Sudan University of Science & Technology

College of Engineering

Electrical Engineering Department

Implementation of Wireless Controlled Monitoring Mobile Robot

تنفيذ تحكم لاسلكي في روبوت متحرك مراقب

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

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الآيـــــة

قال الله تعالى:

﴿ فَتَعَالَى اللَّهُ الْمَلِكُ الْحَقُّ وَلَا تَعْجَلْ بِالْقُرْآنِ مِن قَبْلِ أَن يُقْضَىٰ إِلَيْكَ وَحْيُهُ وَقُل رَّبِّ زِدْنِي عِلْمًا﴾

سورة طه الأية (114) .

DEDICATION

This project is dedicated to…

To our beloved parents, brothers, sisters and all our fellow friends whose always stand with us and help us.

To the teachers we learned from.

To our big nation sudan.

To our university sudan university of science and technology.

ACKNOWLEDGEMENT

In the name of Allah, the most Merciful, the Most Compassionate all praise be to Allah, the Lord of the worlds; and prayers and peace be upon Mohammed His servant and messenger.

We would like to thank Allah for his accommodation.

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Also our thanks to Sumakers lab.

مستخلص

الروبوت عبارة عن ألة صناعية اوتماتيكية تحل محل الانسان في الاعمال الخطرة. في الأماكن الخطرة التي لا يستطيع الانسان الوصول اليها يمكن للروبوت تقديم المساعدة الكافية لمعرفة ما يجري في هذه الأماكن. يهدف هذا المشروع لتنفيذ روبوت له القدرة على التجسس ومراقبة الأوضاع في مكان محدد باستعمال كاميرا لاسلكية. يتم استخدام تطبيق اندرويد للتحكم في الروبوت ويمكن مشاهدة الصورة الحية على التطبيق. يمكن التحكم في الروبوت باستخدام الأزرار او حساس العجلة او الصوت. تم استخدام اردوينو اونو كمتحكم دقيق للروبوت. تم استخدام كاميرا لاسلكية لنقل البث باستخدام تقنية الواي فاي. تم تنفيذ المشروع وقام الروبوت باعطاء النتائج المرجوة.

ABSTRACT

Robot is an automatic industrial machine replacing the human in hazardous work. In dangerous places humans cannot reach robots can help a lot to know what is going on this place. The project aims to implement a robot that has ability to spy and to survey the environment or situation at certain place using wireless camera. The robot is controlled using Android app and live streaming can be viewed on the app. The robot can be controlled using Buttons, accelerometer sensor or voice sensor. An Arduino uno is used as microcontroller for this robot. IP web cam is used to transmit the live video using wifi technology. The project has been accomplished and the robot has given us the performance needed.

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LIST OF ABBREVIATIONS

CNC	Computer Numerically Controlled
MPR	Material Requirements Planning
PUMA	Programmable Universal Machine for Assembly
DC	Direct Current
AC	Alternating Current
ROM	Read Only Memory
(I/O)	Input / Output
CPU	Central Processing Unit
SRAM	Static Random Access Memory
EEPROM	Electrically Erasable Programmable Read Only Memory
PWM	Pulse Width Modulation
DMA	Direct Memory Access
ABS	Antilock Break System
USB	Universal Serial Bus
PCI	Peripheral Component Interconnect
PANs	Personal Area Networks
RF	Radio Frequency
WPANs	Wireless Personal Area Networks
EDR	Enhanced Data Rate
SSP	Secure Simple Pairing
HS	High Speed
LE	Low Energy
Dos	Denial of Service
MITM	Man In The Middle
TV	Television
LED	Light emitting diode
IDE	Integrated Development Environment
UART	Universal Asynchronous Receiver-Transmitter
MCU	Micro Computer Unit
AVR	Aboriginal Voices Radio
DIP	Dual In-line Package
SMD	Surface Mount Device
ADC	Analog to Digital Converter
ICSP	In-Circuit Serial Programming
ESD	Electrostatic Discharge
ISP	Internet service provider
PTC	positive Temperature Coefficient
CCTV	Closed Circuit Television
IP	Internet Protocol
RC	Radio Controlled

CHAPTER ONE

INTRODUCTION

1.1 Project Overview

The advent of new high-speed technology and the growing computer capacity provided realistic opportunity for new robot controls and realization of new methods of control theory. This technical improvement together with the need for high performance robots created faster, more accurate and more intelligent robots using new robots control devices, new drives and advanced control algorithms.

The project aims to design a mini robot car that can move on a given terrain and can see all the things going around using its small mini IP camera.

The robot transmits video via Wifi directly to a Remote Control Android app, which is very convenient since you manage the robot and see what is going on in one single Android app.

It is also equipped with some sensors to avoid dangerous route. The important task for this robot used as a spying purposes or replace it as human eyes in difficult situation.

1.2 Problem

In the event of explosion, earthquake that made the building collapse or fire broke in the building, people faces several constraints in variety of aspect such as the difficulties in entering the building, and move through several obstacles with small size of holes. Besides that bombs near explosive weapons that only rely on the exothermic reaction of an explosive material to provide an extremely sudden and violent release of energy (an explosive device). In this situation it’s hard for us as human to come into the buildings that consist of explosive material which can risk our life. When people cannot enter the building, they also cannot see what happened inside the building and know the source or type of explosion material used or trapped people inside.

1.3 Objectives

The objectives of this project are:

i. To design and construct a robot that can move on a given terrain which would help to monitor all the things through a camera.

ii. To develop an Android application that can control the robot.

iii. To connect a camera to spy on target through live video streaming which is transmitted to the mobile application.

1.4 Methodology

The methodology of this project is to design a mini Wireless Controlled Monitoring Mobile Robot and it is divided into two parts which is hardware and software. Hardware part consists of motor, microcontroller, communication, visual, and sensor. Software consists of Embedded Programming and android Programming. Embedded Programming is for microcontroller that needs to be program for control all the connection input and output circuit. Android Programming is a part of to develop the wireless controller using MIT APP Inventer2. The motors used are dc motor to control the movement of the robot and servo motor to rotate the camera and give wide view. The communication is Bluetooth Technology that controls the signal of movement between the robot and application.

1.5 Thesis layout

The project consists of five chapters.

The first chapter briefly discusses the overviews about the project such as introduction, problem statements, objectives, and methodology used in the project.

Chapter 2 study and discuss research and information about the project. Every facts and information which found through any references had been selected. This literature review has been explained about the robot.

Chapter3 illustrate system circuit and discuss all its components.

Chapter 4 will discuss about the project methodology used in this project such as hardware process, programming, and software. All these methodology should be followed for a better performance followed by project results and operation.

Finally the conclusion has been made and recommendation for the future works.

CHAPTER TWO
GENERAL CONCEPT

2.1 Introduction

It is necessary to provide the summary of literature reviews and information on topics related to spy robot or robot that has capability to survey the environment via wireless vision system including system, control system, motor, microcontroller, Robot, Robotics, communication, and camera.

2.2 System

System mean different things to different people and can include purely physical systems such as the machine table of a computer numerically controlled (CNC) machine tool or alternatively the procedures necessary for the purchase of raw materials together with the control of inventory in a Material Requirements Planning (MPR) system.

However, all systems have certain things in common. They all, for example, require inputs and outputs to be specified. [1]

System can also be defined as a combination of components that act together to perform a function not possible with any of the individual parts. The word system as used here is interpreted to include physical, biological, organizational, and other entities, and combinations thereof, which can be represented through a common mathematical symbolism. The formal name systems engineering can also be assigned to this definition of the word system. Thus, the study of feedback control systems is essentially a study of an important aspect of systems engineering and its application. [2]

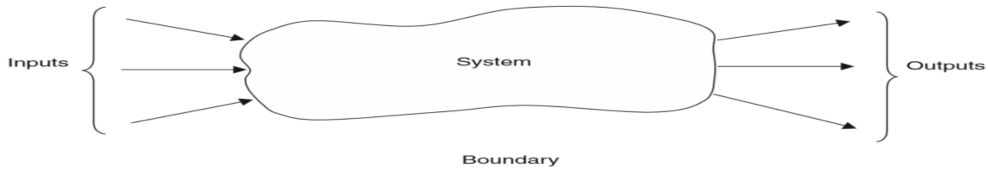

Figure 2.1: The concept of system

2.3 Control System

A control system is an interconnection of components forming a system configuration that will provide a desired system response. The basis for analysis of a system is the foundation provided by linear system, which assumes a cause effect relationship for the components of a system. A component or process to be controlled can be represented by a block as shown in Figure. [3]

Figure 2.2: Control system process

2.3.1 Open - loop control systems:

Those systems in which the output has no effect on the control action are called open-loop control systems. In other words in an open loop control system the output is neither measured nor fed back for comparison with the input. One practical example is a washing machine. Soaking, washing, and rinsing in the washer operate on a time basis. The machine does not measure the output signal that is the cleanliness of the clothes. In any open-loop control system the output is not compared with the reference input. Thus, to each reference input there corresponds to a fixed operating condition; as a result, the accuracy of the system depends on calibration. In the presence of disturbances, an open-loop control system will not perform the desired task. Open-loop control can be used in practice only if the relationship between the input and output is known and if there are neither internal nor external disturbances. Clearly such systems are not feedback control systems. Note that any control system that operates on a time basis is open loop. For instance traffic control by means of signals operated on a time basis is another example of open-loop control.

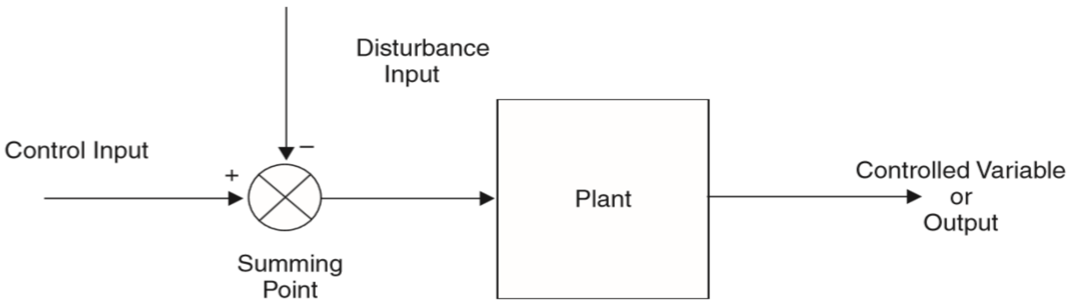

Figure 2.3: open loop control system

2.3.2 Closed-loop control systems:

In a closed-loop control system the actuating error signal,which is the difference between the input signal and the feedback signal (which may be the output signal itself or a function of the output signal and it's derivatives and/or integrals),is fed to the controller so as to reduce the error and bring the output of the system to a desired value.The term closed-loop control always implies the use of feedback control action in order to reduce system error.

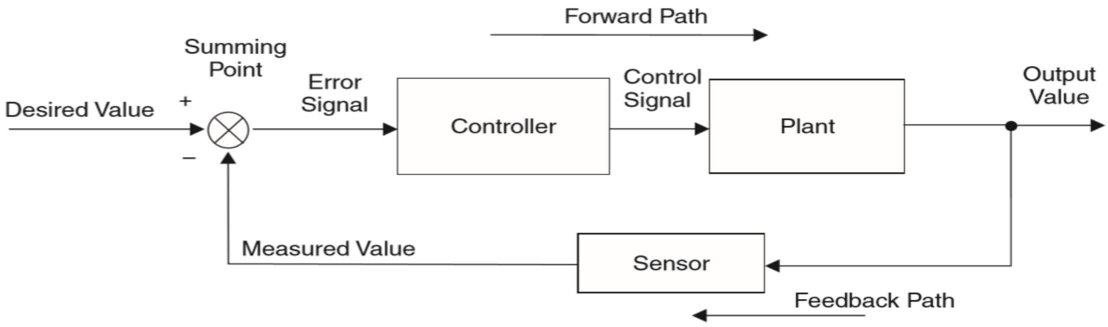

Figure 2.4: Closed loop control system

2.4 Robot and Robotics

Robotics is a field of Engineering that covers the mimicking of human behavior. Robotics includes the knowledge of Mechanical, Electronics, Electrical and Computer Science Engineering. It is the branch of technology that deals with the design, construction, operation, and application of robots well as computer systems for their control, sensory feedback, and information processing.

The word robot comes from the Slavic word robota, which means labour. A robot is usually an electromechanical machine that can perform tasks automatically. It is defined as an industrial machine that replaces the human to work in hazardous and unsafe condition. It is also defined as a machine that removes the mines in war all on it is behalf. Basically a Robot means:

- An automatic industrial machine replacing the human in hazardous work.
- An automatic mobile sweeper machine at a modern home. [4]

The first programmable robot is designed by George Devol in 1954, who coins the term Universal Automation. He later shortens this to Unimation, which becomes the name of the first robot company (1962).

In 1978 the Puma (Programmable Universal Machine for Assembly) robot is developed by Unimation with a General Motors design support.

In 1980 the robot industry enters a phase of rapid growth. Many institutions introduce programs and courses in robotics. Robotics courses are spread across mechanical engineering, electrical engineering, and computer science departments.

In 1995 emerging applications in small robotics and mobile robots drive a second growth of start-up companies and research.

In 2003NASA's Mars Exploration Rovers will launch toward Mars in search of answers about the history of water on Mars.

Robotics consists of following components:

Power conversion unit, Sensors, Actuators, User interface and Manipulat or linkage base as shown in figure 2.5:

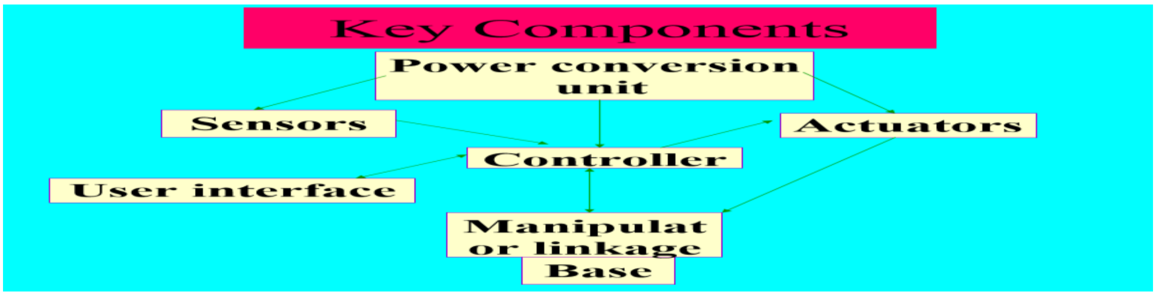

Figure 2.5: key components of Robotics [5]

2.5 Motor

An Electric motor is a machine which converts electric energy into mechanical energy. Its action is based on the principle that when a current-carrying conductor is placed in a magnetic field. [6]

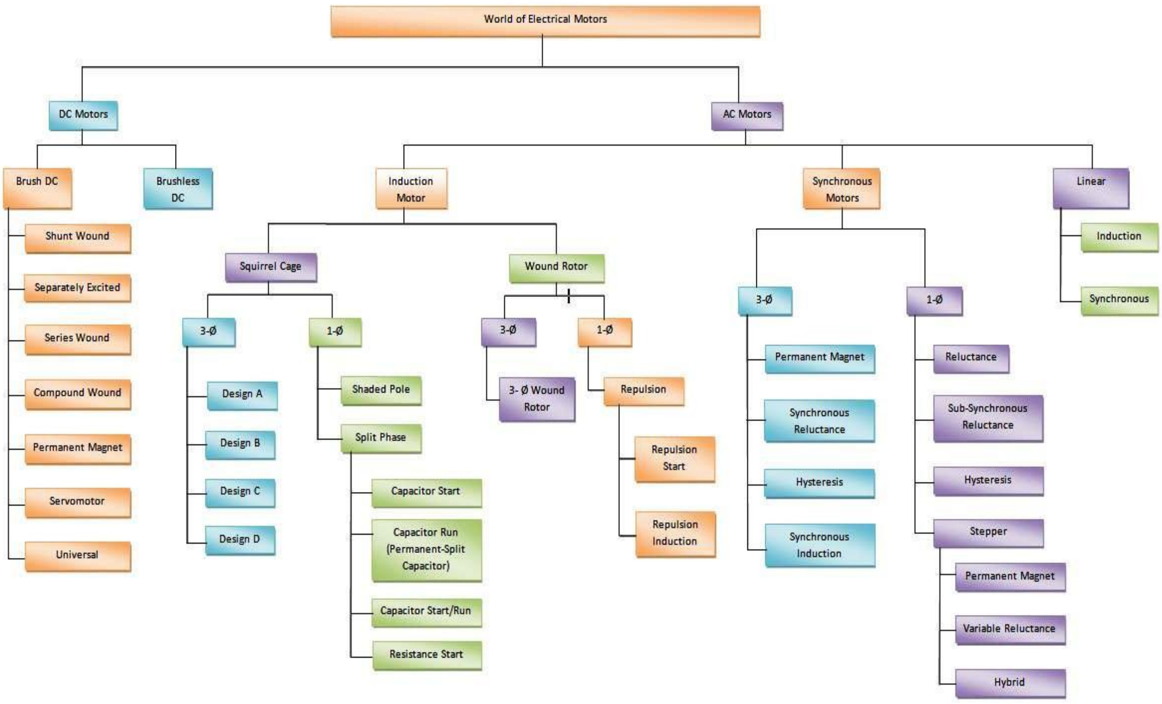

Figure 2.6: classification of electric motor

2.6 Microcontroller

A microcontroller is a computer-on-a-chip or if you prefer a single-chip computer. Micro suggests that the device is small and controller tells you that the device might be used to control objects, processes or events. Another term to describe a microcontroller is embedded controller, because the microcontroller and its support circuits are often built into or embedded in the devices they control. You can find microcontrollers in all kinds of things these days. Any device that measures, stores, controls, calculates, or displays information is a candidate for putting a microcontroller inside.

The largest single use for microcontrollers is in automobiles—just about every car manufactured today includes at least one microcontroller for engine control, and often more to control additional systems in the car.

In desktop computers, you can find microcontrollers inside keyboards, modems, printers, and other peripherals. In test equipment, microcontrollers make it easy to add features such as the ability to store measurements, to create and store user routines, and to display messages and waveforms. Consumer products that use microcontrollers include cameras, video recorders, compact-disk players, and ovens. And these are just a few examples. [7]

Until the mid -1980s most electronic products were still built using extremely intricate and clever combinatory logic circuits, implemented with an awful lot of chips! Starting in the early 1980s, a minority of manufacturers started to build in microprocessors to their products in order to reduce chip count, which brought down manufacturing costs and thus reduced end-user prices. The earliest 8-bit microprocessors such as the Intel 8080 or the Zilog Z80 first appeared toward the late 1970s and were a significant advance on what had gone before. Engineers and designers soon realized that once you put a microprocessor into a device, you could not only make it do much more, but you could also update it much more cheaply if defects or flaws in the original design came to light. Many product defects could now be addressed by using semiskilled labor to plug in a replacement firmware ROM (read-only memory) (this was in the days before programmable flash memory) rather than having to use skilled labor to expensively rework or replace thousands of complete circuit boards. As the 1980s wore on, more and more products had a microprocessor at their core. Even though microprocessors were a huge improvement on what they replaced, they weren't a complete magic bullet for bringing down costs and complexity of product design. The problem was that, to make a microprocessor do anything useful, it had to be surrounded by a large number of additional chips for input output (I/O) and it usually needed other support chips too — such as real-time clock chips and address decoders. By the 1990s, improved silicon processing and chip manufacturing techniques resulted in the ability to put ever more circuitry on one chip. One of the ways this was used was to augment the microprocessor chip with additional functions and features that had previously been implemented by separate external chips. To differentiate these new super-microchips from their simpler forebears, these came to be called microcontrollers.

Some examples of functions that moved from being external chips to being part of the microcontroller are:

- Serial ports to enable the subsystem to talk to a desktop computer or other RS232 Port equipped devices.
- Timers to enable the microcontroller to have an accurate time reference on chip and to carry out events at accurate preset intervals. These timers also enabled microcontrollers to generate music and sounds, since interval accuracy could be assured.
- Serial digital channels to enable microcontrollers to chat with one another, over just two linking wires.
- Analog to digital convertors allowing a microcontroller system to sense analog signals and store or process them as digital data.
- Digital to analog convertors that allowed microcontrollers to interface with external devices like motors that need a continuously variable voltage.
- Input ports for sensing on/off states of things in the outside world.
- Output ports for switching on/off things in the outside world. [8]

In addition to control applications such as the home monitoring system, micro controllers are frequently found in embedded applications. Among the many applications that could be find one or more microcontrollers: automotive applications, appliances, automobiles, environmental control, instrumentation, and thousands of other uses. Microcontrollers are used extensively in robotics. In this application, many specific tasks might be distributed among a large number of microcontrollers in one system. Communications between each microcontroller and central, more powerful microcontroller would enable information to be processed by the central computer, or to be passed around to other microcontrollers in the system. A special application that microcontrollers are well suited for is data logging. Stick one of these chips out in the middle of a corn field or up in a balloon, and monitor and record environmental parameters (temperature, humidity, rain, etc.). Small size, low power consumption, and flexibility make these devices ideal for unattended data monitoring and recording. [9]

Microcontroller construction:

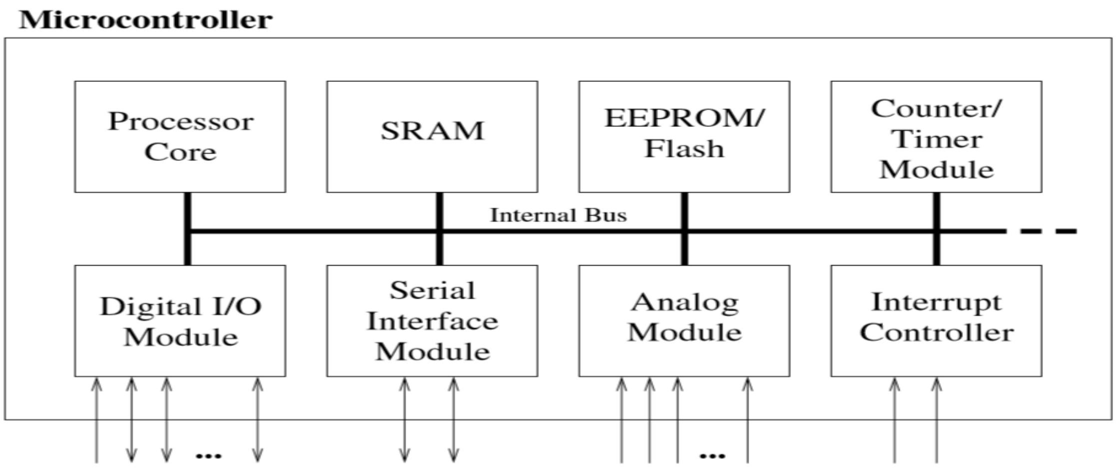

Figure 2.7: Basic layout of a microcontroller.

Processor Core: The CPU of the controller. It contains the arithmetic logic unit, the control unit, and the registers (stack pointer, program counter, accumulator register, register file...).

Memory: The memory is sometimes split into program memory and data memory. In larger controllers, a DMA controller handles data transfers between peripheral components and the memory.

Interrupt Controller: Interrupts are useful for interrupting the normal program flow in case of (important) external or internal events. In conjunction with sleep modes, they help to conserve power.

Timer/Counter: Most controllers have at least one and more likely 2-3 Timer/Counters, which can be used to timestamp events, measure intervals, or count events. Many controllers also contain PWM (pulse width modulation) outputs, which can be used to drive motors or for safe breaking (antilock brake system, ABS). Furthermore the PWM output can, in conjunction with an external filter, be used to realize a cheap digital/analog converter.

Digital I/O: Parallel digital I/O ports are one of the main features of microcontrollers. The number of I/O pins varies from 3-4 to over 90, depending on the controller family and the controller type.

Analog I/O: Apart from a few small controllers, most microcontrollers have integrated analog/digital converters, which differ in the number of channels (2-16) and their resolution (8-12 bits). The analog module also generally features an analog comparator. In some cases, the microcontroller includes digital/analog converters.

Interfaces: Controllers generally have at least one serial interface which can be used to download the program and for communication with the development PC in general. Since serial interfaces can also be used to communicate with external peripheral devices, most controllers offer several and varied interfaces like SPI and SCI. Many microcontrollers also contain integrated bus controllers for the most common (field) busses. IIC and CAN controllers lead the field here. Larger microcontrollers may also contain PCI, USB, or Ethernet interfaces.

Watchdog Timer: Since safety critical systems form a major application area of microcontrollers, it is important to guard against errors in the program and/or the hardware. The watchdog timer is used to reset the controller in case of software “crashes”.
Debugging Unit: Some controllers are equipped with additional hardware to allow remote debugging of the chip from the PC. So there is no need to download special debugging software, which has the distinct advantage that erroneous application code cannot overwrite the debugger.
Contrary to processors , (smaller) controllers do not contain a MMU (Memory Management Unit), have no or a very simplified instruction pipeline, and have no cache memory, since both costs and the ability to calculate execution times (some of the embedded systems employing controllers are real-time systems, like X-by-wire systems in automotive control) are important issues in the microcontroller market.

To summarize, a microcontroller is a (stripped-down) 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 (microwave ,mobile phone),do not need such fast reaction times, so for these applications microcontrollers are a good choice. [10]

2.7 Communication

A process by which information is exchanged between individuals through a common system of symbols, signs or behaviors.
The communication system is shown in figure below:

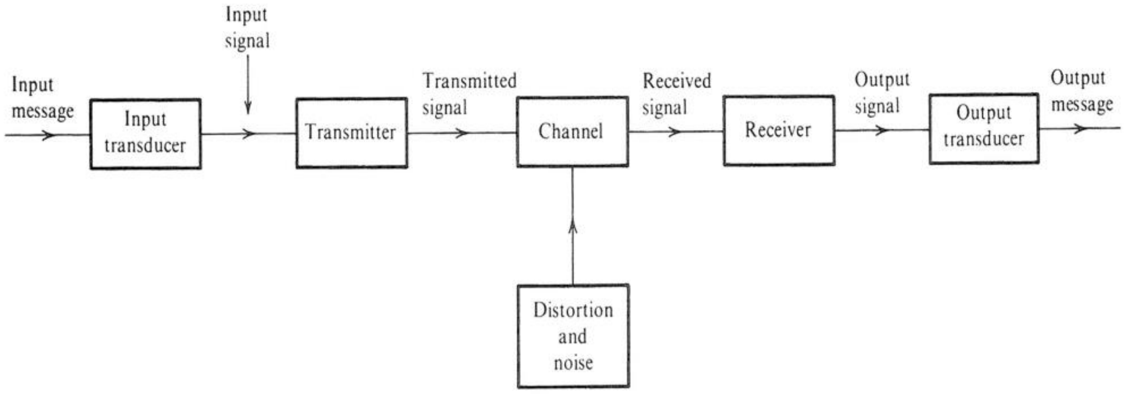

Figure 2.8: Communication Systems

There are two types of Communications:

1. Wireless Communications
2. Wireline Communications

2.7.1 Classification of wireless systems:

- Paging Messaging Systems
- Cordless Telephones
- Satellite Based Mobile Systems
- Cellular Telephony (High-tier)
- Wide Area Wireless Data Systems (High-tier)
- High Speed Local and Personal Area Networks
- 3G Systems [11]

2.7.2 Personal Area Networks (PANs):

Bluetooth is an open standard for short-range radio frequency (RF) communication. Bluetooth technology is used primarily to establish wireless personal area networks (WPANs). Bluetooth technology has been integrated into many types of business and consumer devices, including cell phones, laptops, automobiles, medical devices, printers, keyboards, mice, and headsets. This allows users to form ad hoc networks between a wide variety of devices to transfer voice and data… Several Bluetooth versions are currently in use in commercial devices. At the time of writing, Bluetooth 1.2 (adopted November 2003) and 2.0 + Enhanced Data Rate (EDR, adopted November 2004) are the most prevalent. Bluetooth 2.1 + EDR (adopted July 2007), which is quickly becoming the standard, provides significant security improvements for cryptographic key establishment in the form of Secure Simple Pairing (SSP). The most recent versions include Bluetooth 3.0 + High Speed (HS, adopted April 2009), which provides significant data rate improvements, and Bluetooth 4.0 (adopted June 2010), which includes Low Energy (LE) technology that supports smaller, resource-constrained devices and associated applications. This publication addresses the security of all these versions of Bluetooth. Bluetooth technology and associated devices are susceptible to general wireless networking threats, such as denial of service (DoS) attacks, eavesdropping, man-in-the-middle (MITM) attacks, message modification, and resource misappropriation. They are also threatened by more specific Bluetooth-related attacks that target known vulnerabilities in Bluetooth implementations and specifications. Attacks against improperly secured Bluetooth implementations can provide attackers with unauthorized access to sensitive information and unauthorized use of Bluetooth devices and other systems or networks to which the devices are connected. [12]

Bluetooth transmit range is 10m (1mW transmit power) but can reach100m by increasing transmit power. [13]

2.8 Camera

Broken down to it essential elements, the camera is a box that controls the amount of light which reaches a light-sensitive surface inside (either film, a digital sensor, or another surface). The original cameras did not even have a glass lens, though today we can say that most cameras include: a light-tight box, a glass lens, and a surface that captures light.

The camera has come a long way from its humble beginnings, but it is still just a box that controls the amount of light that reaches a piece of film (or sensor). [14]

The 'body' of a camera is, essentially, the light-tight box that allows light to be captured on film, paper, or a digital sensor. Camera bodies come in a variety of styles, shapes, formats, and have just as many intended uses.

2.9 Android

Android is a mobile operating system developed by Google, based on the Linux kernel and designed primarily for touch screen mobile devices such as smartphones and tablets. Android's user interface is mainly based on direct manipulation, using touch gestures that loosely correspond to real-world actions, such as swiping, tapping and pinching, to manipulate on-screen objects, along with a virtual keyboard for text input.

Initially developed by Android Inc., which Google bought in 2005, Android was unveiled in 2007, along with the founding of the Open Handset Alliance – a consortium of hardware, software, and telecommunication companies devoted to advancing open standards for mobile devices. Beginning with the first commercial Android device in September 2008, the operating system has gone through multiple major releases, with the current version being 8.0 "Oreo", released in August 2017. Android applications ("apps") can be downloaded from the Google Play store, which features over 2.7 million apps as of February 2017. Android has been the best-selling OS on tablets since 2013, and runs on the vast majority[a] of smartphones. As of May 2017, Android has two billion monthly active users, and it has the largest installed base of any operating system.

Android's source code is released by Google under an open source license, although most Android devices ultimately ship with a combination of free and open source and proprietary software, including proprietary software required for accessing Google services. Android is popular with technology companies that require a ready-made, low-cost and customizable operating system for high-tech devices. Its open nature has encouraged a large community of developers and enthusiasts to use the open-source code as a foundation for community-driven projects, which deliver updates to older devices, add new features for advanced users or bring Android to devices originally shipped with other operating systems. The extensive variation of hardware in Android devices causes significant delays for software upgrades, with new versions of the operating system and security patches typically taking months before reaching consumers, or sometimes not at all. The success of Android has made it a target for patent and copyright litigation between technology companies.

CHAPTER THREE

MODEL OF DESIGN

3.1 Introduction

Many components are required to model the design of the spy robot including hardware, software components and circuit diagram.

3.2 Components

- Arduino uno
- DC motor
- Servo motor
- Hc-05 bluetooth module
- Adafruit motor shield
- App inventer
- IP camera

3.2.1 Arduino uno

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a social media message - and turn it into an output - activating a motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board.

Figure 3.1shows Arduino uno board.

Figure 3.1: Arduino uno board

Arduino uno microcontroller has specified properties as shown in table below:

Table 3.1: Arduino uno properties

Microcontroller	ATmega328
Operating Voltage	5V
Input Voltage	7-12V(recommended)
Input Voltage (limits)	6-20 V
Digital I/O Pins	14 (of which 6 provide PWM output
Analog Input Pins	6
DC Current per I/O Pin	40 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328) of which 0.5 KB used by boot loader
SRAM	2 KB (ATmega328)
EEPROM	1 KB (ATmega328)
Clock Speed	16 MHz

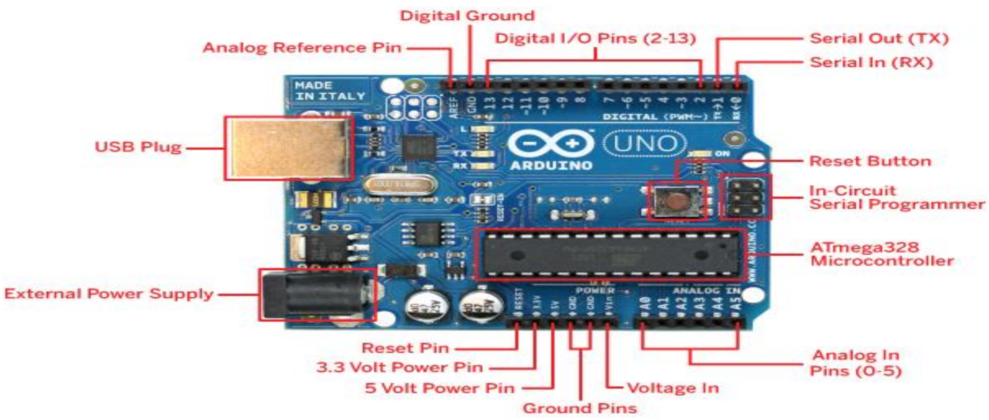

Figure 3.2: Arduino construction

After your code is compiled using Arduino IDE, it should be uploaded to the main microcontroller of the Arduino UNO using a USB connection. Because the main microcontroller doesn't have a USB transceiver, you need a bridge to convert signals between the serial interface (UART interface) of the microcontroller and the host USB signals.

To power your Arduino board, you can use the USB as a power source. Another option is to use a DC jack.

To reset your board, you should use a push button in the board. Another source of reset should be every time you open the serial monitor from Arduino IDE.

Arduino uno is used as follow:

Connect pin number 0 to the Bluetooth TX and pin number 1 to the Bluetooth RX, then connect Arduino Vcc (5v) and Gnd to Bluetooth Vcc(5v) and Gnd respectively.

Arduino act as the brain of the project, it receive signals from the Android APP and sensors ,process this signals and send signals to actuator and motors.

3.2.2 DC Motor

A motor is an electrical machine which converts electrical energy into mechanical energy.

A machine that converts DC power into mechanical energy is known as DC motor.

Figure 3.3: DC Motor

DC motors consist of one set of coils, called armature winding, inside another set of coils or a set of permanent magnets, called the stator, brushes, commutator, shaft. Applying a voltage to the coils produces a torque in the armature, resulting in motion.

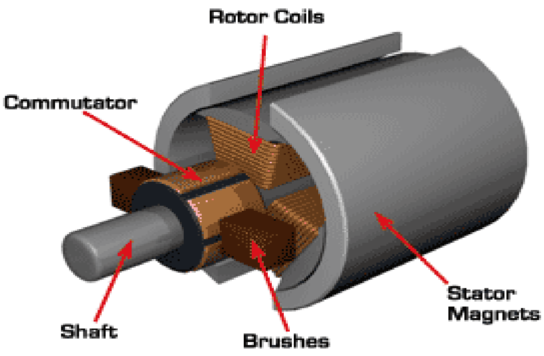

Figure 3.4: DC Motor construction

DC motor operation is based on the principle that when a current carrying conductor is placed in a magnetic field, the conductor experiences a mechanical force. The direction of the force is given by Fleming's left hand rule as shown in figure below.

Figure 3.5: Fleming's left hand rule

DC motor is connected in circuit as follow:

Connect the right dc motor (+) to Adafruit motor shield (M1 PIN +).

Connect the right dc motor (-) to Adafruit motor shield (M1 PIN -).

Connect the left dc motor (+) to Adafruit motor shield (M2 PIN +).

Connect the left dc motor (-) to Adafruit motor shield (M2 PIN -).

DC motor is used to move the wheels of robot in four directions (forward, backward, right, left) after receiving a signal from the arduino which also depend on the input signal from android application in smart phone.

3.2.3 Servo Motor

A servo motor is an electrical device which can push or rotate an object with great precision. If you want to rotate and object at some specific angles or distance, then you use servo motor. It is just made up of simple motor which run through servo mechanism. If motor is used is DC powered then it is called DC servo motor, and if it is AC powered motor then it is called AC servo motor. It is possible to get a very high torque servo motor in a small and light weight packages. Doe to these features they are being used in many applications like toy car, RC helicopters and planes, Robotics, Machine etc.

Figure 3.6: servo motor

A servo consists of a Motor (DC or AC), a potentiometer, gear assembly and a controlling circuit as shown in **figure 3.8**. First of all we use gear assembly to reduce RPM and to increase torque of motor. Say at initial position of servo motor shaft, the position of the potentiometer knob is such that there is no electrical signal generated at the output port of the potentiometer. Now an electrical signal is given to another input terminal of the error detector amplifier. Now difference between these two signals, one comes from potentiometer and another comes from other source, will be processed in feedback mechanism and output will be provided in term of error signal. This error signal acts as the input for motor and motor starts rotating. Now motor shaft is connected with potentiometer and as motor rotates so the potentiometer and it will generate a signal .So as the potentiometer's angular position changes, its output feedback signal changes. After sometime the position of potentiometer reaches at a position that the output of potentiometer is same as external signal provided. At this condition, there will be no output signal from the amplifier to the motor input as there is no difference between external applied signal and the signal generated at potentiometer, and in this situation motor stops rotating.to controlled servo motor All motors have three wires coming out of them. Out of which two will be used for Supply (positive and negative) and one will be used for the signal that is to be sent from the MCU.

Figure 3.7: Construction of servo motor

Servo motor is controlled by PWM (Pulse width Modulation) which is provided by the control wires. There is a minimum pulse, a maximum pulse and a repetition rate. Servo motor can turn 90 degree from either direction form its neutral position. The servo motor expects to see a pulse every 20 milliseconds (ms) and the length of the pulse will determine how far the motor turns. For example, a 1.5ms pulse will make the motor turn to the 90° position, such as if pulse is shorter than 1.5ms shaft moves to 0° and if it is longer than 1.5ms than it will turn the servo to 180°.

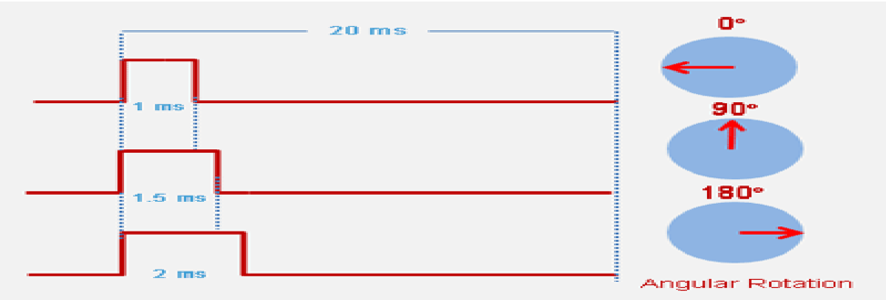

Figure 3.8: servo operation diagram

Servo motors have three wires: power, ground, and signal. The power wire is typically red, and should be connected to the 5V pin on the Arduino board. The ground wire is typically black or brown and should be connected to a ground pin on the Arduino board. The signal pin is typically yellow, orange or white and should be connected to a digital pin on the Arduino board.

Servo is used to Rotate the IP camera to right and left .servo motor can be rotate from 0 to 180 degree.

3.2.4 Bluetooth module HC-05

The HC-05 Bluetooth Module can be used in master or slave configuration, making it a great solution for wireless communication .you can use it simply for a serial port replacement to establish connection between MCU and GPS, PC to your embedded project. The HC-05 Bluetooth Module has 6 pins Vcc, GND, TX, RX, L and LED. It comes programmed as a slave, so there is no need to connect the key pin, unless you need to change it to master mode. The major difference between Master and Slave modes is that, in Slave mode the Bluetooth module cannot initiate a connections, it can however accept incoming connections.

After connection is established the Bluetooth module can transmit and receive data regardless of the mode it is running in. If you are using a phone to connect to Bluetooth module, you can simply use it in the slave mode. The default data transmission rate v is 9600kbps.The range for Bluetooth communication is usually 30m or less. The module has a factory set pin of "1234" which is used while pairing the module to a phone.

The HC-05 module can build a connection to other modules.

Bluetooth module HC-05Specifications are:

- Input Voltage: DC 5V
- Communication Method: Serial Communication
- Master and Slave mode can be switched

Hc-05 bluetooth module consist of CSR bluetooth radio, antenna, RF xformer matching, (5v-3.3v) Regulator, 8 MB flash memory, LED, level shifting, 26MHZ Xtal.

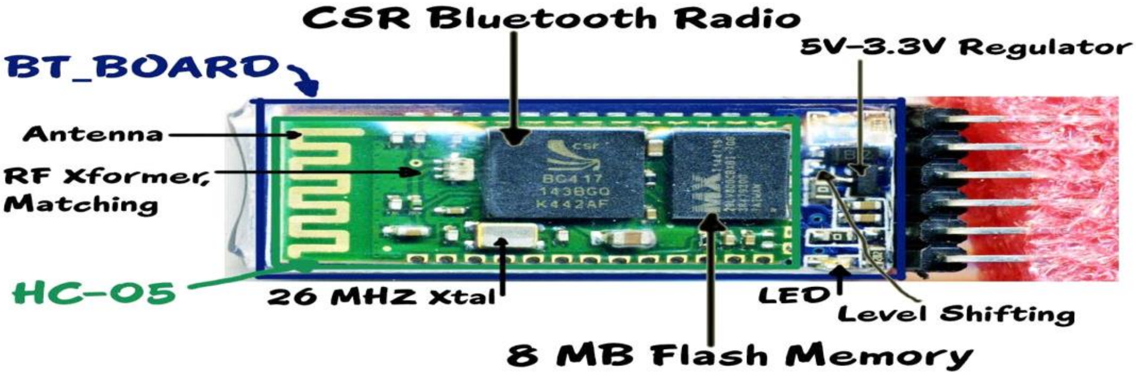

Fig 3.9: Bluetooth Module construction

These modules are based on the Cambridge Silicon Radio BC417 2.4 GHz Bluetooth Radio chip. This is a complex chip which uses an external 8 Mbit flash memory

VCC: +5 Power.

GND: to Ground.

TXD: Transmit Serial Data from HC-05 to Arduino Serial Receive.

RXD: Receive Serial Data from Arduino Serial Transmit

STATE: Tells if connected or not.

Bluetooth module is used by Connecting RX of HC-05 module to TX of Arduino and TX of HC-05 module to RX of the Arduino, then connect Vcc (5V) and GND of the Arduino to Vcc and GND of HC-05 module as shown in figure below:

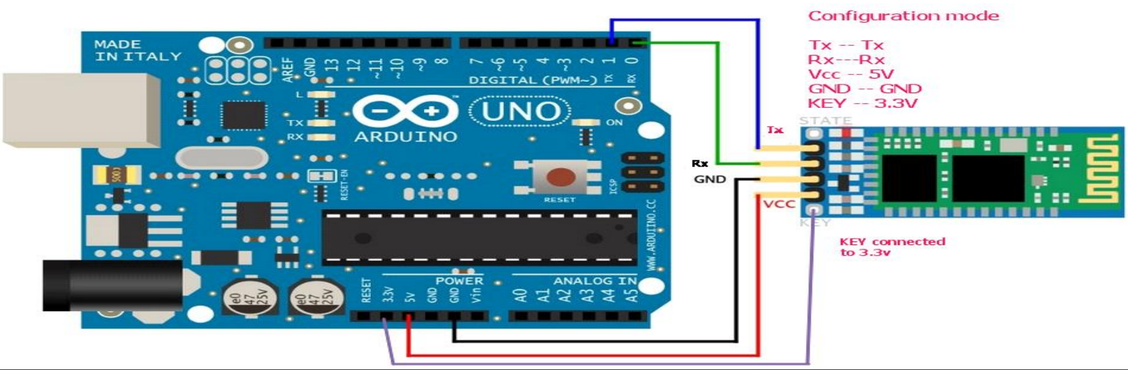

Figure 3.10: Bluetooth Module connection in circuit

Bluetooth module is used to establish Bluetooth communication between the smartphone and Arduino.

3.2.5 Adafruit motor shield

The Motor Shield is a driver module for motors that allows you to use Arduino to control the working speed and direction of the motor.

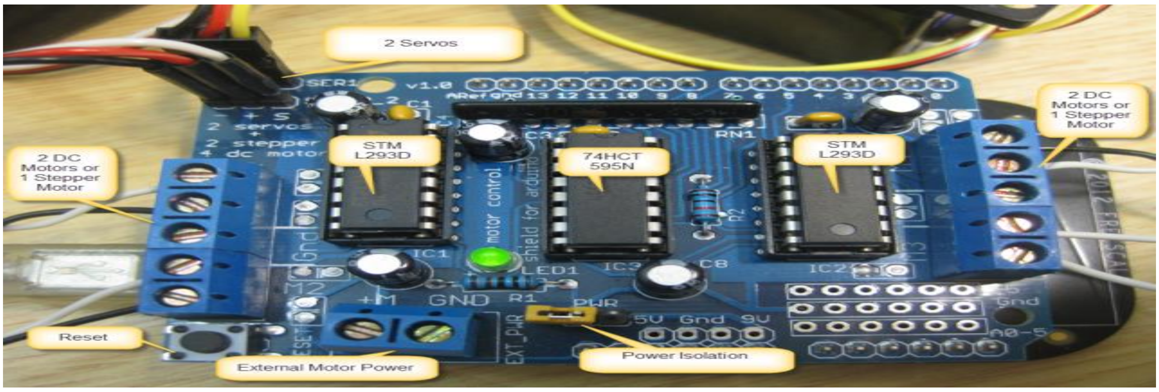

Figure 3.11: Adafruit Motor shield

The shield contains two L293D motor drivers and one 74HC595 shift register. The shift register expands 3 pins of the Arduino to 8 pins to control the direction for the motor drivers. The output enable of the L293D is directly connected to PWM outputs of the Arduino.

To increase the maximum current, the L293D allows extra chips with "piggyback". Piggyback is soldering one or two or three extra L293D drivers on top of the L293D drivers on the board to increase the maximum current. The L293D allows parallel operation.

The shield is connected in circuit as follow:

- Connect sevo_2 pins to servo motor.
- Connect right and left motor to M1 and M2 pins respectively.

Motor shield is used to control the right motor, the left motor and servo motor.

3.2.6 App inventor

App Inventor lets you develop applications for Android phones using a web browser and either a connected phone or emulator. The App Inventor servers store your work and help you keep track of your projects.

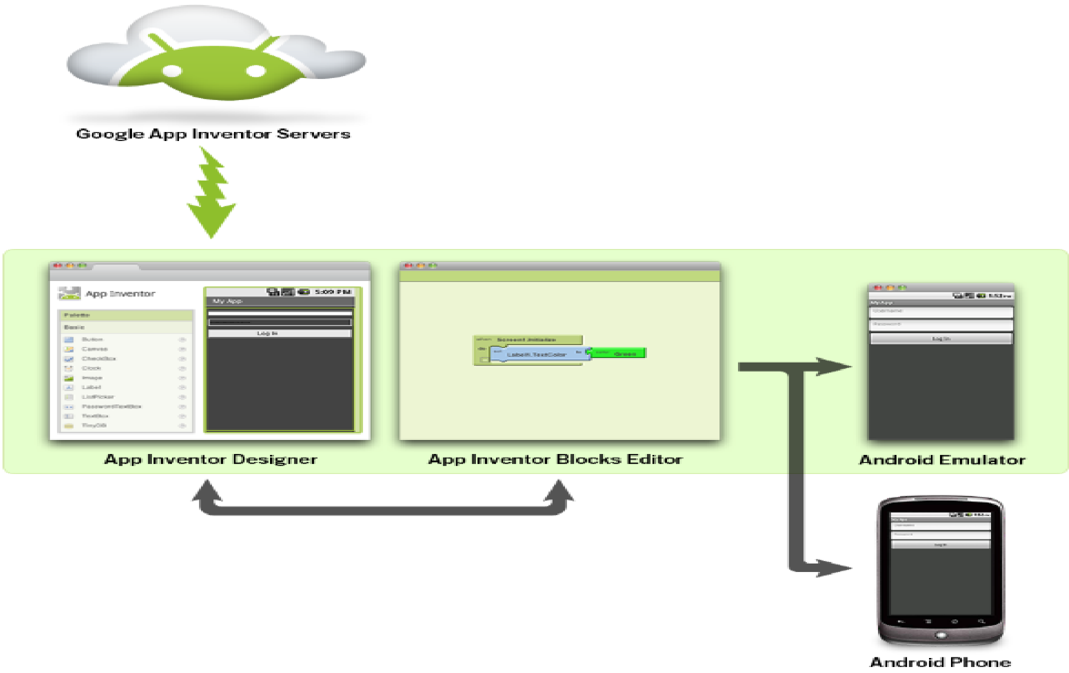

Figure 3.12: app inventor

App inventor is used for programing the controller android mobile app.

3.2.7 IP camera

An Internet protocol camera, or IP camera, is a type of digital video camera commonly employed for surveillance, and which, unlike analog closed circuit television (CCTV) cameras, can send and receive data via a computer network and the Internet. Although most cameras that do this are webcams, the term "IP camera" or "net cam" is usually applied only to those used for surveillance.

IP camera is used to transmit live video streaming to mobile APP application

3.3 Circuit diagram

All system components have been connected using wires as shown in figure below.

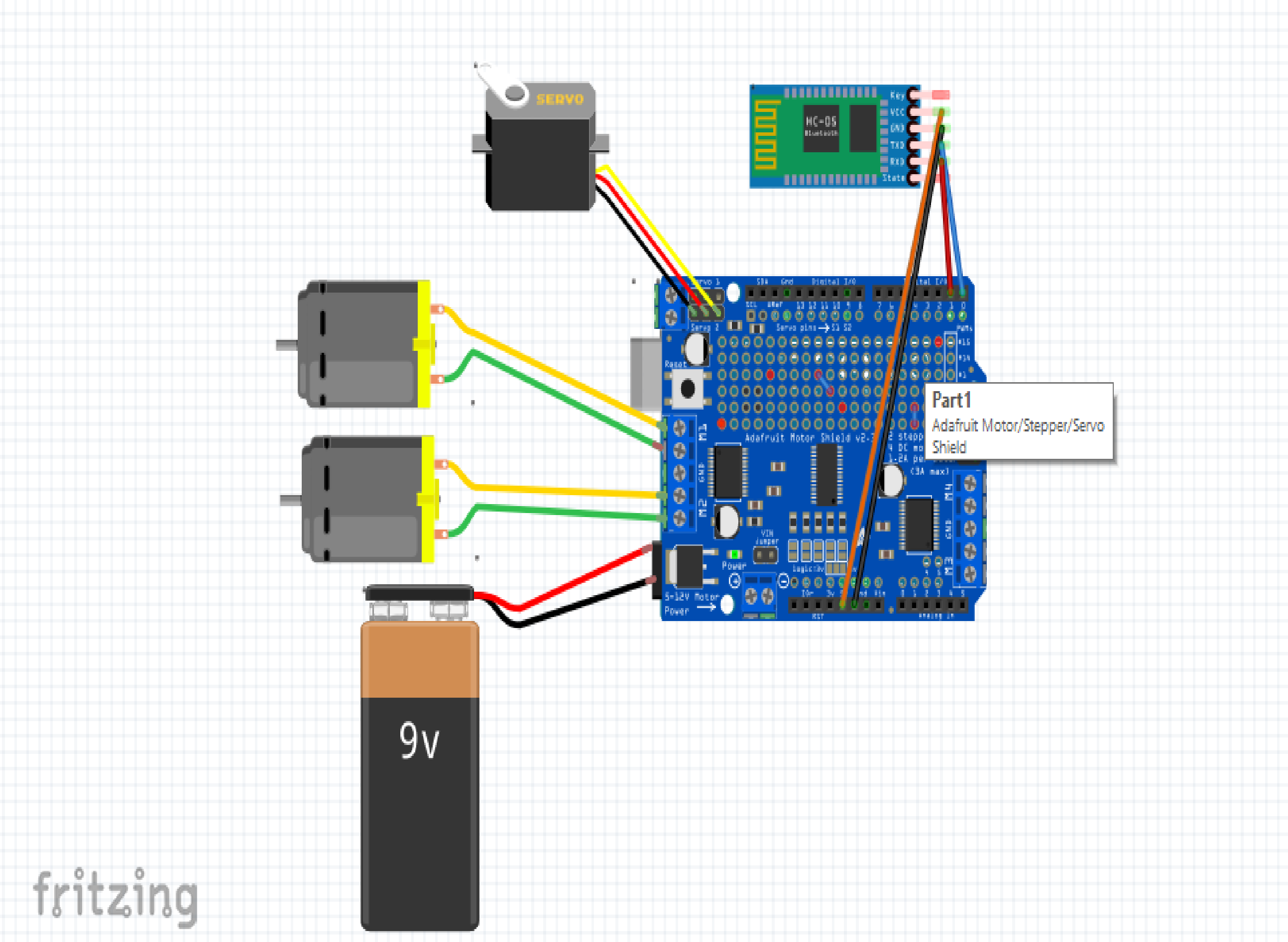

Figure 3.13: circuit diagram

CHAPTER FOUR

IMPLEMENTATION OF DESIGN

4.1 Introduction

Methodology is the systematic, theoretical analysis of the methods applied to a field of study.

It is important to discuss about the project methodology used in this project such as software programing and practice description then results and operation.

4.2 Software program

A programming tool or software development tool is a computer program that software developers use to create, debug, maintain, or otherwise support other programs and applications.

4.2.1 Android app design

Firstly the controlling Android APP have been made using MIT App Inventer2.

The app has been made to give the user three different choices to control the robot.

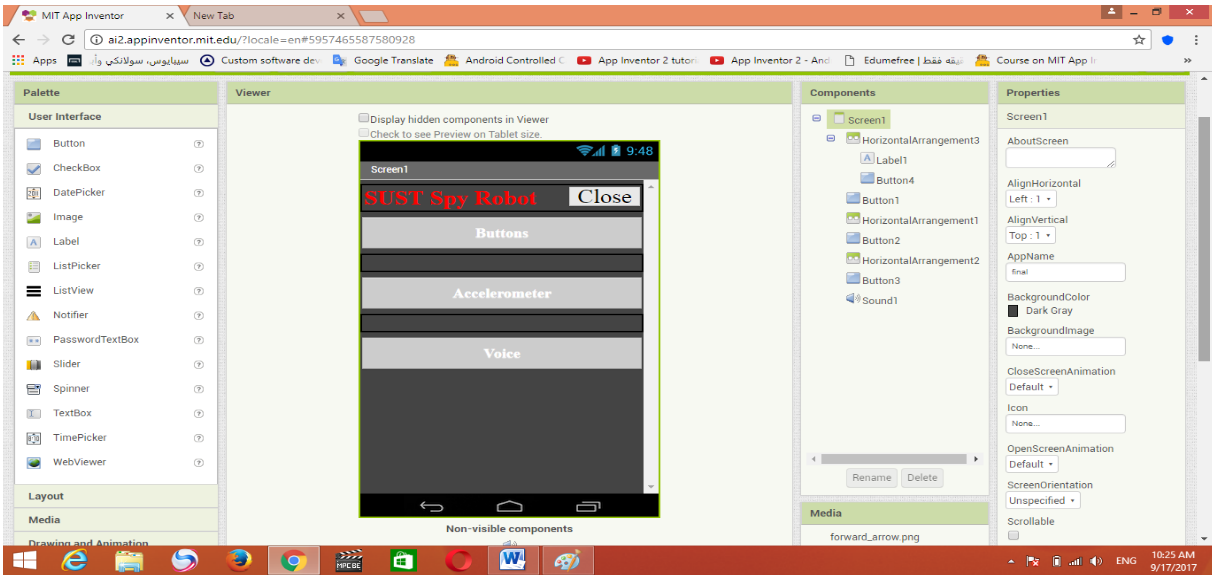

Figure 4.1: Main screen design

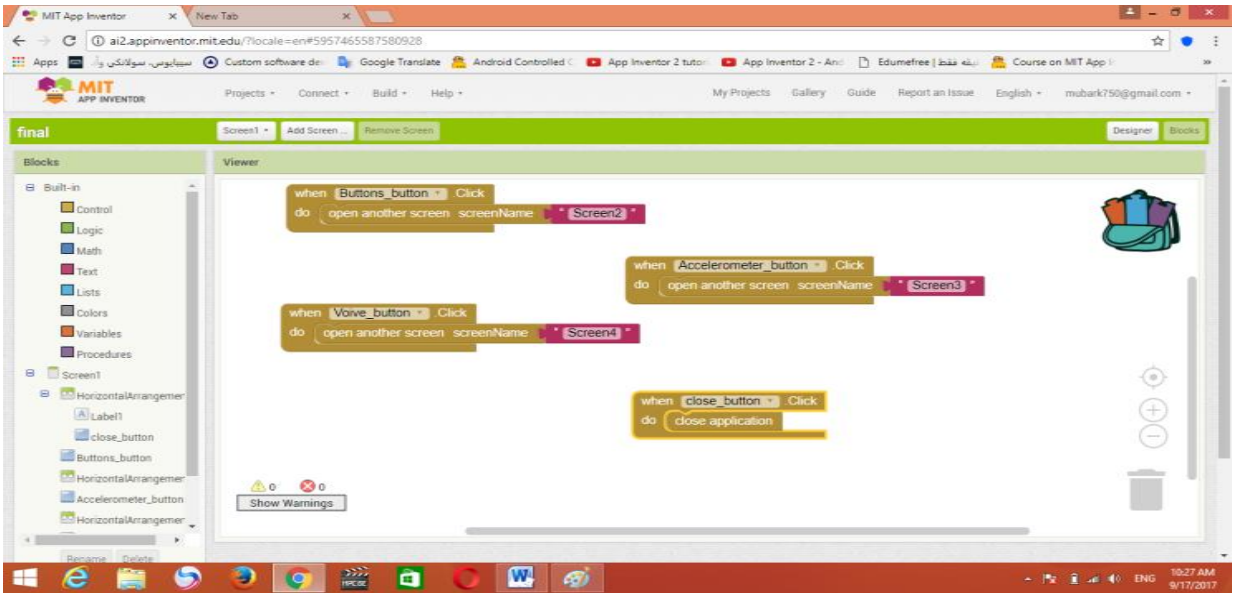

Figure 4.2: Main screen control blocks

➤ Buttons

In the Button choice the app show five buttons for controlling the robot and two buttons for controlling the camera.

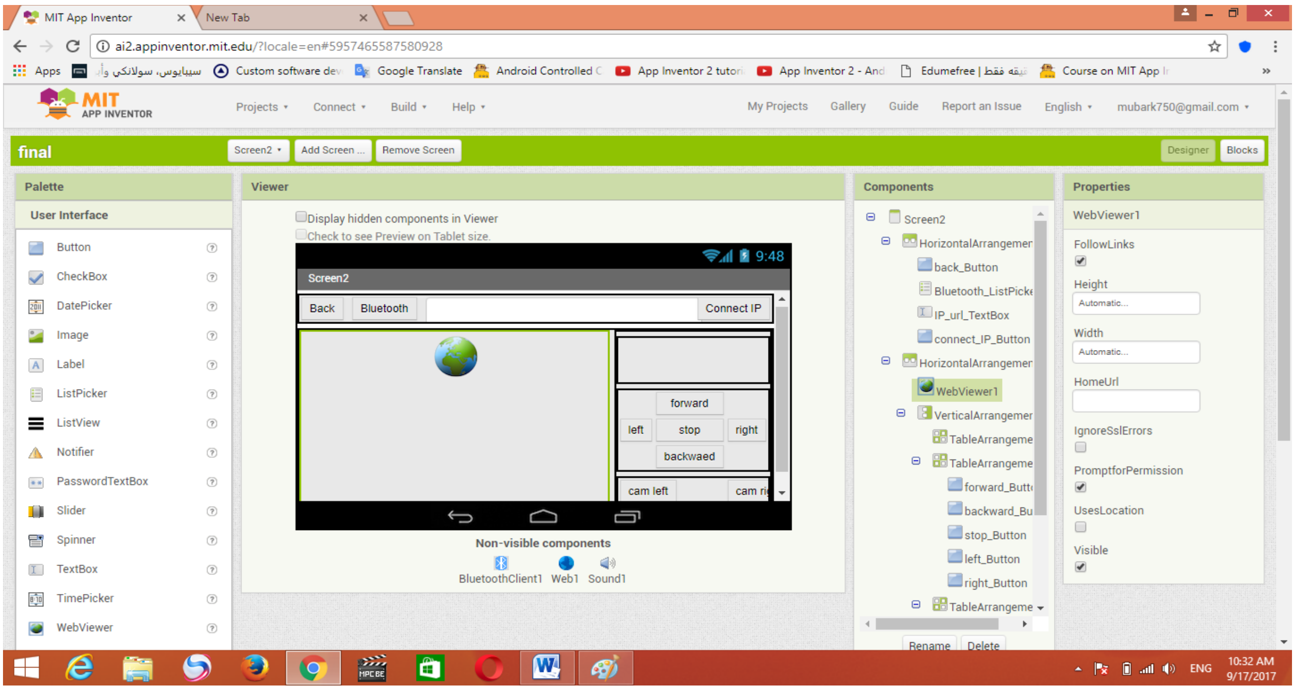

Figure 4.3: Buttons screen design

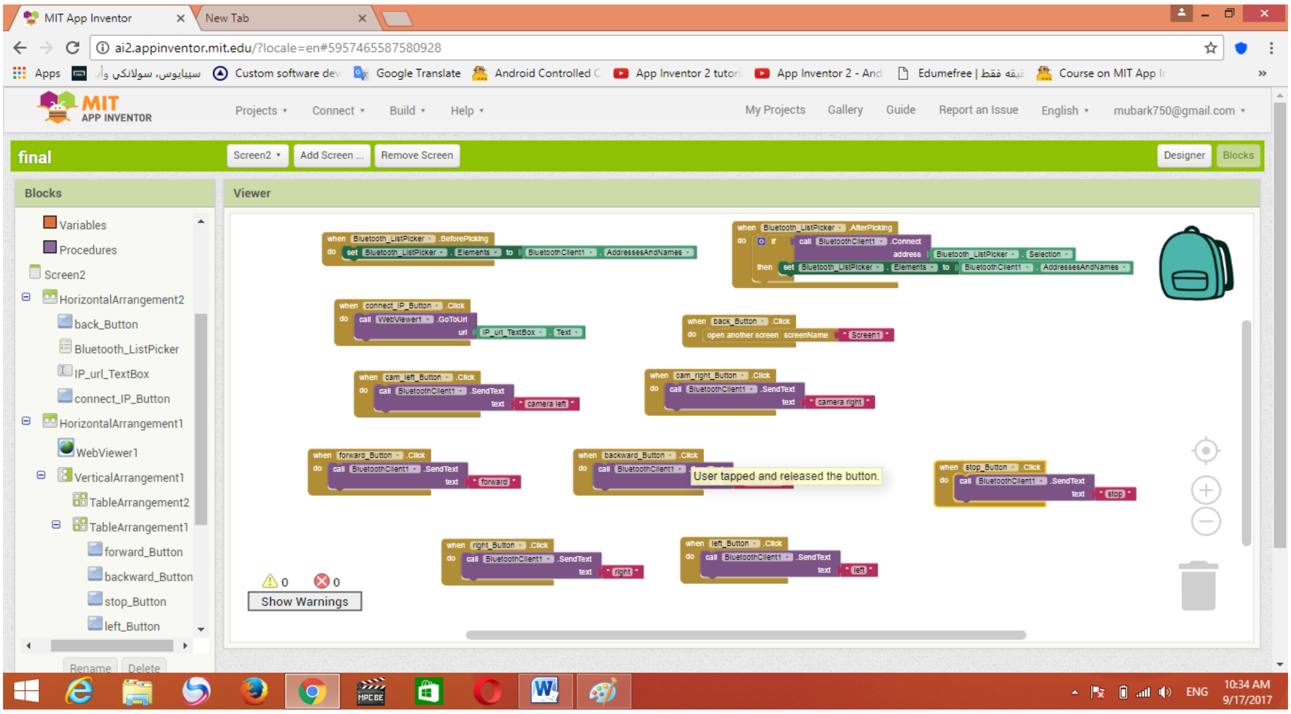

Figure 4.4: Buttons screen control blocks

➢ Accelerometer

The user can control the robot using accelerometer sensor in the mobile device. The app sends five kinds of texts to the Arduino as follow:

“forward” When the phone x angle is more than 10°.

“backward” When the phone x angle is less than -10°.

“right” When the phone y angle is more than 10°.

“left” When the phone y angle is more than 10° .

“stop” when the phone is shaking.

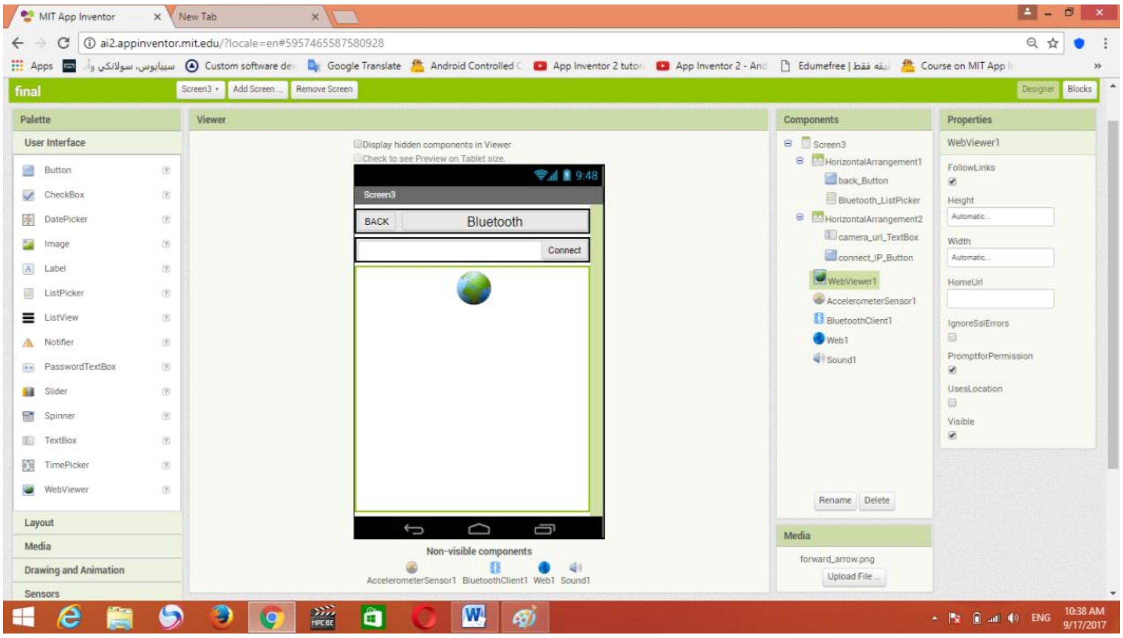

Figure 4.5: Accelerometer screen design

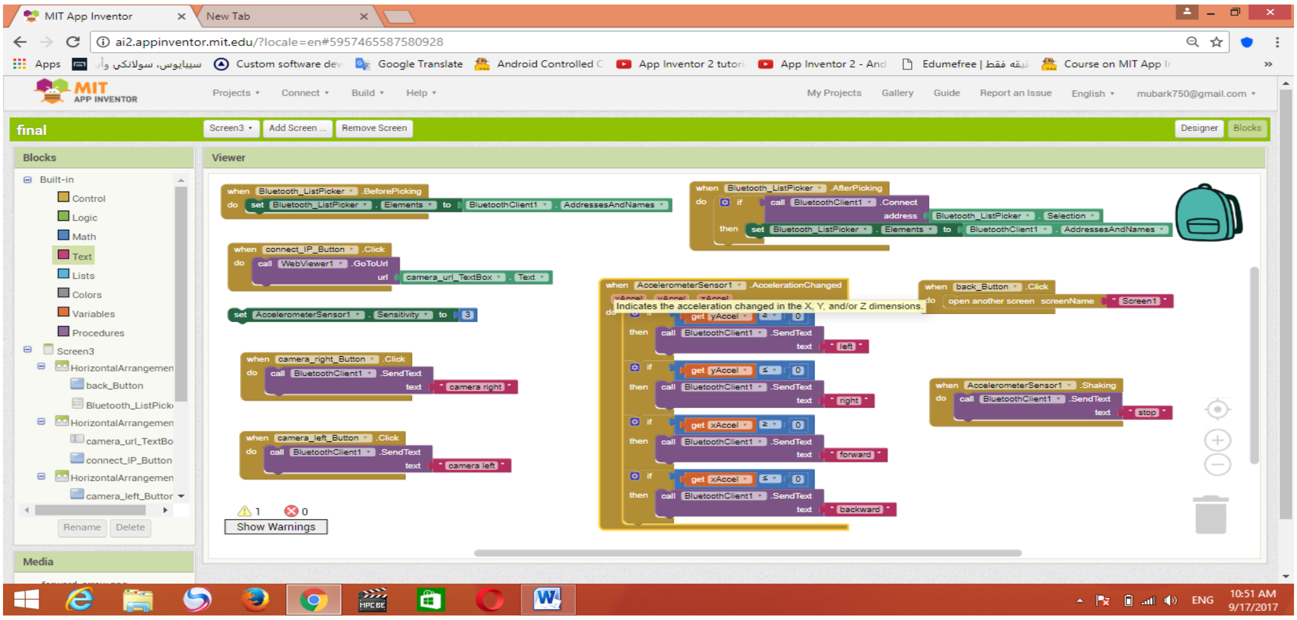

Figure 4.6: Accelerometer screen control blocks

➢ Voice

The app use voice sensor in the phone to recognize the voice and send to Arduino as a text.

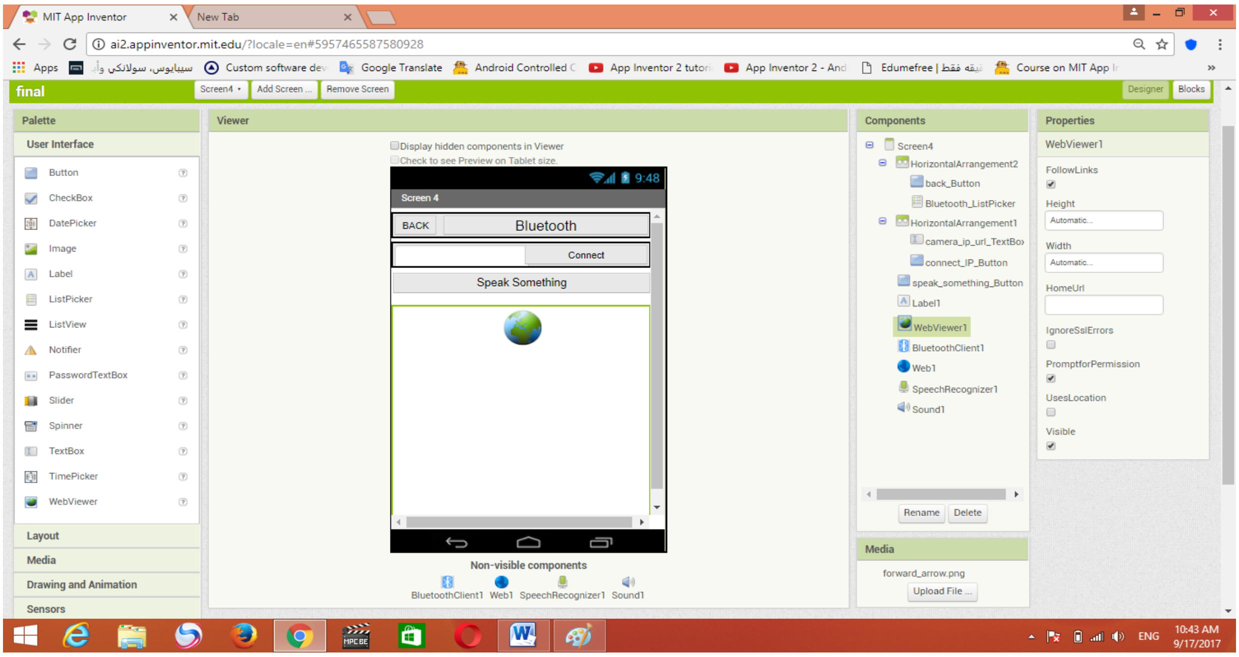

Figure 4.7: Voice screen design

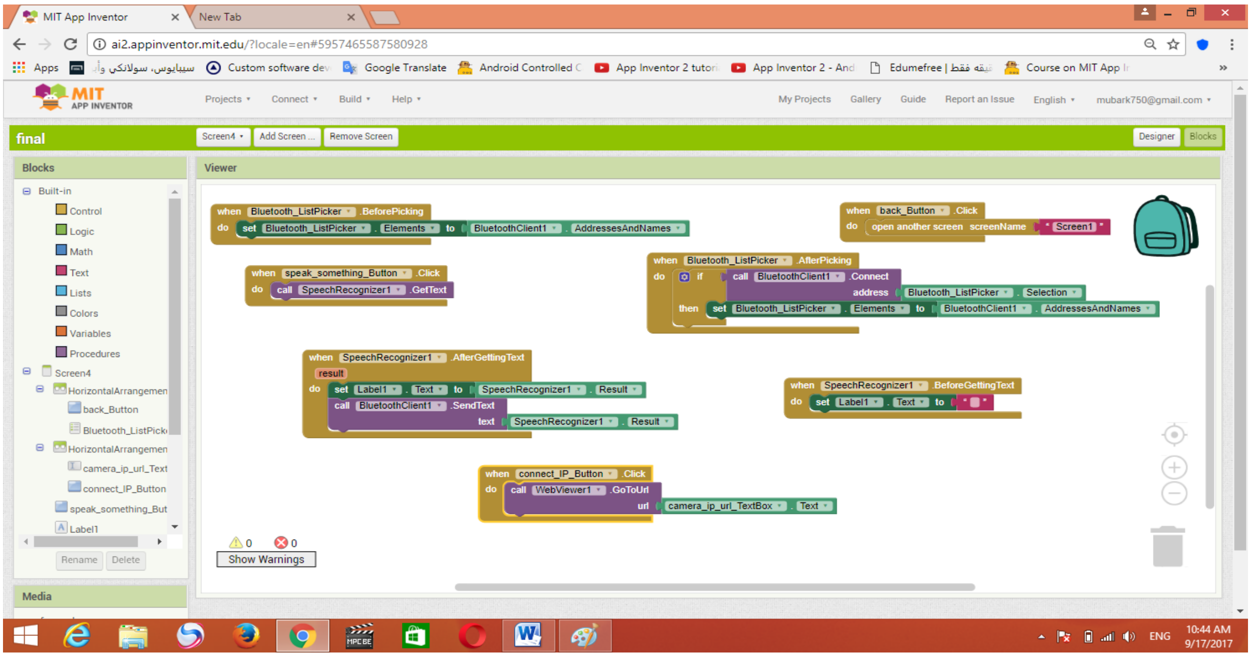

Figure 4.8: Voice screen control blocks

In each choice:

There is a Bluetooth list picker button to connect the mobile APP to the Bluetooth module.

The app use web viewer component to stream the video from the IP camera using WIFI technology.

There is a text box to write the IP camera URL and a connect button to connect it to web viewer.

4.2.2 Arduino code

The Arduino code was designed to interpret signals received through Bluetooth from the phone controller. For each state that the robot can be in, a different code was assigned. Five IF conditions have been used to drive DC motors in four directions (forward, backward, right and left) and stop them.

An integer variable (angle) has been created to represent servo angle and two IF conditions to add or sub 20° to the angle then send the angle to the servo.

NOTE: The integer variable (angle) initial value is 90°.

4.3 Practice description

- Robot chassis

The chassis include a body consist of two DC motors, servomotor and camera platform.

- Attach the Arduino to the chassis.
- Connect the Bluetooth module wires to Arduino.
- Attach the Motor shield to Arduino.
- Connect the motors to the motor shield.

Two DC motors are attached to H-bridges. By using an H-bridge, the microcontroller can easily change the direction and speed of each motor independently.

The H-bridge is implemented in the Arduino motor shield.

- Connect the 9V batteries to Arduino using battery connecters.
- Upload the code to Arduino.

Note: The code can’t be loaded when the Bluetooth module is connected to the Arduino.

- Connect the Bluetooth module.
- Start the robot

4.4 Operation

Firstly when you open the app you should select the choice you want then connect the APP to the Bluetooth module and the IP camera.

In button control screen there is seven buttons:

When clicking “forward” button the robot go forward.

When clicking “backward” button the robot go backward.

When clicking “right” button the robot go right.

When clicking “left” button the robot go left.

When clicking “cam right” button the camera rotate right.

When clicking “cam left” button the camera rotate left.

In accelerometer control screen when you rotate the phone in one direction the robot moves to this direction.

In voice control screen firstly you press speak something button then you say the control word.

“forward” to move the robot forward.

“backward” to move the robot backward.

“right” to move the robot right.

“left” to move the robot left.

CHAPTER FIVE

CONCLUSIN AND RECOMMENDATIONS

5.1 CONCLUSION

The purpose of the project was to implement an inexpensive and high-efficient Wireless Controlled Monitoring Mobile Robot that can transmit live video stream from distance using IP camera.

The robot is controlled using Android App.

We built a robotic vehicle which moves in different directions like Forward, Backward, Left, and Right when input is given to it.

The robot is controlled either using Buttons, Accelerometer sensor or voice sensor.

5.2 RECOMMENDATIONS

We recommend improving this project by:

- Adding more sensors to the robot.
- Expanding transmission range using Bluetooth module with higher transmit power or using Wifi technology.
- The robot can be a helicopter instead of the car.

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APPENDIX (A)

Arduino code:

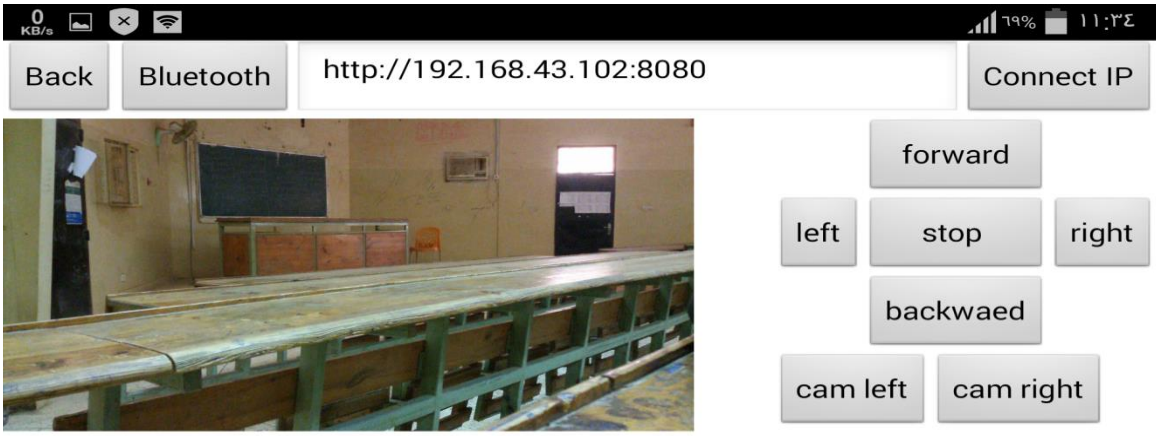
```
#include <AFMotor.h>

#include <Servo.h>

int i=90;

AF_DCMotor motor1(1);

AF_DCMotor motor2(2);

Servo servo1;

void setup()

{

   servo1.attach(9);

   // Start up serial connection

   Serial.begin(38400); // baud rate

   Serial.flush();

   motor1.setSpeed(200); //I'm not sure if the motor is turning left or not

   motor2.setSpeed(200); //I'm not sure if the motor is turning left or not

}

void loop()

{

   String input = "";
```

```
// Read any serial input
while (Serial.available() > 0)
{
   input += (char) Serial.read(); // Read in one char at a time
   delay(5); // Delay for 5 ms so the next char has time to be received
}
if (input == "stop")
{
   motor1.run(RELEASE);
   motor2.run(RELEASE);
   delay(500);
}
 else if (input == "camera right" && i<=180 )
{
  i=i+20;
   servo1.write(i);
}
 else if (input == "camera left" && i>=0 )
{
  i=i-20;
   servo1.write(i);
```

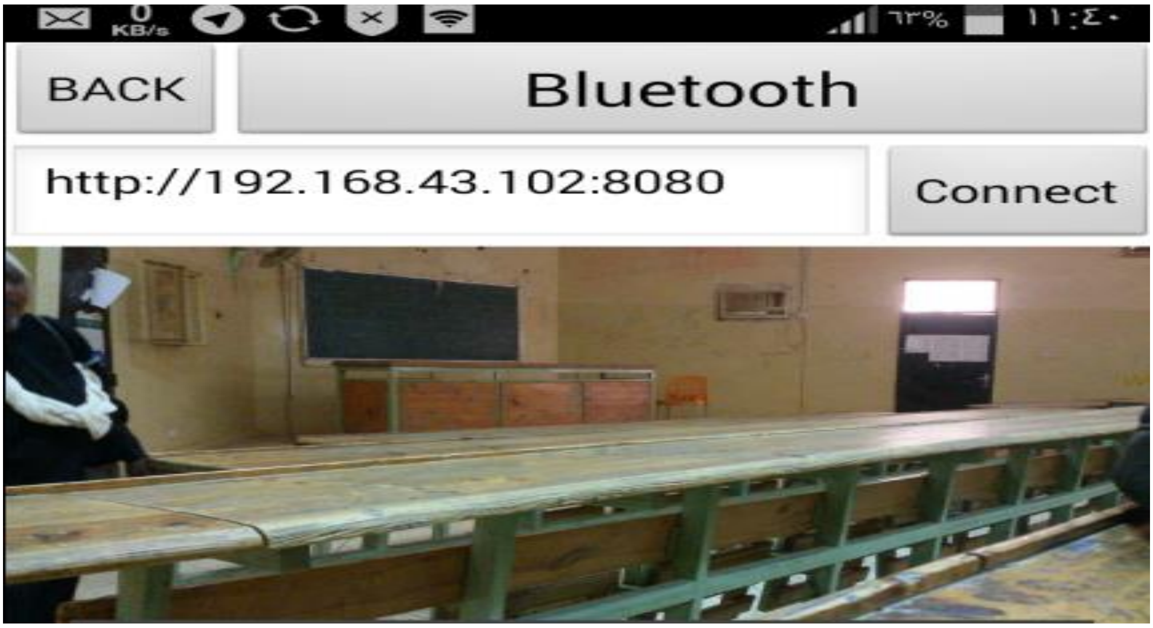
```
    }
    else if (input == "forward")
    {
      motor1.run(FORWARD); //If it is not, change this function to
run(BACKWARD)
      motor2.run(FORWARD);
       delay(500);
        motor1.run(RELEASE);
        motor2.run(RELEASE);
    }
    else if (input == "backward")
    {
            motor1.run(BACKWARD); // and change this function to
.run(FORWARD)
            motor2.run(BACKWARD);
             delay(500);
              motor1.run(RELEASE);
        motor2.run(RELEASE);
    }
    else if (input == "right")
    {
```

```
      motor2.run(FORWARD); //If it is not, change this function to
run(BACKWARD)
      motor1.run(BACKWARD);
       delay(500);
        motor1.run(RELEASE);
       motor2.run(RELEASE);
   }
   else if (input == "left")
   {
      motor1.run(FORWARD);
      motor2.run(BACKWARD); // and change this function to
.run(FORWARD)
     delay(500);
      motor1.run(RELEASE);
      motor2.run(RELEASE);
   }
   }
```

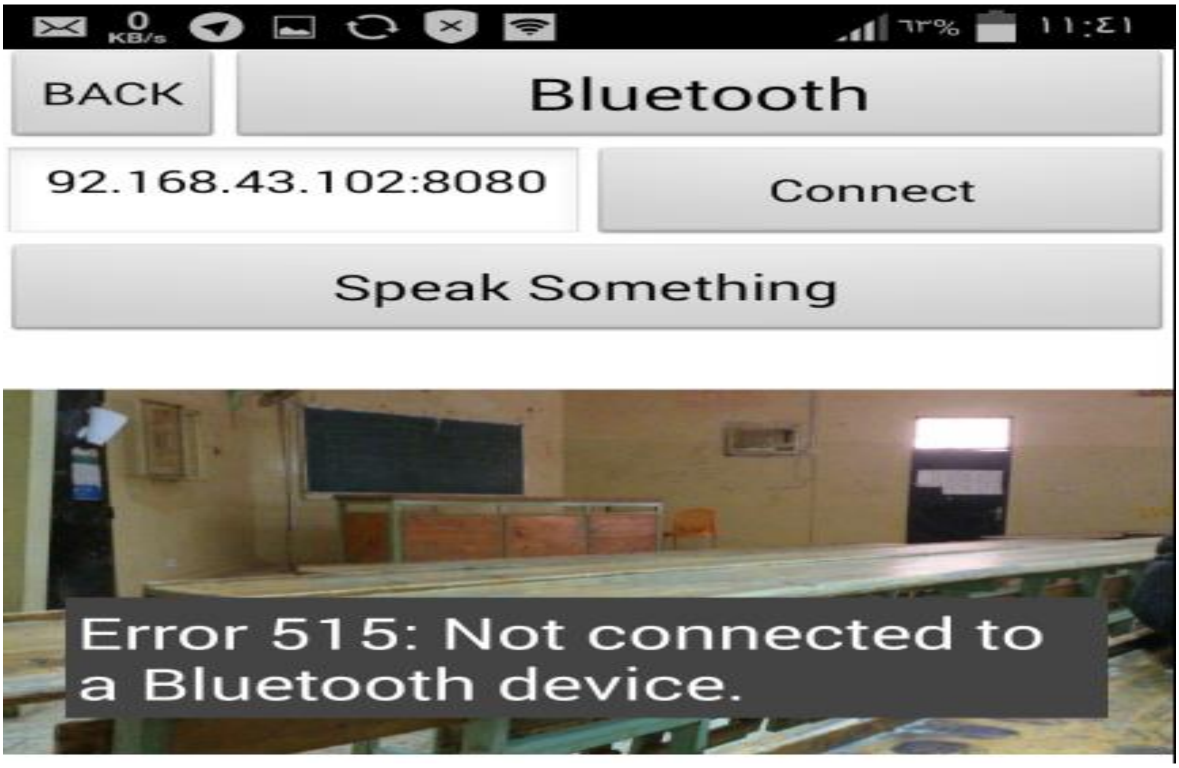
Appendex (B)



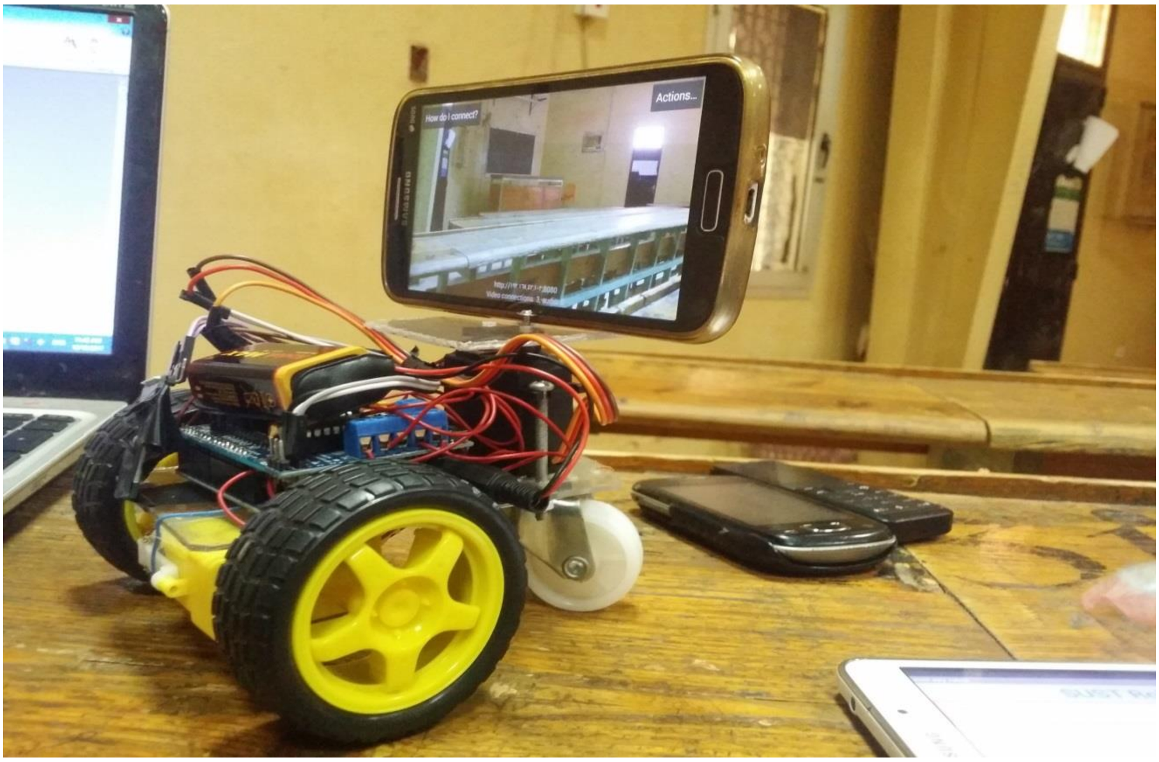
Button control screen



Accelerometer control screen



Voice control screen



Wireless Controlled Monitoring Mobile Robot