring equipment, hospital beds, surgical fluid management systems, and pressure-operated dental instruments.

Figure 2.1 Medical Pressure Sensor

- Temperature sensors are used in anesthesia delivery machines, sleep apnea machines, ventilators, kidney dialysis machines, blood analyzers, medical incubators, humidified oxygen heater temperature monitoring and control equipment, neonatal intensive care units to monitor patient temperature, digital thermometers, and for organ transplant s
- ystem temperature monitoring and control.

Figure 2.2Medical temperature sensor

- Image sensor applications include radiography, fluoroscopy, cardiology, mammography, dental imaging, endoscopy, external observation, minimally invasive surgery, laboratory equipment, ocular surgery and observation, and artificial retinas.

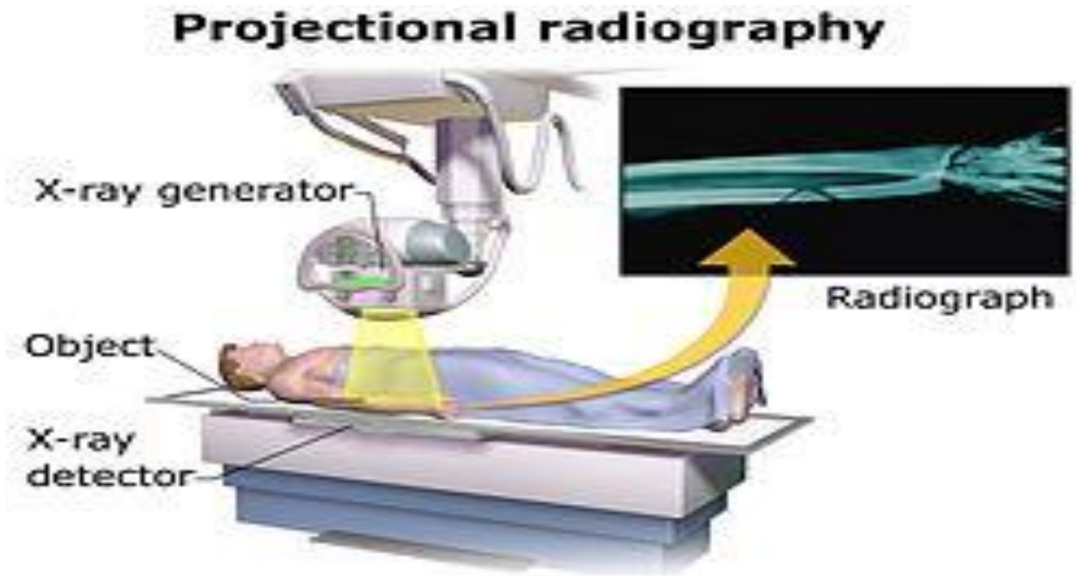


Figure 2.3 Image Sensor application (Projection radiography)

- Biosensors find applications in blood glucose and cholesterol testing, as well as for testing for drug abuse, infectious diseases, and pregnancy.

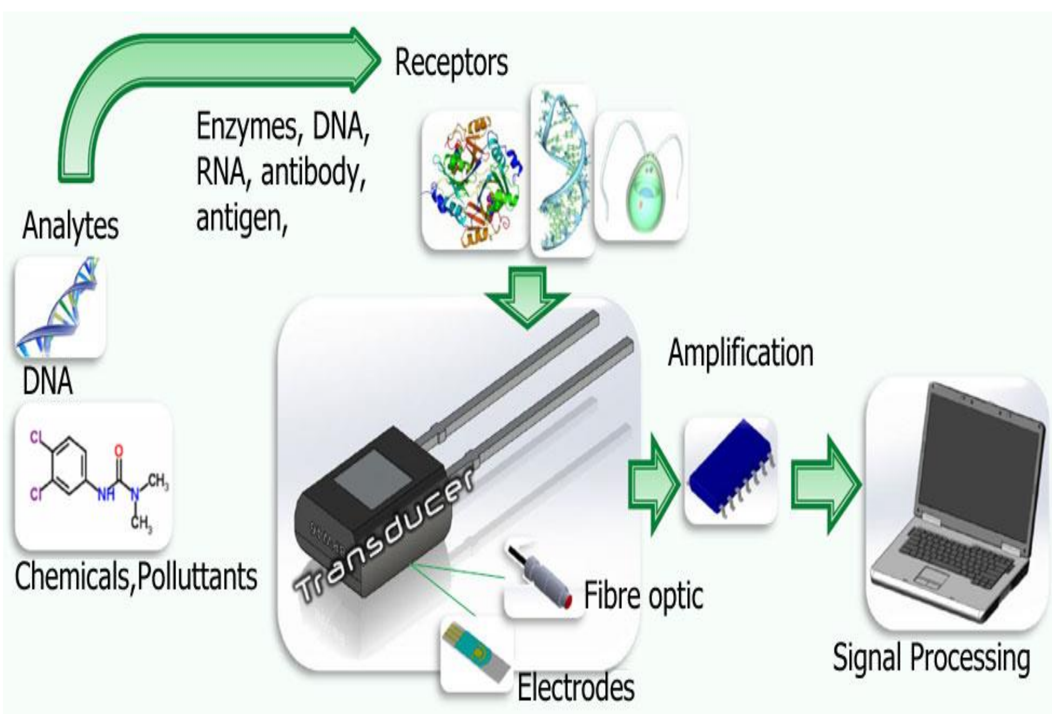


Figure 2.4 Biosensor application

CHAPTER THREE

MODEL DESIGN

3.1 Introduction

The techniques that mentioned in chapter two will be used to make the final project by hardware by main components which are training box consists of pulse sensor, vibration sensor, potentiometer, web camera, led , Arduino Uno , power supply ,and the software that used C sharp language and Arduino C language.

3.2 External System Part

The external system part consists of closed box in addition to laparoscopy Instrument (bowel grasper and Maryland).

Figure 3.1 external system part

3.3 Hardware Components

The main component of Training Box used in this project are Arduino Uno, sensors potentiometer and Camera system.

3.3.1 Arduino Uno

Arduino is a small microcontroller board with a USB plug to connect to the computer and a number of connection sockets that can be wired up to external electronics, such as motors, relays, light sensors, laser diodes, loudspeakers, microphones, etc. Powered through the USB connection from the computer or from a 9V battery. Arduino can be controlled from the computer or programmed by the computer and then disconnected and allowed to work independently.

❖ The Arduino board as shown in Figure 3.2 it is an open-source electronics prototyping platform based on flexible, easy-to-use hardware and software. It's intended for artists, designers, hobbyists, and anyone interested in creating interactive objects or environments in simple terms, the Arduino is a tiny computer system that can be programmed with instructions to interact with various forms of input and output. The current Arduino board model, the Uno, is quite small in size compared to the average human hand, as shown in Figure.

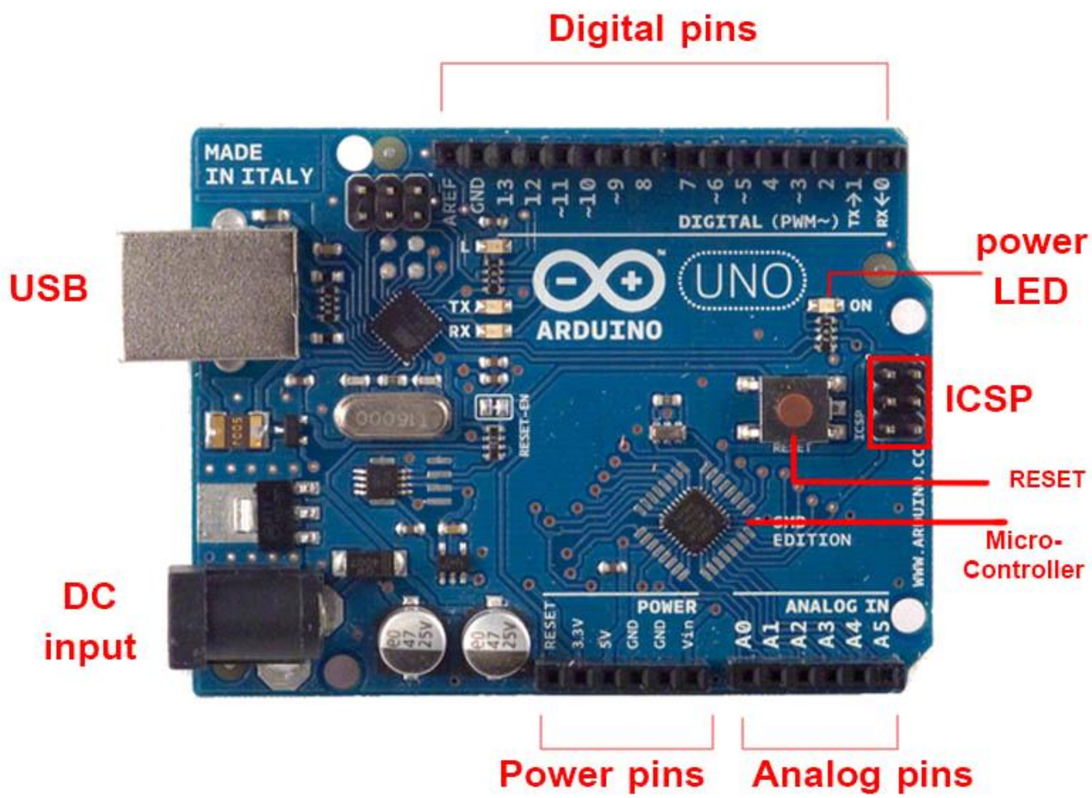


Figure 3.2 Arduino Uno (Components Explanation)

Although it might not look like much to the new observer, the Arduino system allows creating devices that can interact with the world. By using an almost unlimited range of input and output devices, sensors, indicators, displays, motors, and more, the exact interactions required to create a functional device can be programmed. For example, artists have created installations with patterns of blinking lights that respond to the movements of passers-by, high school students have built autonomous robots that can detect an open flame and extinguish it, and geographers have designed systems that monitor temperature and humidity and transmit this data back to their offices via text message. In fact, there are infinite numbers of examples with a quick search on the Internet .By taking a quick tour of the Uno Starting at the left side of the board there are two connectors, On the far left is the Universal Serial Bus (USB) connector .This connects the board to the computer for three reasons; to supply power to the board, to upload the instructions to the Arduino, and to send and receive from a computer. On the right is the power connector, this connector can power the Arduino with a standard mains power adapter.at the lower middle is the heart of the board: the microcontroller, the microcontrollers represent the “brains” of the Arduino. It is a tiny computer that contains a processor to execute instructions, includes various types of memory to hold data and instructions from the sketches, and provides various avenues of sending and receiving data. Just below the microcontroller are two rows of small sockets, the first row offers power connections and the ability to use an external RESET button. The second row offers six analog inputs that are used to measure electrical signals that vary in voltage. Furthermore, pins A4 and A5 can also be used for sending data to and receiving it from other devices. Along the top of the board are two more rows of sockets, Sockets (or pins) numbered 0 to 13 are digital input/output (I/O) pins. They can either detect whether or not an electrical signal is present or generate a signal on command. Pins 0 and 1 are also known as the serial port, which is used to send and receive data to other devices, such as a computer via the USB Connector circuit. The pins labeled with a tilde (~) can also generate a varying electrical signal, which can be useful for such things as creating lighting effects or controlling electric motors. Next are some very useful devices called light-emitting diodes (LEDs); these very tiny devices light up when a current passes through them. The Arduino board has four LEDs: one on the far right labeled ON, which indicates when the board has power, and three in another group, The LEDs labeled TX and RX light up when data is being transmitted or received between the Arduino and attached devices via the serial port and USB. The L-LED connected to the digital I/O pin number 13. The little black square part to the left of the LEDs is a tiny microcontroller that controls the USB interface that allows Arduino to send data to and receive it from a computer. And, finally, the RESET button

3.3.2 Vibration Sensor SW420 with LM393 Compilation:

This sensor module produce logic states depends on vibration and external force applied on it. When there is no vibration this module gives logic LOW output. When it feels vibration then output of this module goes to logic HIGH. The working bias of this circuit is between 3.3V to 5V DC the vibration sensor SW-420 Comes with breakout board that includes comparator LM 393 and Adjustable on board potentiometer for sensitivity threshold selection, and signal indication LED.

Figure 3.3 Vibration sensor

- Features the default state of the switch is close
- Digital output Supply voltage:3.3V-5V

- On-board indicator LED to show the results
- On-board LM393 chip
- SW-420 based sensor, normally closed type vibration sensor
- Dimension of the board: 3.2cm x 1.4cm

➢ Application used to trigger the effect of various vibration theft alarm intelligent car earth quick alarm motor cycle alarm this module is compared with the normally open type vibration sensor module vibration trigger for longer periods of time can drive the relay module.

➢ Operation of vibration sensor in the training box we use the vibration sensor to measure the accuracy of the doctor when moving triangles from one column to another When one of triangles fall the output of vibration sensor goes to logic1 that is means error in the calculation of the result . And when there is no vibration (no one of the triangles fall) the output of vibration sensor goes to logic0 that is means there is no error.

➢ Vibration sensor arduino interface connect VCC pin of sensor board to +5V pin of Arduino board, connect GND pin to GND pin of Arduino, Connect DO output signal pin of sensor board to Arduino digital pin D3.

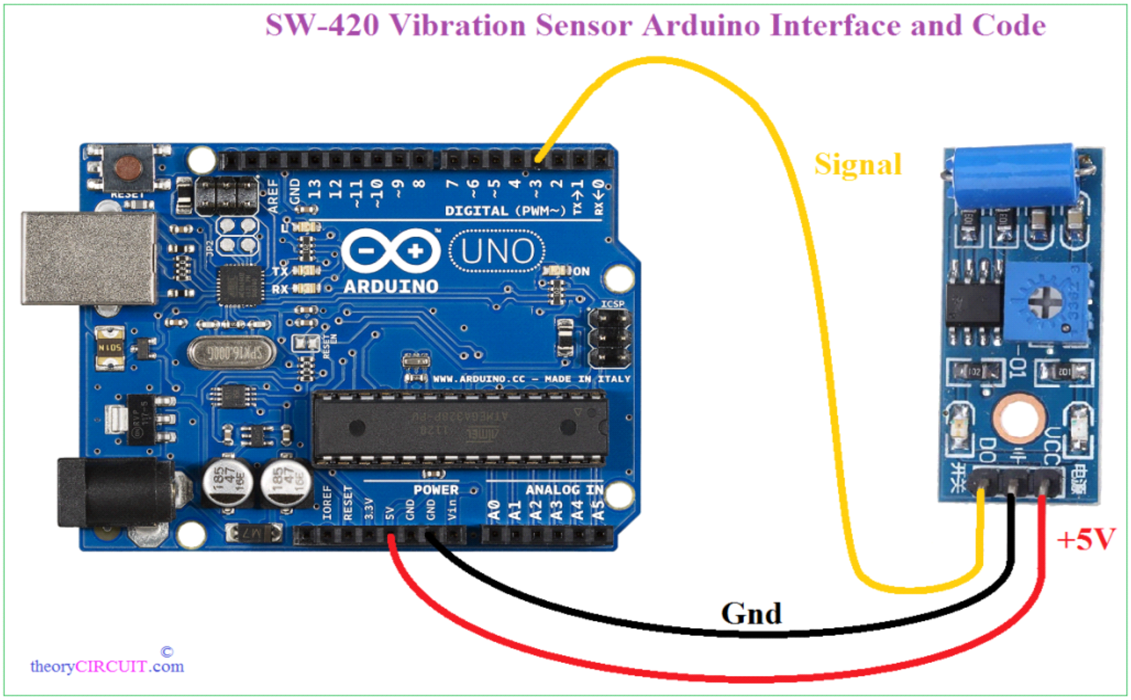


Figure 3.4 Vibration sensor arduino interface

3.3.3 Pulse Sensor:

The pulse sensor we are used is a plug and play heart rate sensor This sensor is quite easy to use and operate place your finger on top of the sensor and will sense the heartbeat by measuring the change in light from the expansion of capillary blood vessels.

❖ Pin out-Pulse sensor the pulse sensor has three pins which are as described below:

- GND: Ground pin.
- VCC: 5V or 3V pin.
- A0: Analog pin.

There is also a LED in the center of this sensor module which helps in detecting the heartbeat. Below the LED there is a noise elimination circuitry which is supposed to keep away the noise from affecting the readings.

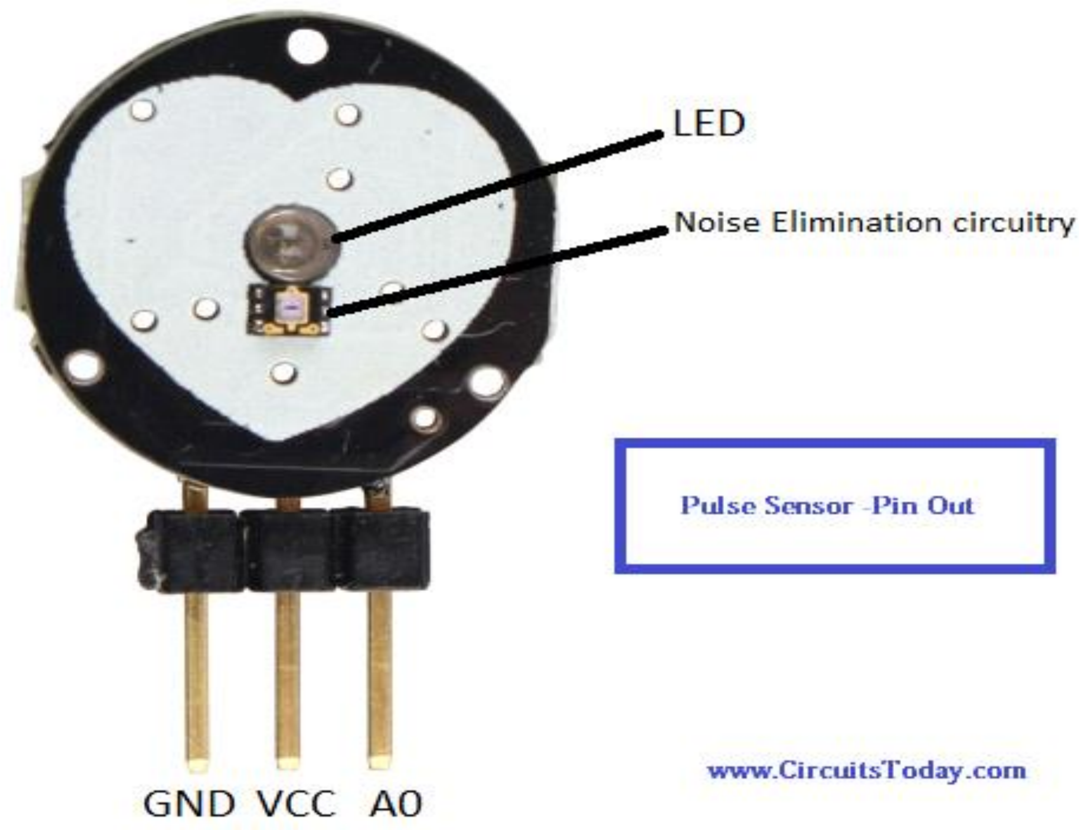


Figure 3.5 Pules sensor

- Operation of pules sensor when a heartbeat occurs blood is pumped through the human body and get squeezed into the capillary tissues the volume of these capillary tissues increases as a result of the heartbeat but in between the heartbeat (the time between two consecutive heartbeats) this volume inside capillary tissues this change in volume between the heartbeats affects the amount of light that will transmit through these tissues this change is very small but we can measure it with the help of Arduino the pulse sensor module has a light which helps in measuring the pulse rate When we place the finger on the pulse sensor the light reflected will change based on the volume of blood inside the capillary blood vessels During a heartbeat ,the volume inside the capillary blood vessels will be high This affects the reflection of light and the light reflected at the time of a heartbeat will be less compared to that of the time during which there is no heartbeat or the time period in between heartbeats the volume inside the capillary vessels will be lesser This will lead higher reflection of light).this variation in light transmission and reflection can be obtained as a pulse from the output of pulse sensor. This pulse can be then conditioned to measure heartbeat and then programmed accordingly to read as heartbeat count in the training box we used pulse sensor to measure the heart rate of the doctor during the training (where the rate of pulses of the doctor are compared with the normal rate of pulses) when the pulse rate of the doctor is out of normal rate that is means the doctor is tense or in an unstable state (that is means error in the calculation of the result).

❖ Pulse sensor arduino interface connect the pulse sensor with arduino as follow:

- GND pin of pulse sensor to GND of Arduino.
- VCC of pulse sensor to 5V of Arduino.
- A0 of pulse sensor to A0 of Arduino.

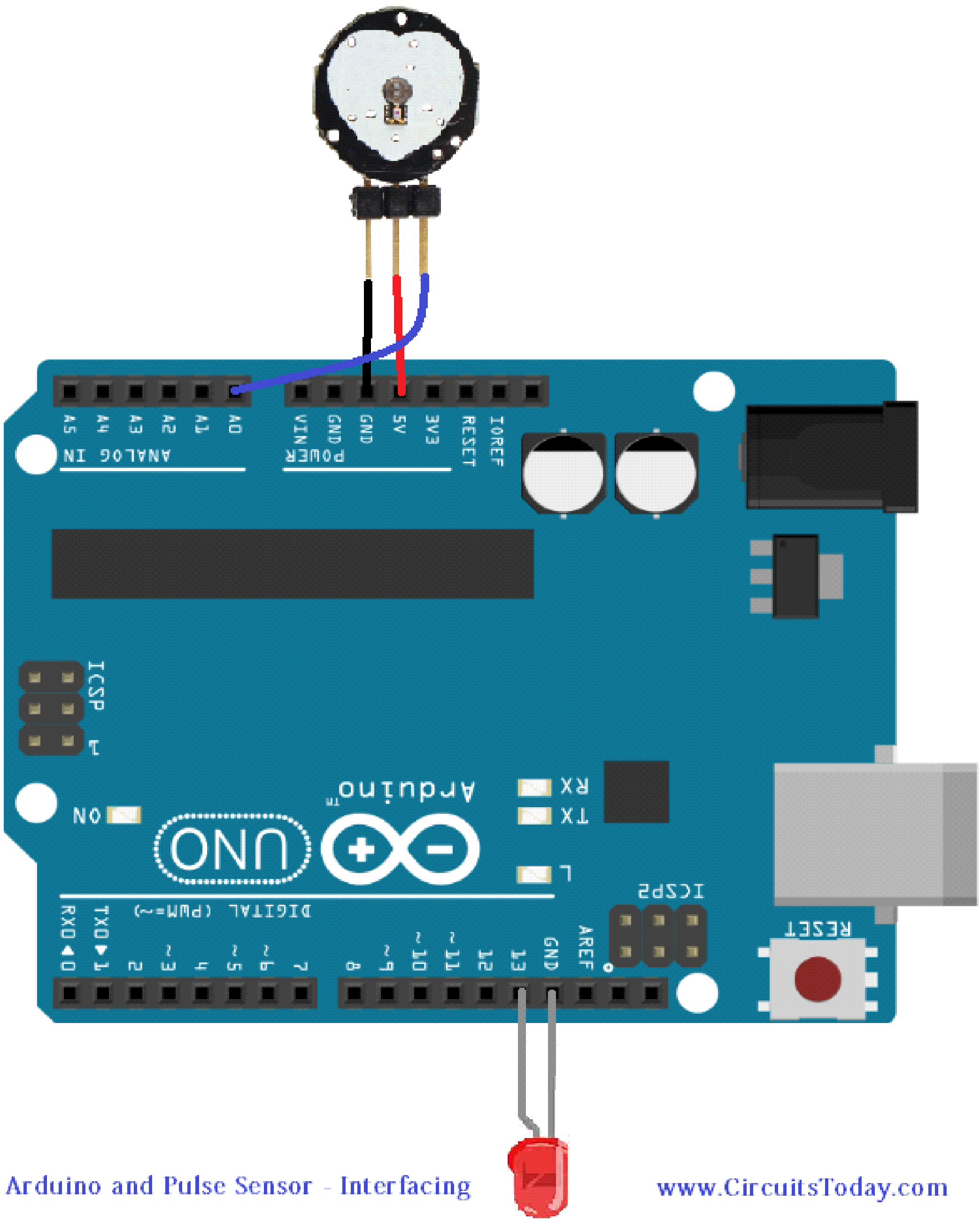


Figure 3.6 Pules sensor arduino interface

3.3.4 Potentiometer

A potentiometer is a three-terminal resistor with a sliding or rotating contact that forms an adjustable voltage divider If only two terminals are used, one end and the wiper, it acts as a variable resistor or rheostat the measuring instrument called a potentiometer is essentially a voltage divider used for measuring electric potential (voltage); the component is an implementation of the same principle, hence its name potentiometers are commonly used to control electrical devices such as volume controls on audio equipment. Potentiometers operated by a mechanism can be used as position transducers, for example, in a joystick.

Figure 3.7 Potentiometer

- Operation of Potentiometer by turning the shaft of the potentiometer, we change the amount of resistance on either side of the wiper which is connected to the center pin of the potentiometer. This changes the relative "closeness" of that pin to 5 volts and ground, giving us a different analog input. When the shaft is turned all the way in one direction, there are 0 volts going to the pin, and we read 0. When the shaft is turned all the way in the other direction, there are 5 volts going to the pin and we read 1023. In between, analog Read () returns a number between 0 and 1023 that is proportional to the amount of voltage being applied to the pin.in the training box we use two Potentiometer to express the high and the low pressure of the doctor.During the training (where the rate of pressure of the doctor are compared with the normal rate of pressure) when the pressure of the doctor is out of normal rate that is means the doctor in an unstable state (that is means error in the calculation of the result).

- Interface with Arduino we connect three wires to the Arduino board. The first goes to ground from one of the outer pins of the potentiometer. The second goes from 5 volts to the other outer pin of the potentiometer. The third goes from analog input 2 to the middle pin of the potentiometer.

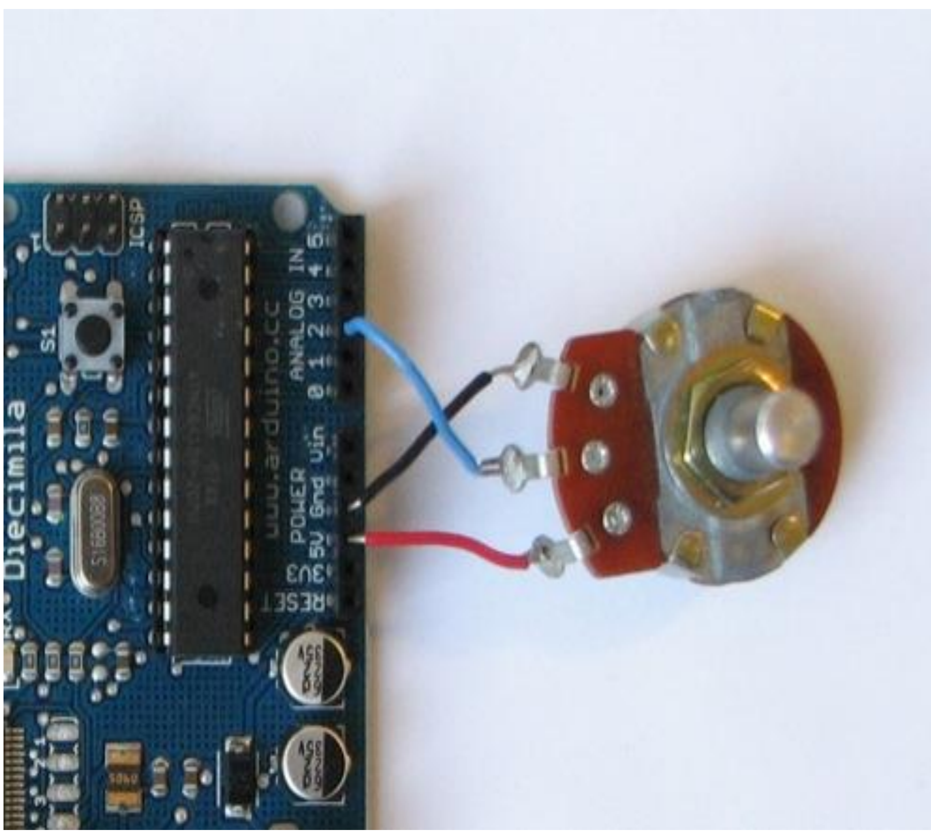


Figure 3.8 Potentiometer arduino interface

3.3.5 Camera system

A webcam is a video camera that feeds or streams its image in real time to or through a computer to a computer network, webcam is generally connected by a USB cable, or similar cable, or built into computer hardware, such as laptops, table 3.2 shows the camera specification

Table 3.1 shows the camera specification

Interface	USB 2.0
Sensor	COMS sensor
Effective static pixels	10 Mega pixels
Maximum resolution	4000*3000(10 Mage pixels)
Output frame rate	30 fps
Lens view angle	51 degrees
Focus rang	80mm to infinity
White balance	Auto
Auto exposure (AE)	Auto
USB cable length	1.2m
Weight	50g
Dimension	53*53*25mm

3.4 Block Diagram

The block diagram of complete object detection and tracking is shown below

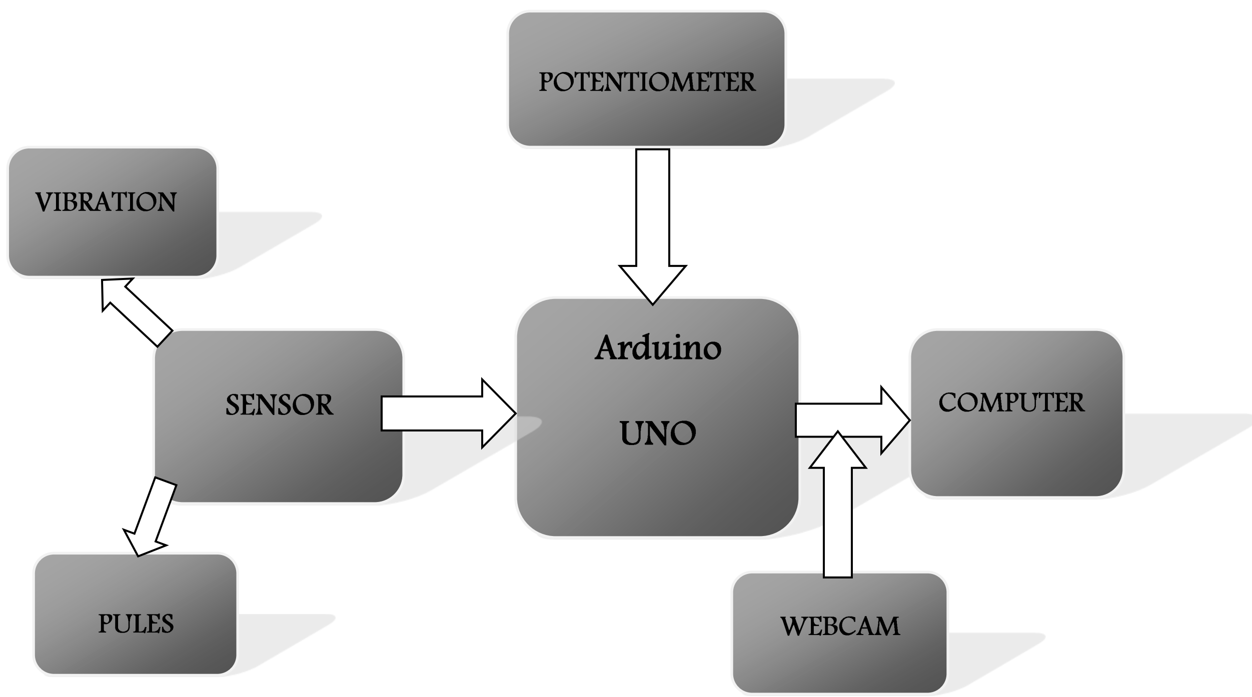


Figure 3.9 system Block Diagram

CHAPTER FOUR

Simulation & Practical

4.1 Introduction

The circuit that was designed in the third chapter before its implementation will be simulated, and after simulation we will run it in the simulations we will use the:

4.1.1 Proteus

Proteus Virtual System Modeling a tool that combines a variety of software tools in electronic systems simulation to put the hands of students, engineers and professionals in an integrated environment that contains all the tools needed for a realistic simulation process. It combines SPICE systems to emulate circuits and electronic components and microprocessor models to facilitate a later stage of simulation of microcontroller-based electronic systems ... The first tool developed the methods of testing and simulation of these systems as a pre-practical phase of their circuit schematics.

4.2 Simulation

is a network of wires showing how the circuit components connected, It explains the signals requirement for the movability and the ON- OFF control, also it declare the power feeding lines for the circuit, simulation describe how all wires connected between the system circuit components.

In this circuit the controller was connected to three potentiometers as follows

- The first potentiometer represent the pulse sensor. The first terminal of the potentiometer was connected to +5V and the second was connected to GND and the third terminal of the potentiometer was connected to A0 in arduino

- The second potentiometer represents the high pressure sensor the first terminal of the potentiometer was connected to +5V and the second was connected to GND and the third terminal of the potentiometer was connected to A1 in the arduino
- The third potentiometer represents the low pressure sensor. The first potentiometer terminal was connected to +5V, the second was connected to GND and the third terminal of the potentiometer was connected A2 in the arduino

And also we connected two switch as follows. the first switch represent the first vibrator sensor where the first terminal of the switch is connected to the GND and the other terminal was shortened was the first terminal and from the same the compartment point connected to D3 in the arduino and the third terminal was connected to +5v. the second switch represent the second vibrator sensor where the first terminal of the switch was connected to the GND and the other terminal was shortened with the first terminal and from the same the compartment point connected to 4D in the arduino and the third terminal was connected to +5V. the VCD in LCD was connected to the GND the GND and a compartment with RW. The VDD from LCD was connected with +5v and RS from LCD was connected with 7D on the arduino and E from the LCD was connected with 8D of arduino RE from LCD was connected with D9 from the arduino and D5 from the LCD with D10 from arduino and D6 from LCD with D11 from arduino and D7 from LCD with D12 from arduino

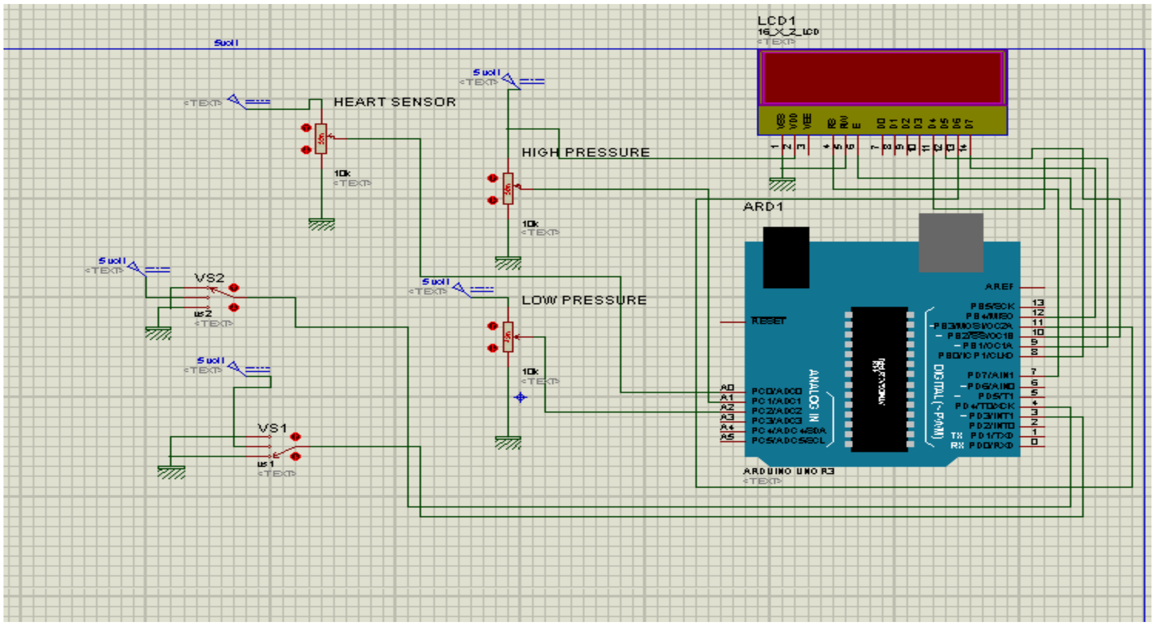


Figure (4-1): Simulation

4.3 Software Program

SQL Server is Microsoft relational database management system (RDBMS) it is a full-featured database primarily SQL Server is sometimes referred to as MSSQL and Microsoft SQL Server

- ➢ SQL Language is a standard language for accessing and manipulating databases" communicate with databases ".
- ➢ What Can SQL do execute queries against a database.

- Retrieve data from a database.
- Insert, update//delete records in a database.
- Create new databases new tables stored procedures and create views in a database.

- Set permissions on tables, procedures, and views Database Tables.

- Some of The Most Important SQL Commands such as update//delete//insert into and create.

4.3.1 Microsoft Visual Studio

Microsoft Visual Studio is an integrated development environment from Microsoft. It is used to develop computer programs, as well as websites, web apps, web services and mobile apps. Visual Studio supports 36 different programming languages provided a language-specific service exists. Built-in languages include C, C++, C++/CLI, Visual Basic .NET, C#, F#.

- C sharp C# is a simple, modern, general-purpose, object-oriented programming language developed by Microsoft C# programming is very much based on C and C++ programming languages, C# type is safer than C++ and has safe default conversions.

- The doctor's data is entered through the doctor's port. The data is saved and displayed via Visual Studio and taken in the form of tables in the database with the possibility of updating and deleting the data the figure (4-2) shown the doctor form

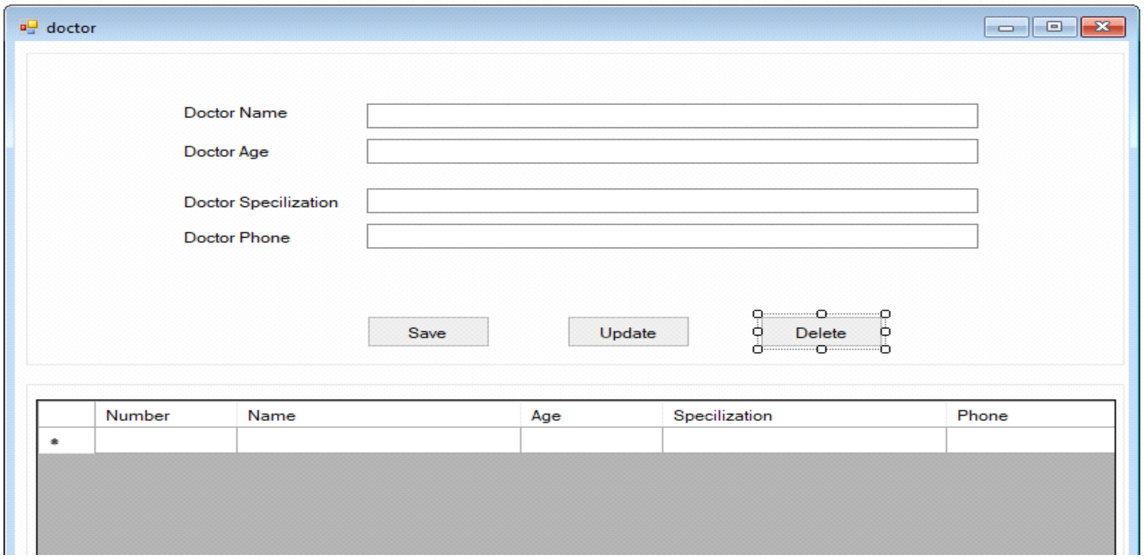


Figure (4-2): First Interface of Visual Studio

- Through this port, the patient's data are entered in addition to his health condition such as blood pressure, oxygen, temperature, and heart rate. after entering these data , then compare it with saved data to determine if the patient is ready or not(if the patient is ready will go to next step , on the left side of the same page, some of the problem is done if there is a defect in the patient's states. The doctor will answer the question explaining the patient's condition it then displayed as a result at the end of the page the figure (4-3) shown The patient form

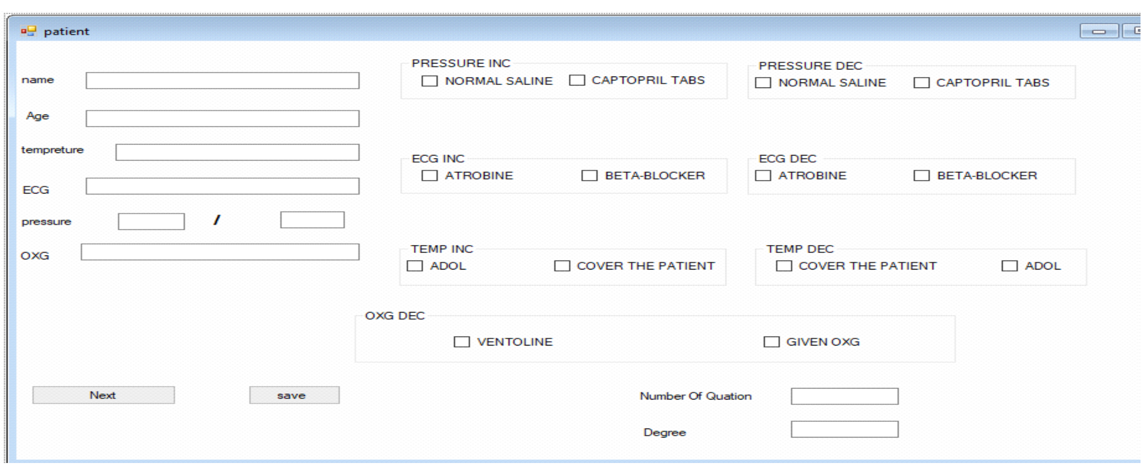


Figure (4-3): Second Interface Visual Studio

- This form the camera displayed the working field inside the box and on the left side serial circuit port name board rate (save the data) and vital indicators of the doctor's pressure and heart rate and vibration reading the figure (4-4) shown The training form

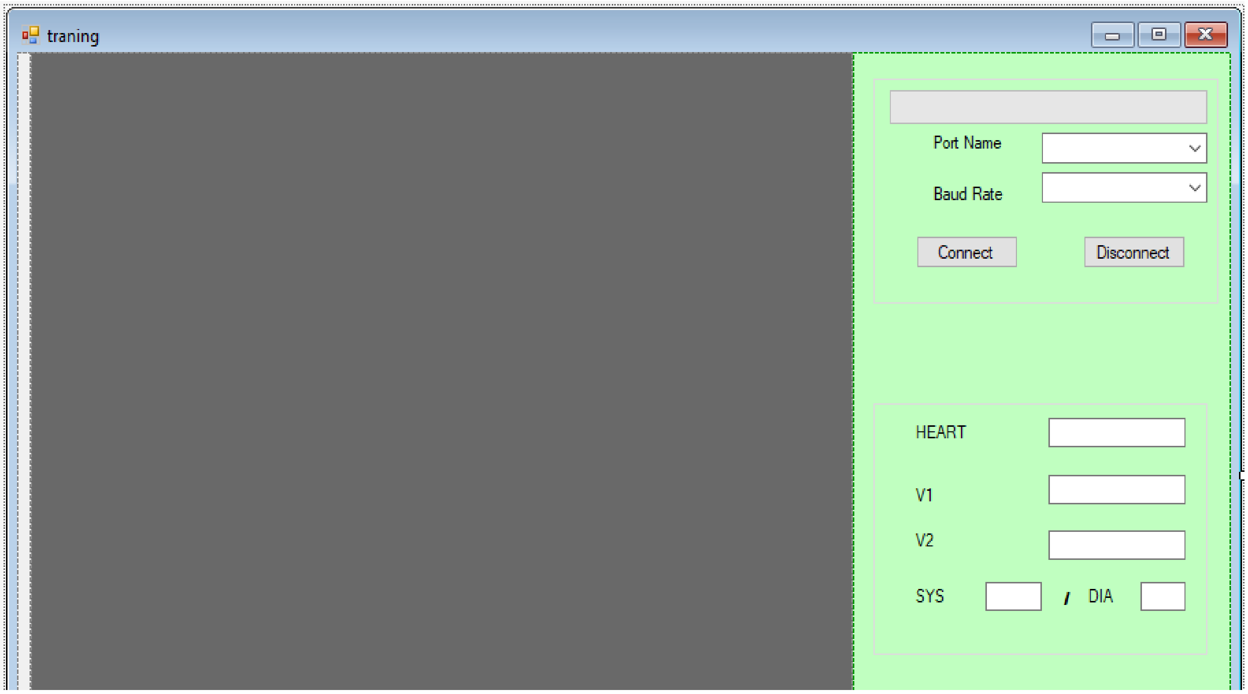


Figure (4-4): Third Interface Visual Studio

4.4 Practical

The exercises programmed on the device are divided in to basic skills training such as how to use the camera for nose surgery how to move in harmony and proper timing and enlarge and reduce the image as needed surgeon and how to use tools and choose the appropriate tools for each surgical step and coordination in the movement surgical instruments and other the device relies on the training box operation through simulation which leads to raise the skills of doctors and the weight of their experience laparoscopic surgery and reduces the risk of open surgery

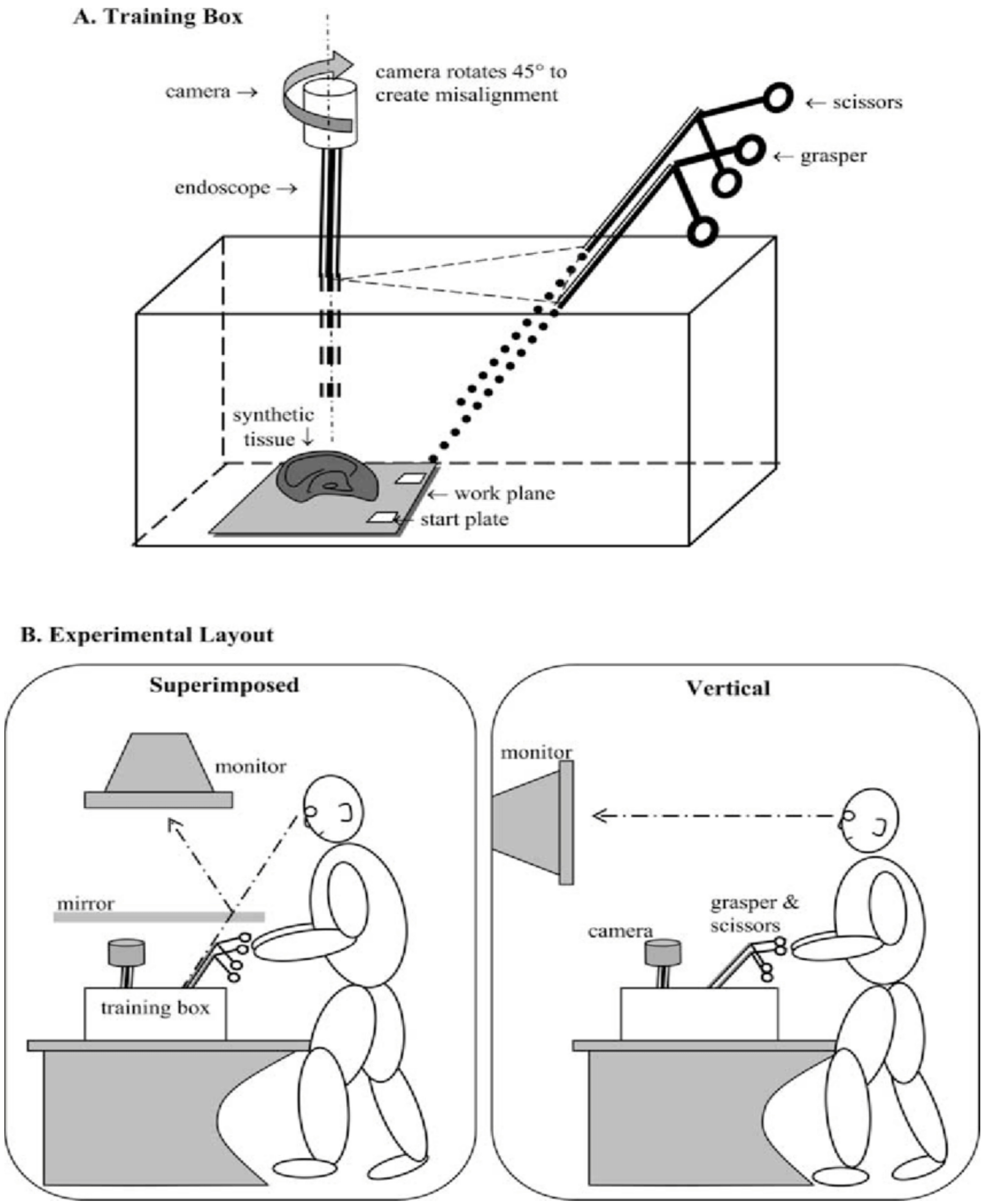


Figure (4-5): Training Box –Practical image

The training box of doctors on endoscopes is mostly composed of a black box (35*30*20) cm and the camera is 9cm years away from the work level in the training box insert the camera and pair of scissors in to the training box to from an isosceles triangle 20cm between the holder and scissors and18cm between the camera and scissors we focus the camera s optical axis on the working level center that contains a game column and triangles ensuring that the lighting and zoom effects are identical even when rotating the camera

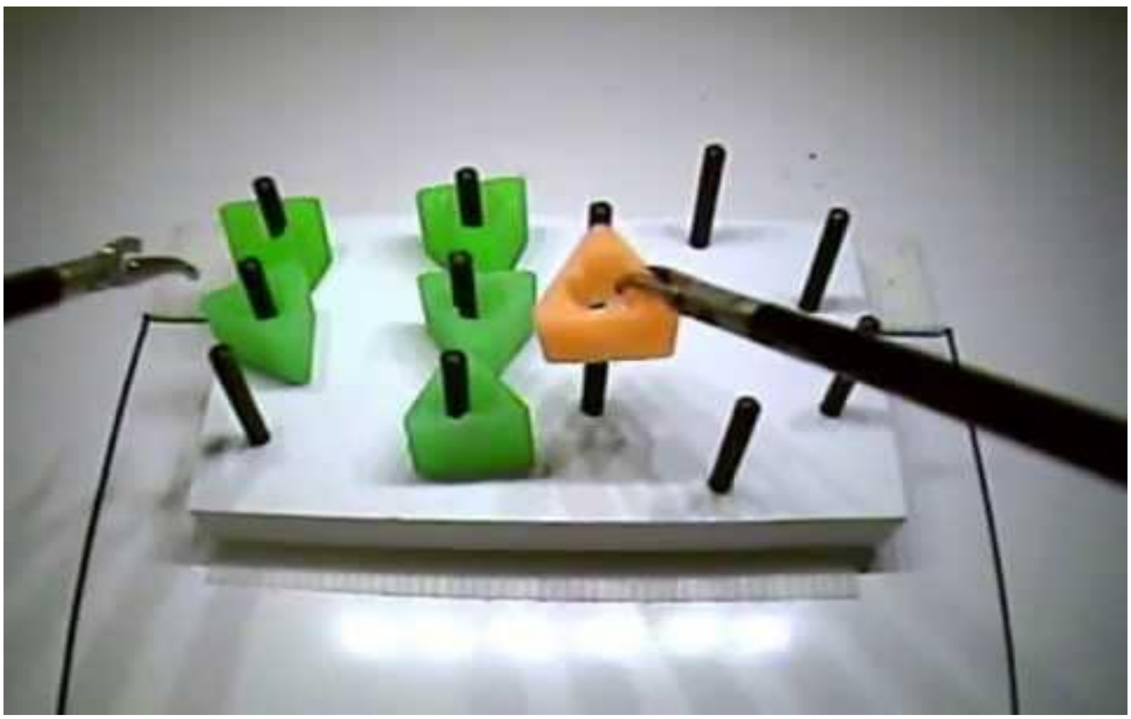


Figure (4-6): Game Model

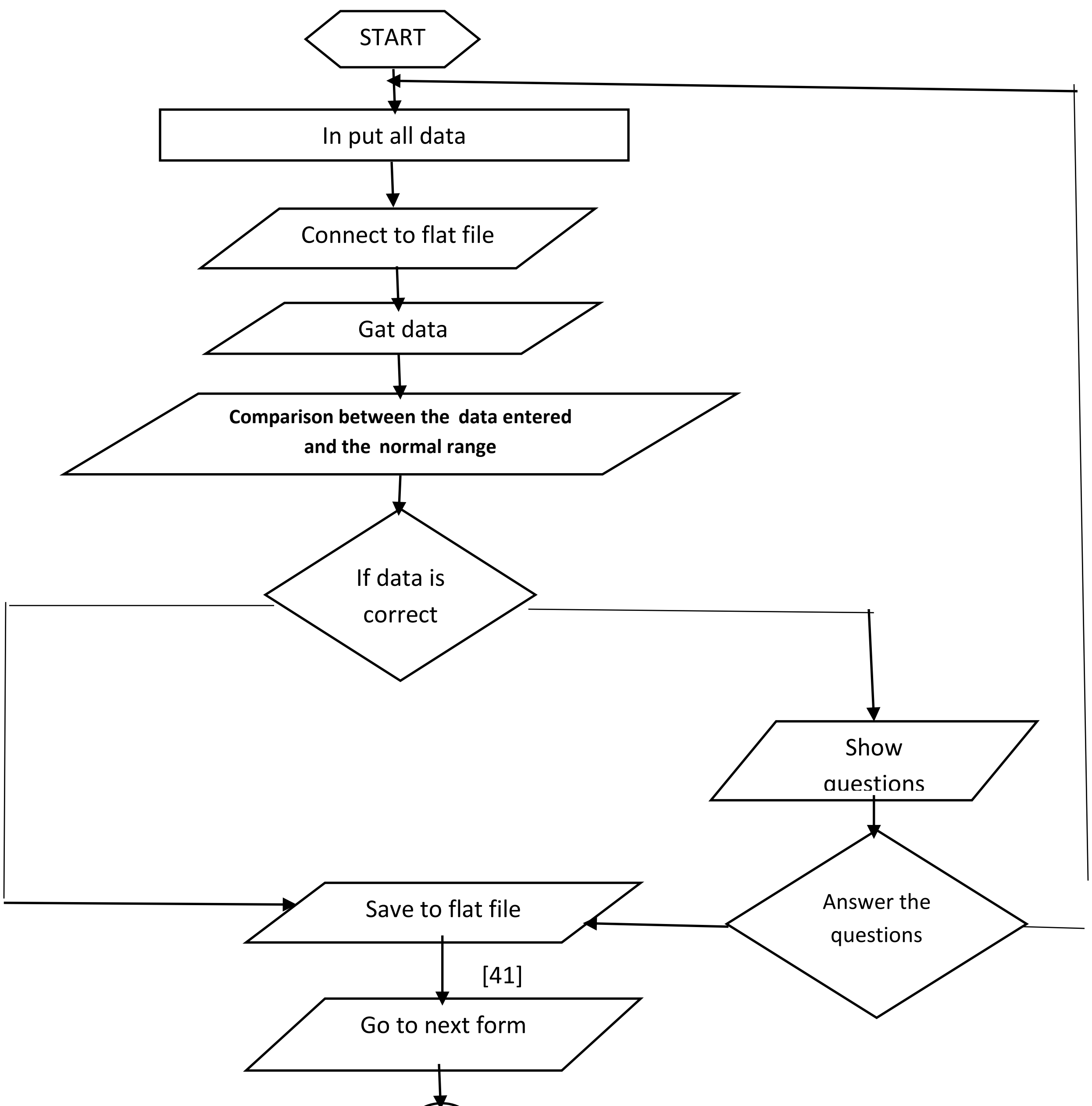
Figure (4-7): Training box Model

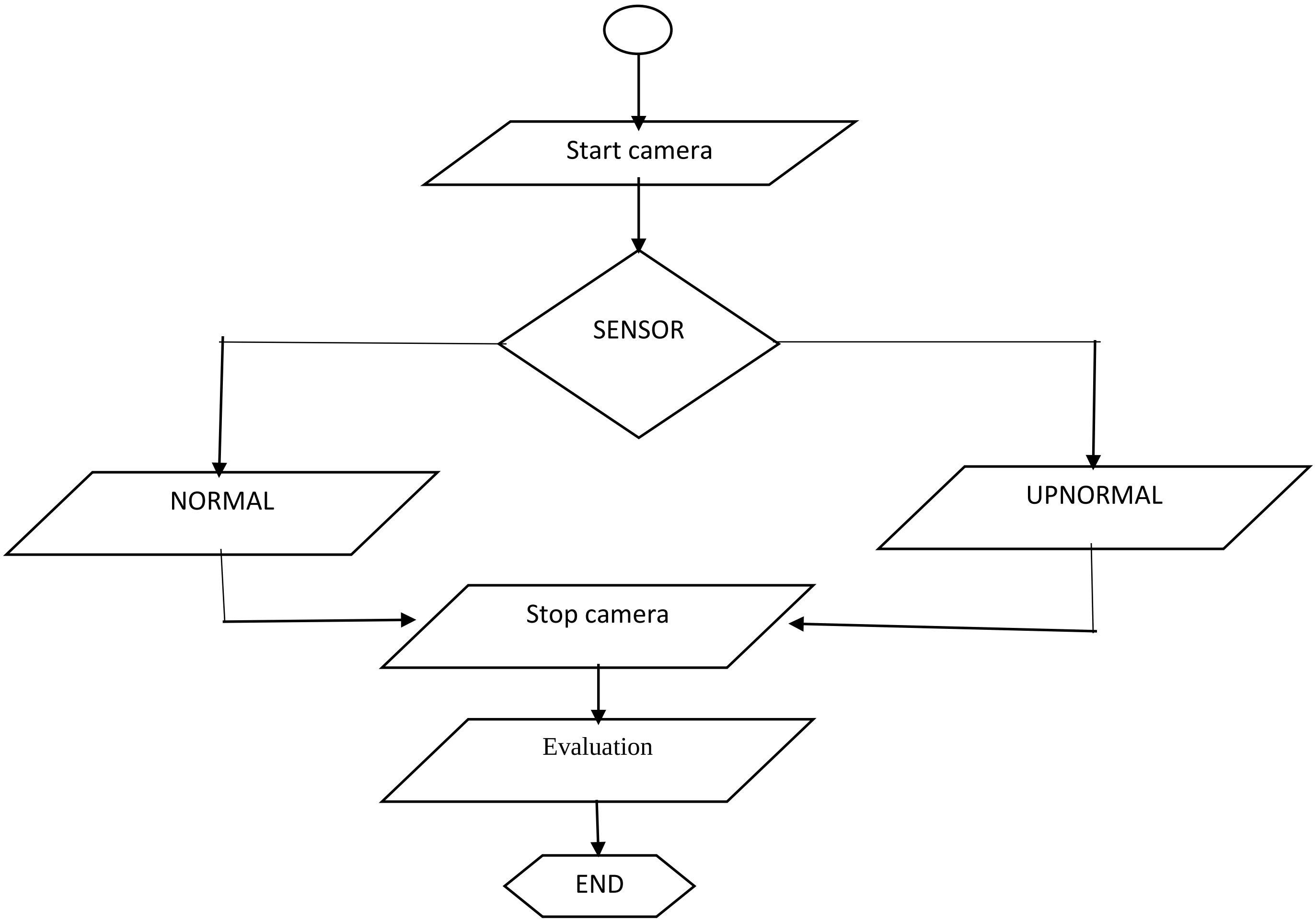
4.5 Operation

The method of operation of the device is based on a software which consist of more ports the first port for the trainee or the doctor and here we enter the trainees data and its stored in a table below the port and then we move to log in port here we give the doctor a serial number after that move to the mental testing stage or patient port by entering the patients data after then a comparison between the data entered and the normal range of (blood pressure oxygen heart rate and temperature) if in the normal range next stage (training port) but if there is a defect there is a set of questions do according to the data to be answered by the doctor if the answer is correct it move next stage (training port) but if the answer is error stop programed When you open training port and start the camera show the inside training box (hard ware) and the reading of the pulse sensor which is connected to the body of the doctors where it detects the pulse and comparison between the pulse and the normal range potentiometer (pressure sensor) which we control manual and comparison between the value and the normal range Vibration inside the box to the measure the accuracy of the doctor at the start training by trigonometry which is moved in columns by the shears if given the Vibration (0 logic) this means that the triangle on the column and this is true but if given (1 logic) this means that the triangle fell on the box .the inside of the box occurs at a specific time through the timer and at the end of time separates the timer camera and shows the final result.

4.5.1 Flow Chart

Flow chart below represent the software algorithm, it's divided into two major Parts first one is software in the object and the second part is training box.




Start camera
SENSOR
NORMAL
UPNORMAL
Stop camera
Evaluation
END

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The concept of the project, which consists of manufacturing a training box for laparoscope, was designed, controlled, simulated, executed and tested successfully.

This project provides opportunities for good training on laparoscope reduces training spending and has proved effective in achieving this goal.

5.2 Recommendation

To improve the performance of this prototype it is recommended that

- Add more exercises to the box.
- Take advantage of modern techniques such as the use of technical image processing for training on tailoring.

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]

APPENDIX

ARDUINO CODE

```
const int hard=A0;

int hard_rate;

const int s1=8;

const int s2=9;

int s1_val1,s2_val2;

const int pressure=A1;

int pressure_val;

////////////////////////////////////////////////////////

void hard_sensor(){

 hard_rate=analogRead(hard);

 hard_rate = map(hard_rate, 0, 1023, 40, 100);

}

///////////////////////////////////////////////////////

void pressure_sensor(){

 pressure_val=analogRead(pressure);

 pressure_val = map(pressure_val, 0, 1023, 120, 200);

}

//////////////////////////////////////////////////////////////////////

void sensor1(){
```

```
 s1_val1=digitalRead(s1);

}

////////////////////////////////////////////////////////

void sensor2(){

 s2_val2=digitalRead(s2);

}

//////////////////////////////////////////////////////

void send_data(){

  Serial.print("*");

  Serial.print(",");

  Serial.print(hard_rate);

   Serial.print(",");

   Serial.print(s1_val1);

   Serial.print(",");

   Serial.print(s2_val2);

   Serial.print(",");

   Serial.print(pressure_val);

   Serial.print(",");

   Serial.println("#");

}

void setup() {
```

```
  // put your setup code here, to run once:
Serial.begin(9600);
}


void loop() {
  // put your main code here, to run repeatedly:
   send_data();
   delay(1000);
hard_sensor();
 sensor1();
 sensor2();
 pressure_sensor();
}
```

SIMULATION CODE

```
#include<LiquidCrystal.h>
LiquidCrystal lcd(7,8,9,10,11,12);


const int heart=A0;
int heart_rate;
const int s1=3;
const int s2=4;
```

```
int s1_val1,s2_val2;

const int pressure1=A1;

const int pressure2=A2;

int pressure_val;

int pressure_va2;



/////////////////////////////////////////////////////////

void heart_sensor(){

 heart_rate=analogRead(heart);

 heart_rate = map(heart_rate, 0, 1023, 40, 100);

}

////////////////////////////////////////////////////////

void pressure_sensor1(){

 pressure_val=analogRead(pressure1);

 pressure_val = map(pressure_val, 0, 1023, 120, 200);}

 void pressure_sensor2(){

 pressure_va2=analogRead(pressure2);

 pressure_va2 = map(pressure_va2, 0, 1023, 80, 100);

}

///////////////////////////////////////////////////////////////////////
```

```
void sensor1(){
 s1_val1=digitalRead(s1);
}
////////////////////////////////////////////////////////////
void sensor2(){
 s2_val2=digitalRead(s2);
}
//////////////////////////////////////////////////////////
void send_data(){
  Serial.print("*");
  Serial.print(",");
  Serial.print(heart_rate);
   Serial.print(",");
   Serial.print(s1_val1);
   Serial.print(",");
   Serial.print(s2_val2);
   Serial.print(",");
   Serial.print(pressure_val);
   Serial.print(",");
    Serial.print(pressure_va2);
    Serial.print(",");
```

```
   Serial.println("#");
}

void loop() {
  // put your main code here, to run repeatedly:
   send_data();
   delay(1000);
heart_sensor();
 sensor1();
 sensor2();
 pressure_sensor1();
 pressure_sensor2();
 lcd.setCursor(0,1);
 lcd.print(pressure_val);
 lcd.print("/");
 lcd.print(pressure_va2);
 lcd.print(",");
 lcd.print(s1_val1);
 lcd.print(",");
 lcd.print(s2_val2);
 lcd.print(",");
```

```
 lcd.print( heart_rate);

}

void setup() {

lcd.begin(16,2);

Serial.begin(9600);

}
```