Sudan University of Science and Technology
College of Engineering
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Control of Robot Car Using Arduino

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

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الآية

بسم الله الرحمن الرحيم

قال تعالى:

{وَ قُلْ رَبِّ زِدْنِي عِلْماً}

[طه: 114]

Dedication

We dedicate this project to our great families and friends who exerted valuable efforts to enrich our spirits and reinforce our wills and energies and constantly work to support us, to all the engineers whose knowledge and wisdom represented rich source of illumination and ideas for us and skillfully guided us through this project in the same way our families guided us through life, we highly appreciate their efforts and energies that they spent to raise and improve our skills and capabilities. To all those we forgot to mention

Thank you.

Acknowledgement

we would like to acknowledge and highly Appreciate the great and priceless efforts spent in educating Us and enriching our thirsty minds for information and knowledge about a field we willfully decided to choose as our Career. To the Electrical Engineering department, to all the Professors, teachers and assistants who energetically and Enthusiastically helped and prompted us to expand and Deepen our knowledge and skills through discussions, lectures and other forms of support. To all those who accompanied us on this path and those who will come after us. To those who Sincerely and genuinely helped us with their time and effort, to Galal Abdalrahman Mohammed who jointly supervised this project thankyou we highly appreciate every minute you spent with us.

Abstract

The technology revolution evolves the human needs are increasing and one of the most advanced areas in technology is the robot's world. Robots It's an intelligent technology manufacture which can do things the human can't do it specifically in transporting a dangerous stuff, that making the robot playing a huge part in our life and added many advantages like speed, accuracy and safety in so many fields. Robots had come so far lately, making life easier, do the applications which working on it will put the human life in danger and so many other benefits.

المستخلص

تطورت التكنولوجيا بشكل ملحوظ حيث أصبحت من اهم احتياجات الإنسان، وأحد أكثر المجالات تقدمًا في التكنولوجيا هو عالم الروبوتات، الروبوتات هي صناعة لتقنية ذكية يمكنها القيام بأشياء لا يستطيع الإنسان فعلها على وجه التحديد نقل أشياء خطيرة، ذلك مما جعل الروبوت يلعب دورًا كبيرًا في حياتنا وصول الروبوتات إلى وأضاف العديد من المزايا مثل السرعة، الدقة، الأمان، في العديد من المجالات. هذا الحد مؤخرًا، جعل الحياة أسهل على الانسان حيث تقوم بتنفيذ التطبيقات التي تضع حياة الإنسان في خطر والعديد من الفوائد الأخرى.

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CHAPTER ONE

INTRODUCTION

1.1 General Overview:

Robots have helped humans explore space and the deep oceans, and their use is expanding into healthcare, farming, food preparation, manufacturing and even education the field of robotics has been undergoing a major change from manufacturing applications to entertainment, home, rehabilitation, search and rescue, and service applications. Although robots seem to possess fantastic skills in science fiction and movies, most people would be surprised to learn how much remains to be accomplished to provide today's robots with the ability to do relatively simple tasks. Autonomous robots are only able to complete very simple tasks within limited environmental conditions. Humans can be incorporated to teleoperate or supervise robots, but as the robot complexity increases so does the human's workload. Robotics requires research in many areas that include hybrid systems, embedded systems, sensory fusion, distributed artificial intelligence, computer vision, machine learning, human-machine interaction, localization, planning, navigation, etc. This large field provides ample research problems. The Engineering School's Department of Electrical Engineering and Computer Science houses the Center for Intelligent Systems (CIS) that encompasses both the Cognitive Robotics Lab (CRL) and the Intelligent Robotics Lab (IRL). In addition to CIS, the department also includes six addition laboratories that conduct robotics research: the Computational Cognitive Neuroscience Laboratory (CCN),the Embedded Computing Systems Laboratory (ECS), the Embedded and Hybrid Systems Laboratory (EHS), the Human-Machine Teaming Laboratory (HMT), the Modeling and Analysis of Complex Systems (MACS) group, and the Robotics and Autonomous Systems Laboratory (RAS). Each individual laboratory provides a specific robotics research focus.

1.2 Problem Statement:

Transferring some materials can be harmful or the field itself could be dangerous, for example in the chemical factories, the military industries and in any critical transfer process. controller errors can damage the field. The high sensitivity of project materials.

1.3 Objective:

the main aim objectives of project are:

- control the car by a transmitting circuit put in gloves
- Movement the symbol by gripper
- support in dangerous status

1.2 Methodology:

- Programming Arduino nano
- Implementation the model
- Testing and result

1.3 Lay Out

This thesis includes five chapters, chapter one is an introduction, while chapter two is the general information and literature review was included along with the pervious works, and chapter three is contains the physical and technical components used, while chapter four represent the design and system of the project, and the final chapter five represent the conclusion and recommendation.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

A robot is a machine designed to execute one or more tasks repeatedly, with speed and precision. There are as many different types of robots as there are tasks for them to perform. A robot is a mechanical or virtual artificial agent, usually an electro-mechanical machine that is guided by a computer programmer electronic circuitry. Robots can be auto nomos or semi- autonomous. Robots have replaced human in performing repetitive and dangerous tasks which humans prefer not to do, or are unable to do because of size limitations, or which take place i n extreme environments such as outer space or the bottom of the sea. The advent of new high-speed techno logy and the growing computer Capacity provided realist ic op port unity for new robot controls and realization of new methods of control state. This technical improvement together with the need for high performance robots created faster, more accurate and more intelligent robots using new robots control devices in recent years, the applications of mobile robot have gradually become more diverse, which makes the robot closer to people's daily life. At present, the middle and small scale motion robot are usually designed based on single chip microcomputer without operating system This is why we are doing a study of the surrounding environment with simple research to see the world's need for robots and their importance and needs in daily and practical life, therefore we need robots with the advent of the age to reduce the risks against human life.

2.2 Robot Car:

Abstract In robotic car, real time obstacle detection and obstacle avoidance are significant issues. In this study, design and implementation of a robotic car have been presented with regards to hardware, software and communication environments with real time obstacle detection and obstacle avoidance.

Arduino platform, android application and Bluetooth technology have been used to implementation of the system. In this paper, robotic car design and application with using sensor programming on a platform has been presented. This robotic device has been developed with the interaction of Android-based device. Arduino Uno has been used as the robot's brain. The robot has many hardware components such as Bluetooth module, PIR sensor, ultrasonic sensor, and buzzers. It also consists of the software component that uses a mobile application. The desired direction or mode by mobile application can be selected by the user of the robotic car to control the movement of the car. The user can control the robot movements from his/her own intelligent device or take the robot in automatic mode and let the car drive its own way. Thus, the robot can flee from the obstacle and also detect live objects. The purpose of this article is to alert the civilian and military personnel to potential terrorist attacks especially in military areas with live detectable sensors in the last decade, with the development of technology, sensors used with electronic devices have been used in many areas to facilitate life. Sensors are devices that convert energy forms into electrical energy. The sensors serve as a bridge connecting the environment and various electronic devices. The environment can be any physical environment such as military areas, airports, factories, hospitals, shopping malls, and electronic devices can be smartphones, robots, tablets, smart clocks. These devices have a wide range of applications to control, protect, image and identification in the industrial process.

Today, there are hundreds of types of sensors produced by the development of technology such as heat, pressure, obstacle recognizer, human detecting. Sensors were used for lighting purposes in the past, but now they are used to make life easier. Thanks to technology in the field of electronics, incredibly fast developments are experienced. In this respect, it is possible to develop a new invention or a new application in every day and make life easier. Today, robot systems are developed with the use of artificial intelligence algorithms. The robotics field is one of them. The most important part of the robot is the perception. Perceive of the environment will be important for a robot design. For instance, it is very important to identify explosives by a robot to detect a terrorist in the military field by using sensors. A robot has to perceive some variables (like heat changes) around it, interpret it, and then decide to act accordingly. In this article, remote and autonomous controlled robotic car has been presented in terms of obstacle detection and avoidance by using sensors. The connection between the robot and the Android device has been established via Bluetooth technology.

The incoming data will be processed by Arduino Uno and according to the input value of the user, robot action can be performed. There are two main modes that control the robotic car by Android application (mobile phone). These are user control mode and automatic mode. A menu with buttons has been seen on the screen to select the actions. These buttons will be used to move the robotic car forward, backward, right and left, stopping the car and switching to automatic mode.

By selecting automatic mode, the user leaves the robot control and the robot finds its way without hitting the obstacles.7

Similar studies in the past have been explored and some of the methods and working principles used are summarized. S. S. Pujari et al.

1- designed a Robot for the working families that could monitor children remotely and communicate with the camera. Raspberry Pi 3, camera module, Wi-Fi and Bluetooth technology used by the robot. For Raspberry Pi, the heart was defined as the Robot and used the Phyton language to code it. MR Mishi et al.

2- designed a robotic car. Arduino Uno and Raspberry Pi were used together to control robot in this project. GPS was also used

to trace the car and the distances between the obstacle and the path are measured.
The data in the cloud was used without having to be online. Thus, the multi
-motion system was controlled. D. Chakraborty et al.

3- designed and developed a robotic car using sensors and Bluetooth technology. They had established communication between smart device and the robot. Thanks to the phone camera, they had observed the living beings. The obstacles in the opposite direction were prevented from colliding with the ultrasonic ranging sensor. Images recorded with the camera were recorded in the database and analyzed. S. J. Lee et al.
4- designed an autonomous robotic car used Arduino Uno R3 for robot's brain. Also, Bluetooth module and the ultrasonic sensor had been used in
this paper. The robot scanning the placed QR codes could move along the
road in autonomous form thanks to the QR codes. It also provided voice
communication with the Android device in the Text-to -speech feature. It also moved with the help of an ultrasonic sensor without

hitting the objects around it. In this view, range information was collected. In order for the motion of the robot to be smooth, the deviation was minimized by the
PID algorithm. E. Amare war et al.

5- designed a robot used for the military area. Thanks to the metal detector, the robot played an important role in the detection of explosives, and the surroundings could be viewed thanks to the camera of the used Android device. This robot system consisted of Android device, Bluetooth module, a microcontroller (Arduino Uno), DC motors, motor driver, wireless camera and metal detector. Ramkumar et al.
6- designed robotic arm controlled using Raspberry Pi. The main purpose of this robot was to add the human arm feature to the robot arm. Raspberry Pi was the code written in the Python language that provided arm movement. With the Android application, the user moved the robot arm in the desired direction. Robotic arm control was provided in this way. The Android app was written in Java. Thus, the communication between the Android application and Raspberry Pi was provided by the Wi-Fi connection. This communication moved the robot arm to the right and left. In this study, real time obstacle detection and avoidance with remote and autonomous controlled robotic car based on Arduino has been carried out by using Android application.
The system structure of the developed robotic car using various sensors is shown in Figure 2.1. In this paper, the robotic car consists of two modes: The user control and Automatic mode. The robot and Android device communicate with each other using Bluetooth technology.

The robotic car is made up of an Arduino Uno, H -06 Bluetooth module, Arduino motor shield, DC motor, Ultrasonic sensor HC-SR04, PIR sense or, buzzer, 9V battery (Figure 10). In the implementation part, firstly the user should download the "Arduino

Bluetooth Controller" from Google Play. After downloading the application, make sure that the Bluetooth connection is open.

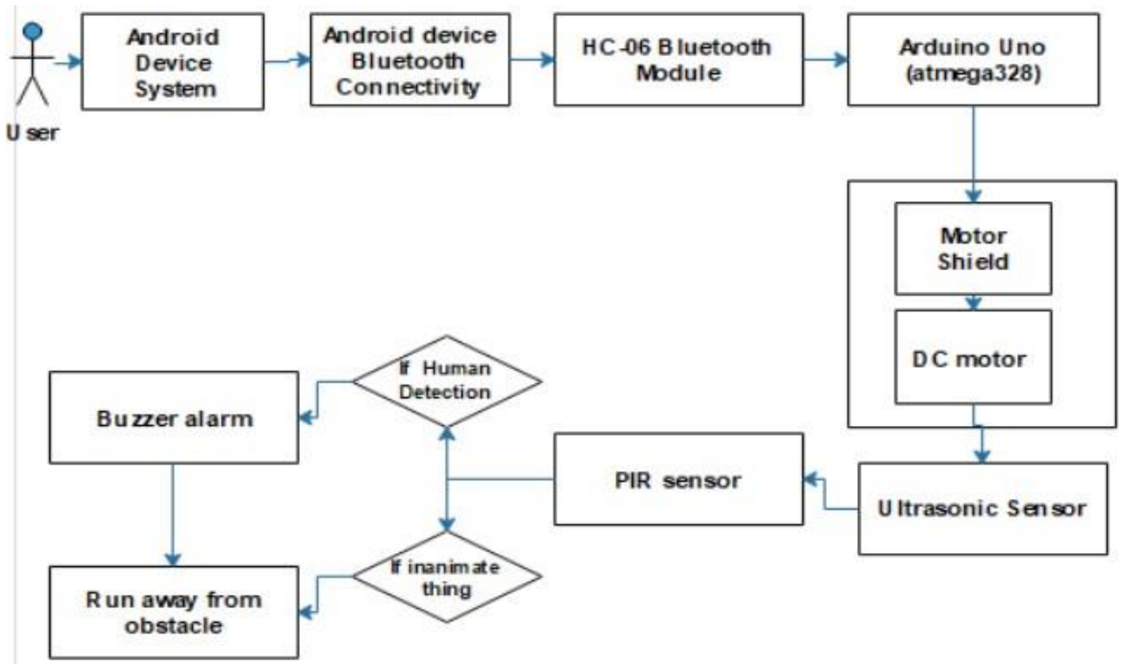

Figure 2.1: robotic car using various sensors

After entering the application, it must be connected with the Bluetooth module (HC-06) with "1234" password. After connecting to the application, the user should assign values to the desired keys. Once the assignment is done, the robots can now send input values. The data sent from the Android application to the Arduino Uno with the Bluetooth module. Arduino Uno controls incoming signals and informs which signals
should be transmitted to the motor driver Thus, the robot moves in a certain order according to the inputs entered. The user can control the basic movements of the robot, back and forth, right-left rotation, robot stop motion from their own intelligent device. The user can also take the robot in auto mode and allow the car to drive its own way.

The robotic car can determine whether the obstacles across the vehicle are human. If there is an obstacle in existence, the red led on the robot lights up, the buzzer sounds an alarm, and the shortest distance that can be avoided is calculated and proceeded.

If the obstacle facing the robot is an inanimate entity, it computes the shortest distance that it can avoid and proceeds in this direction. Furthermore, when the robot reaches the cliff, it perceives the abyss and stops itself. Ref (Sathyanarayanan M, Azharuddin S, Kumar S, Khan G, ―Gesture Controlled Robot for Military Purpose‖, International Journal For Technological Research In EngineeringVolume 1, Issue 11, July-2014.

2.3 Control:

Abstract In engineering and mathematics, control theory deals with the behavior of dynamical systems. The desired output of a system is called the reference.

When one or more output variables of a system need to follow a certain reference over time, a controller manipulates the inputs to a system to obtain the desired effect on the output of the system.

Rapid advances in digital system technology have radically altered the control design options.

It has become routinely practicable to design very complicated digital controllers and to carry out the extensive calculations required for their design.

These advances in implementation and design capability can be obtained at low cost because of the widespread availability of inexpensive and powerful digital processing platforms and high-speed analog IO devices.

To design a controller that makes a system behave in a desirable manner, we need a way to predict the behavior of the quantities of interest over time, specifically how they change in response to different inputs.

Mathematical models are most often used to predict future behavior, and control system design methodologies are based on such models.

Understanding control theory requires engineers to be well versed in basic mathematical concepts and skills, such as solving differential equations and using Laplace transform.

The role of control theory is to help us gain insight on how and why feedback control systems work and how to *systematically* deal with various design and analysis issues. Specifically, the following issues are of both practical importance and theoretical interest:

- Stability and stability margins of closed-loop systems.

How fast and smooth the error between the output and the set point is driven to zero.

- How well the control system handles unexpected external disturbances, sensor noises, and internal dynamic changes.

There are two types of control systems namely:

- Open loop control systems (non-feedback control systems)
- Closed loop control systems (feedback control systems)

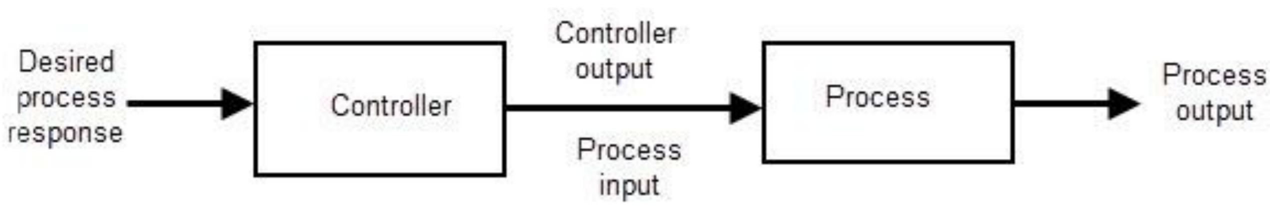

Figure 2.2: Open loop control system

If in a physical system there is no automatic correction of the variation in its output, it is called an open loop control system. That is, in this type of system, sensing of the actual output and comparing of this output (through feedback) with the desired input does not take place.

The system on its own is not in a position to give the desired output and it cannot take into account the disturbances. In these systems, the changes in output can be corrected only by changing the input manually show in figure 2.3.

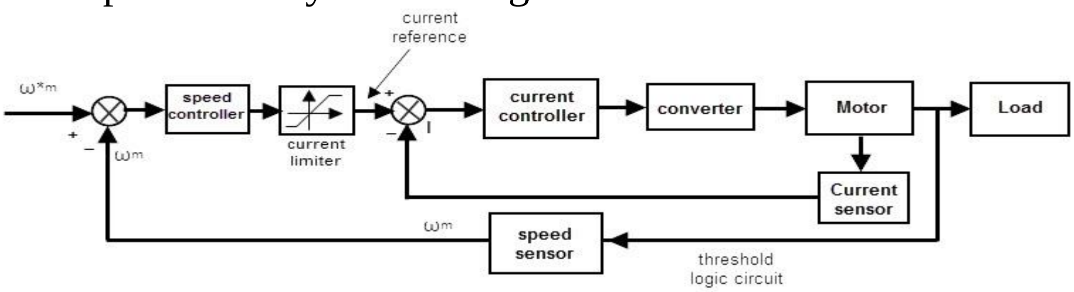

Figure2.3: Close loop control system

These systems are simple in construction, stable and cost cheap. But these systems are inaccurate and unreliable. Moreover, these systems do not take account of external disturbances that affect the output and they do not initiate corrective actions automatically.

2.4 Microcontroller:

It is the heart of the microcontroller system. It consists of Arithmetic Logic Unit (ALU), registers and control circuit.
The arithmetic and logic operations are carried out by the ALU.

The microprocessor executes the program stored in the memory in a sequence.

The Intel 8051 is single chip microcomputer which was developed by Intel in 1980 for use embedded system. It was popular in the 1980’s and the early 1990’s, but today it has largely been superseded.

Intel’s original 8051 family was developed using NMOS technology, but later versions identified by a letter –c‖ in their name. Example 80C51 used CMOS technology and were less power hungry than their NMOS predecessors-this made them eminently more suitable for battery power devices.

A particularly useful features of the 8051 core is the inclusion of a Boolean processing engine which allows bit level Boolean logic operation to be carried out directly and efficiently on internal register and RAM.

The features of boo lean processing helped to cement the 8051’s popularity in industrial control applications.

Another feature is that it has form separate register sets, which can be used to greatly reduce interrupt context in a stack.

Microcontrollers are frequently used in automatically controlled products and devices, such as automobile engine control systems, remote controls, office machines, appliances, power tools and toys. By reducing the size, cost and power consumption compared to a design using a separate microprocessor, memory and input/output devices, microcontrollers make it economically to electronically control many more process.

Microcontrollers are hidden inside a surprising number of products these days.

Any device that has a remote control almost certainly contains a microcontroller.

TVs, UCRs, answering machines, laser printers, telephones (the ones with caller id, 20 - number memory, etc.)

pagers and feature-laden refrigerators, dishwashers, washers and dryers (the ones with display and keypads), basically, any product or device that interacts with its users has a microcontroller buried inside.

Microcontrollers are ‒embedded‖ inside some devices (often a consumer product) so that

they can control the features or actions of the product. Another name for a microcontroller, therefore is ‒embedded controller‖.

Microcontrollers are dedicated to one task and run one specific program. Program is stored in ROM (read only memory) and generally does not change.

Microcontrollers are often lower-power devices. A desktop computer is almost plugged into a wall socket and might consume 50 watts of electricity. A battery-operated microcontroller might Be 50 milliwatts.

A microcontroller has a dedicated input device and often (but not always) has a LED or LCD display for output.

A microcontroller also takes input from the devices it is controlling and controls the device by sending signals to different components in the device for example: the microcontroller controls the channel selector, the speaker system and certain adjustments on the picture tube electronics such as tint and brightness.

The engine controller in a car takes input

from sensors such as the oxygen and knock sensors and controls things like fuel mix and spark

plug timing. A microwave oven controller takes input from a keypad, displays output on an LCD display and controls the relays that turns the microwave generator on and off.

A microcontroller is often small and low-cost components are chosen to minimize size and to be as inexpensive as

possible.

2.5 sensors:

A device which provides a usable output in response to a specified measure, a sensor acquires a physical quantity and converts it into a signal suitable for processing (e.g. optical, electrical, mechanical) Nowadays common sensors convert measurement of physical phenomena into an electrical signal active element of a sensor is called a transducer.

Common Conversion Methods:

- Physical

thermo-electric, thermo-elastic, thermo-magnetic, thermo-optic photo-electric, photo-elastic, photo-magnetic, electro-elastic, electro-magnetic magneto-electric

- Chemical

chemical transport, physical transformation, electro-chemical

- Biological

biological transformation, physical transformation

Motion Sensors

- Monitor location of various parts in a system

absolute/relative position angular/relative, displacement proximity, acceleration

- Principle of operation

Magnetic, resistive, capacitance, inductive, eddy current, etc.

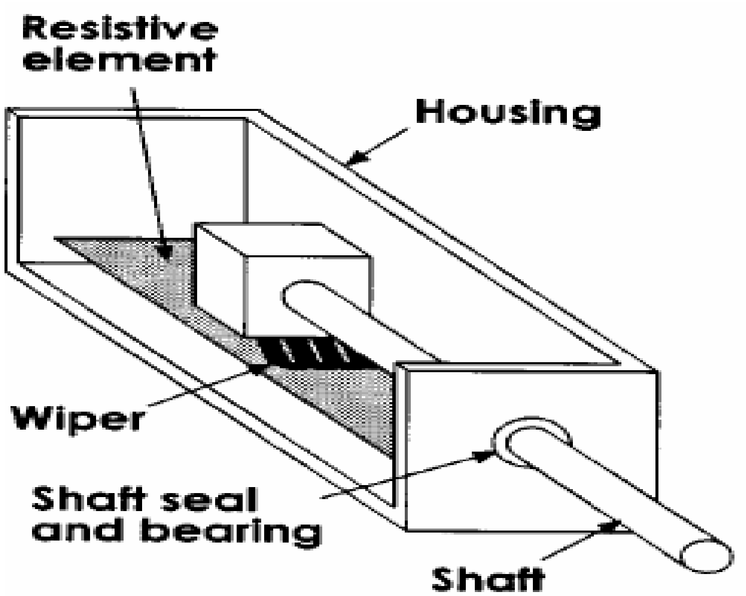

Figure2.4: Temperature Sensor: RTD

Accelerometer–I

Accelerometers are used to measure acceleration along one or more axis and are relatively insensitive to orthogonal directions Applications

- Motion, vibration, blast, impact, shock wave
- Mathematical description is beyond the scope of this operation.
- Electromechanical device to measure acceleration forces

– Static forces like gravity pulling at an object lying at a table

Accelerometer Applications

- Automotive: monitor vehicle tilt, roll, skid, impact, vibration, etc., to deploy safety devices (stability control, anti-lock braking system, airbags, etc.) and to ensure comfortable ride (active suspension).
- Aerospace: inertial navigation, smart munitions, unmanned vehicles

- Sports/Gaming: monitor athlete performance and injury, joystick, tilt.
- Personal electronics: cell phones, digital devices
- Security: motion and vibration detection
- Industrial: machinery health monitoring
- Robotics: self-balancing

2.6 Motors:

An **electric motor** is an electrical machine that converts electrical energy into mechanical energy. Most electric motors operate through the interaction between the motor's magnetic field and electric current in a wire winding to generate force in the form of torque applied on the motor's shaft. Electric motors can be powered by direct current (DC) sources, such as from batteries, motor vehicles or rectifiers, or by alternating current (AC) sources, such as a power grid, inverters or electrical generators. An electric generator is mechanically identical to an electric motor, but operates with a reversed flow of power, converting mechanical energy into electrical energy.

DC motors

The first commutator DC electric motor capable of turning machinery was invented by British scientist William Sturgeon in 1832.[16] Following Sturgeon's work, a commutator-type direct-current electric motor was built by American inventor Thomas Davenport, which he patented in 1837. The motors ran at up to 600 revolutions per minute, and powered machine tools and a printing press.[17] Due to the high cost of primary battery power, the motors were commercially unsuccessful and bankrupted Davenport. Several inventors followed Sturgeon in the development of DC motors, but all encountered the same battery cost issues. As no electricity distribution system was available at the time, no practical commercial market emerged for these motors.[18] After many other more or less successful attempts with relatively weak rotating and reciprocating apparatus Prussian Moritz von Jacobi created the first real rotating electric motor in May 1834. It developed remarkable mechanical output power.

DC motors can be operated at variable speeds by adjusting the DC voltage applied to the terminals or by using pulsewidth modulation (PWM). AC motors operated at a fixed speed are generally powered directly from the grid or through motor soft starters. AC motors operated at variable speeds are powered with various power inverter, variable-frequency drive or electronic commutator technologies.

The term electronic commutator is usually associated with self-commutated brushless DC motor and switched reluctance motor applications show in figure2.4.

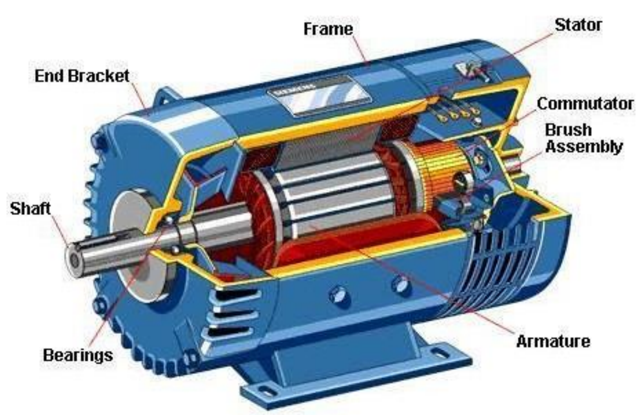

Figure2.5: cutaway view of induction motor stator

2.7 History of Robotics:

1978: The Puma (Programmable Universal Machine for Assembly) robot is developed by Unimation with a General Motors design support.
1980s: 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.
1995-present: Emerging applications in small robotics and mobile robots drive a second growth of start-up companies and research.
2003: NASA's Mars Exploration Rovers will launch toward Mars in search of answers about the history of water on Mars.

Figure 2.5: NASA's Mars Exploration

CHAPTER THREE

SYSTEM MODELING AND DESIGN

3.1 introduction:

Arduino is a microcontroller platform that has captured the imagination of electronics enthusiasts. Its ease of use and open source nature make it a great choice for anyone wanting to build electronic projects.

Ultimately, it allows you to connect electronics through its pins so that it can control things—for instance, turn lights or motors on and off or sense things such as light and

temperature. This is why Arduino is sometimes given the description *physical computing*.

Because Arduinos can be connected to your computer by a universal serial bus (USB) lead, this also means that you can use the Arduino as an interface board to control those same electronics from your computer.

This chapter is an introduction to the Arduino, including the history and background of the Arduino, as well as an overview of the hardware.

3.2 Components:

In order to simulate, test and implement that designed circuit model and the robotic car model after it had been discussed the way of its methodology to achieve the project destination, it had needed the components:

- Microchip -L293D.
- Arduino Nano.
- Servo Motor.

- Receiver and Transmitter RF433 module.
- Accelerometer.
- Universal Serial Bus (USB).

3.2.1 Microchip– LN293D

The L293 and L293D are quadruple high-current half-H drivers. The L293 is designed to provide bidirectional drive currents of up to 1 A at voltages from 4.5 V to 36 V. The L293D is designed to provide bidirectional drive currents of up to 600-mA at voltages from 4.5 V to 36 V. Both devices are designed to drive inductive loads such as relays, solenoids, dc and bipolar stepping motors, as well as other high-current/high-voltage loads in positive-supply applications. All inputs are TTL compatible. Each output is a complete totem-pole drive circuit, with a Darlington transistor sink and a pseudo- Darlington source. Drivers are enabled in pairs, with drivers 1 and 2 enabled by 1,2EN and drivers 3 and 4 enabled by 3,4EN. When an enable input is high, the associated drivers are enabled, and their outputs are active and in phase with their inputs. When the enable input is low, those drivers are disabled, and their outputs are off and in the high-impedance state. With the proper data inputs, each pair of drivers forms a full-H (or bridge) reversible drive suitable for solenoid or motor applications show in figure 3.1.

Features

- Featuring Unit rode L293 and L293D Products Now from Texas Instruments

- Wide Supply-Voltage Range: 4.5 V to 36 V
- Separate Input-Logic Supply
- Internal ESD Protection
- Thermal Shutdown
- High-Noise-Immunity Inputs
- Functionally Similar to SGS L293 and SGS L293D
- Output Current 1 A Per Channel (600 mA for L293D)
- Peak Output Current 2 A Per Channel (1.2 A for L293D)
- Output Clamp Diodes for Inductive Transient Suppression (L293D).

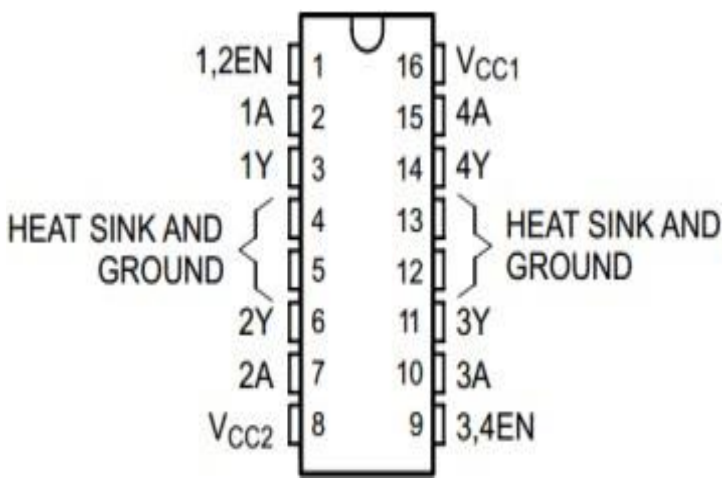

Figure 3.1: Microchip–LN293D

3.2.2 Arduino Nano

Arduino Nano is a small, compatible, flexible and breadboard friendly Microcontroller board, developed by Arduino.cc in Italy, based on ATmega328p (Arduino Nano V3.x) /Atmega168 (Arduino Nano V3.x).

It comes with exactly the same functionality as in Arduino UNO but quite in small size. It comes with an operating voltage of 5V; however, the input voltage can vary from 7 to 12V. Arduino Nano Pinout contains 14 digitals pins, 8 analog Pins, 2 Reset Pins & 6 Power Pins. Each of these Digital & Analog Pins are assigned with multiple functions but their main function is to be configured as input or output. They are acted as input 8 pins when they are interfaced with sensors, but if you are driving some load then use them as output. Functions like pin Mode and digital Write are used to control the operations of digital pins while analog Read is used to control analog pins. The analog pins come with a total resolution of 10bits which measure the value from zero to 5V.
Arduino Nano comes with a crystal oscillator of frequency 16 MHz It is used to produce a clock of precise frequency using constant voltage. There is one limitation using Arduino Nano i.e. it doesn't come with DC power jack, means you cannot supply external power source through a battery. This board doesn't use standard USB for connection with a computer, instead, it comes with Mini USB support. Tiny size and breadboard friendly nature make this device an ideal choice for most of the applications where a size of the electronic components is of great concern. Flash memory is 16KB or 32KB that all depends on the Atmega board i.e. Atmega168 comes with 16KB of flash memory while Atmega328 comes with a flash memory of 32KB. Flash memory is used for storing code. The 2KB of memory out of total flash memory is used for a bootloader. [16] show in figure 3.2 and Arduino nano characteristics in table 3.1

Figure 3.2: Arduino Nano

Table 3.1 Arduino Nano specifications

Microcontroller	Atmega328p/Atmega168
Operating Voltage	5V
Input Voltage	7-12V
Digital I/O Pins	14
PWM	6 out of 14 digital pins
Max. Current Rating	40ma
USB	Mini
Analog Pins	8
Flash Memory	16KB or 32KB
SRAM	1KB or 2KB
Crystal Oscillator	16MHZ
EEPROM	512 bytes or 1KB
USART	Yes

viewed as the cerebrum of the equipment, where it will assume the part of offering orders to alternate segments associated with it through its pins. Arduino is open source physical handling which is based on a microcontroller board and a consolidated advancement condition for the board to be customized, Arduino can be modified and prepared to play out an almost unending rundown of capacities. It’s the best all-around centerpiece to a present many project

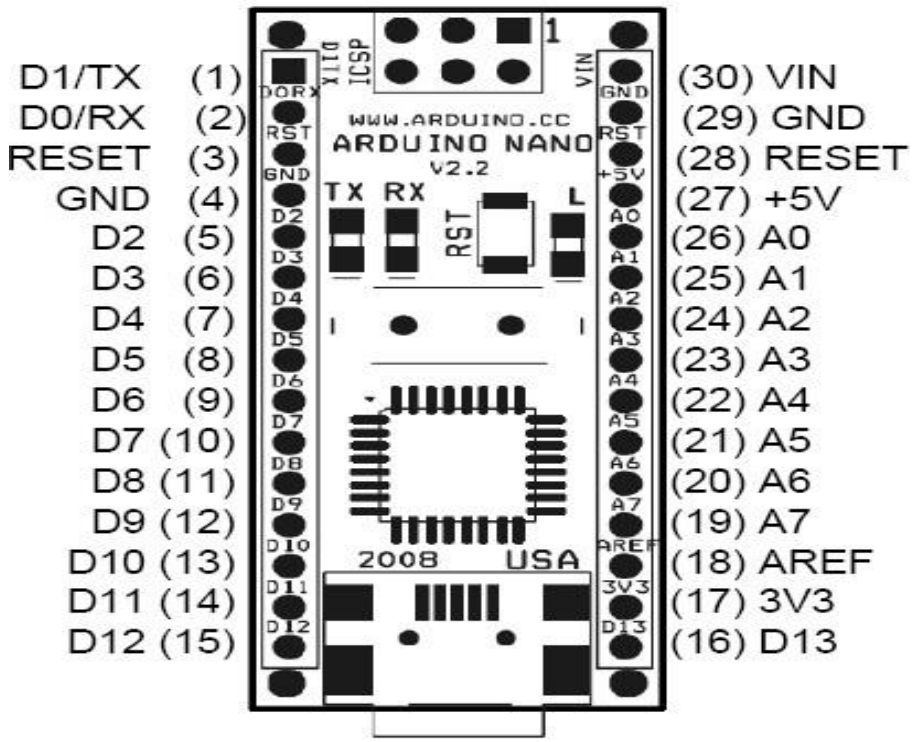

Figure 3.3: Schematics of Adruino Nano

3.2.3 Servo Motor

Servo motor have received a wide acceptance in industrial motion control by virtue of their significant merits such as energy efficiency, servo mg995 motor high-speed standard servo can rotate approximately 180 degrees (90 in each direction). You can use any servo code, hardware or library to control these servos, so it's great to make stuff move without building a motor controller with feedback & gear box, especially since it will fit in small places. The MG995 Metal Gear Servo also comes with a selection of arms and hardware to get you set up nice and fast. [20] show in figure 3.4.

Figure 3.4: Servo Motor mg99

3.2.4 Receiver and Transmitter RF433 module

This is 433Mhz RF transmitter with receiver kit for Arduino ARM MCU wireless. Remote control switch, receiver module, motorcycles, automobile anti-theft products, home security products, electric doors, shutter doors, windows, remote control socket, remote control LED, remote audio remote control electric doors, garage door remote control, remote control retractable doors, remote volume gate, pan doors, remote control door opener, door closing device control system, remote control curtains, alarm host, alarm, remote control motorcycle remote control electric cars, remote control MP3 .

Transmitter Specification:

- Product Model: XD-FST
- Launch distance :20-200 meters (differentvoltage, different results)
- Operating voltage :3.5-12V
- Dimensions: 19 * 19mm
- Operating mode: AM
- Transfer rate: 4KB / S
- Transmitting power: 10mW
- Transmitting frequency: 433M
- Pin out from left → right: (DATA; VCC; GND)

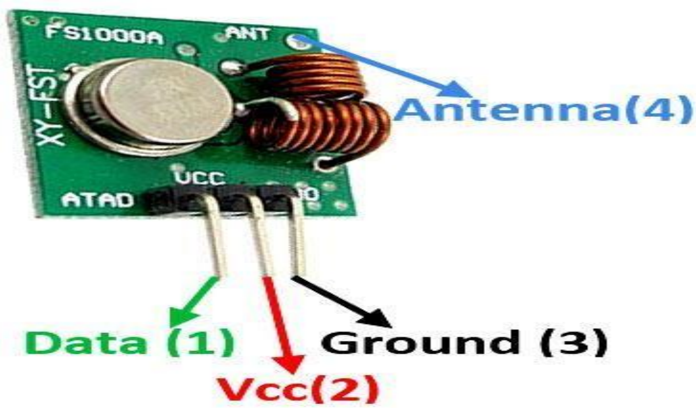

Figure 3.5: Transmitter RF4300 MHZ Module

Receiver Specification:

- Product Model: XD-RF-5V
- Operating voltage: DC5V
- Quiescent Current: 4MA
- Receiving frequency: 433.92MHZ
- Receiver sensitivity: -105DB
- Size:30x14x7mm

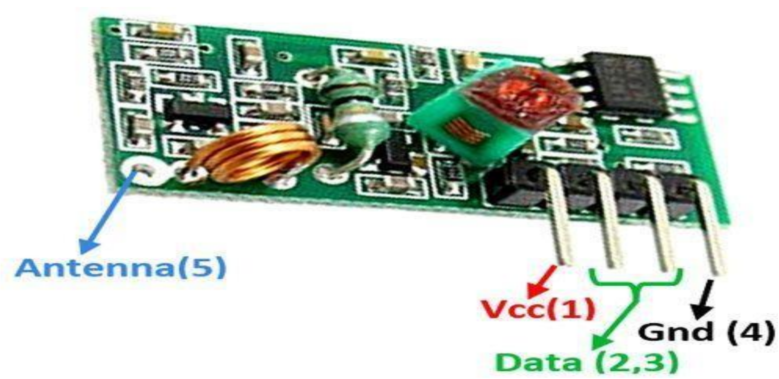

Figure 3.6: Receiver RF4300 MHZ Module

3.2.5 Accelerometer

The Invernesses GY521 Figure (3.7) Sensor Board contains a very accurate (and tiny) sensor chip – MPU6050 – that contains an accelerometer and gyroscope inbuilt in the sensor based on MEMS (Micro Electro Mechanical Systems) technology. The MEMS Technology uses silicon wafers to fabricate capacitive circuits that emulate an accelerometer and a gyroscope (and other mechanical parts like have holes, cavity, channels, cantilevers, membranes, etc.) generating currents proportional to the magnitude of acceleration (linear or angular) induced on the sensor، the outputs would be in three forms:

· Yaw: Angular rate on the vertical axis.
· Pitch: Angular rate on the horizontal axis.
· Roll: Angular rate on the front to back axis (most likely y-axis but dependent on orientation).

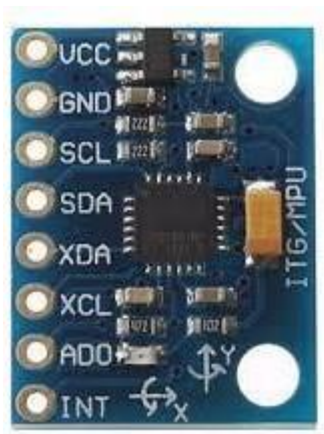

Figure 3.7: Accelerometer Gy521

3.2.6 Universal Serial Bus

The Universal Serial Bus (USB) Figure (3.8) connector is designed in a way that allows it to reset an attached board by software running on a connected computer the external reset line mirrors the DTR line of the virtual serial device on the computer. It's typically connected to the reset line of the connected board (e.g. an Arduino Ethernet board) through a 100 nF capacitor, allowing the board to reset on upload.
This setup has other implications. When the board is connected to either a computer running Mac OS X or Linux, it resets each time a connection is made to it from software (via USB). While it is

programmed to ignore malformed data (i.e. anything besides an upload of new code), it will intercept the first few bytes of data sent to the board after a connection is opened. If a sketch running on the board receives one-time configuration or other data when it first starts, make sure that the software with which it communicates waits a second after opening the connection and before sending this data. The pinouts on the connector are compatible with a standard FTDI header (as well as the Adafruit and Sparkfun USB-Serial adapters).

Connecting up the USB-Serial converter is pretty straight forward. You'll want to connect the 5V pin to the 5V input of your board to power it (or you can power it separately and only connect the ground). Then the TX pin on your converter to the RX pin on your board, and the RX pin on your converter to the TX pin on your board. If this sounds a bit confusing and backward, remember that TX is outgoing data, and RX is inbound data, so the TX pin on the converter is sending data from the USB port, and the RX pin on the Arduino is receiving data, so you want those to be connected, and vice-versa. If you're using the Arduino USB 2 Serial converter, you can take advantage of the external reset pin show in figure 3.8.

Figure 3.8: Universal Serial Bus

3.3 Circuit Mounting Diagram

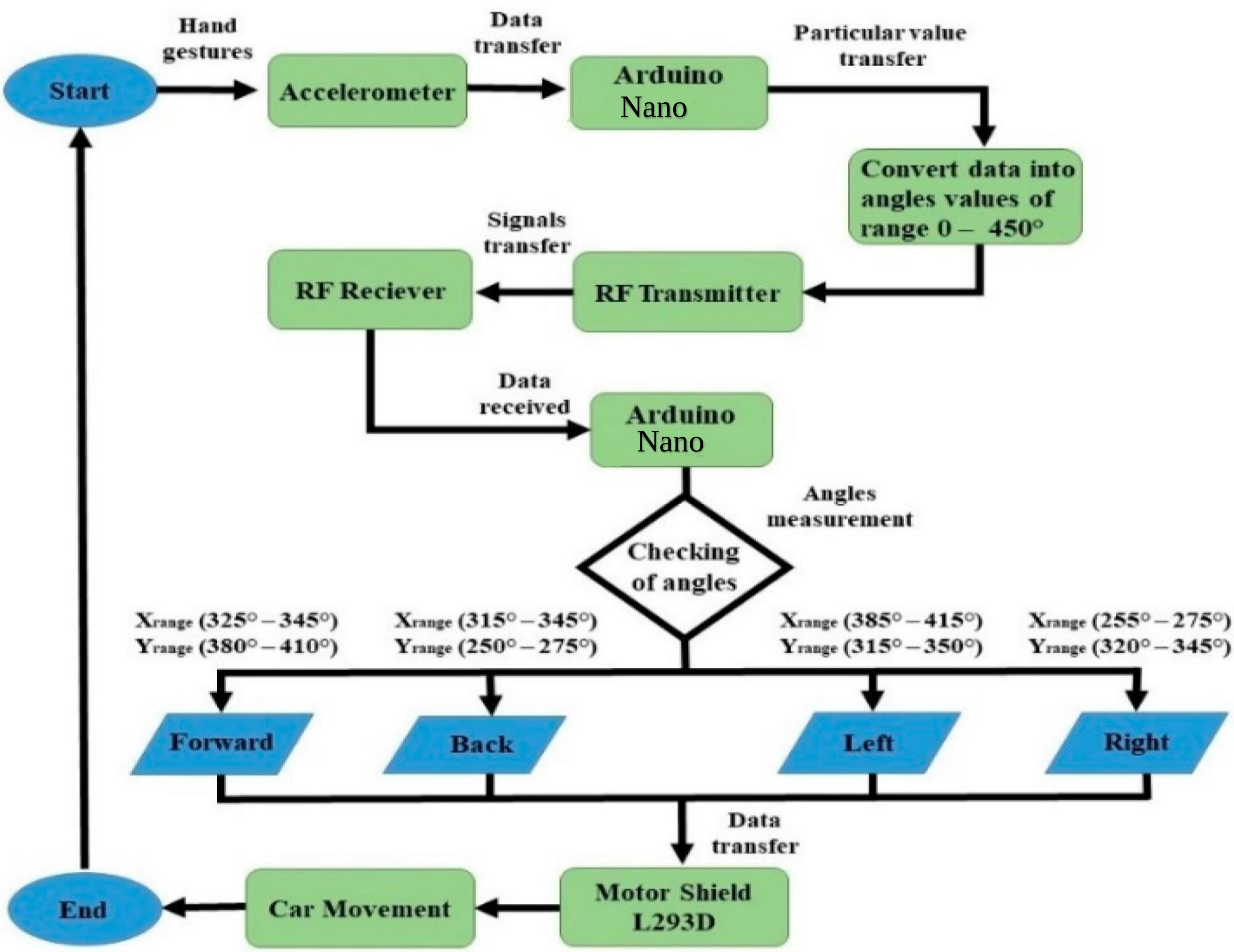

Figure 3.9: Circuit Mounting Diagram

CHAPTER FOUR

SYSTEM SIMULATION AND IMPLEMENTATION

4.1 Introduction:

The system model which content of robotic car model and its control circuit model that had been installation and made it circuit diagram and block diagram previously, it has to simulate and implement it.

4.2 simulation:

Fritzing is an open-source initiative [3] to develop amateur or hobby CAD software for the design of electronics hardware, to support designers and artists ready to move from experimenting with a prototype to building a more permanent circuit. It was developed at the University of Applied Sciences Potsdam.[4] show in figure 4.3.

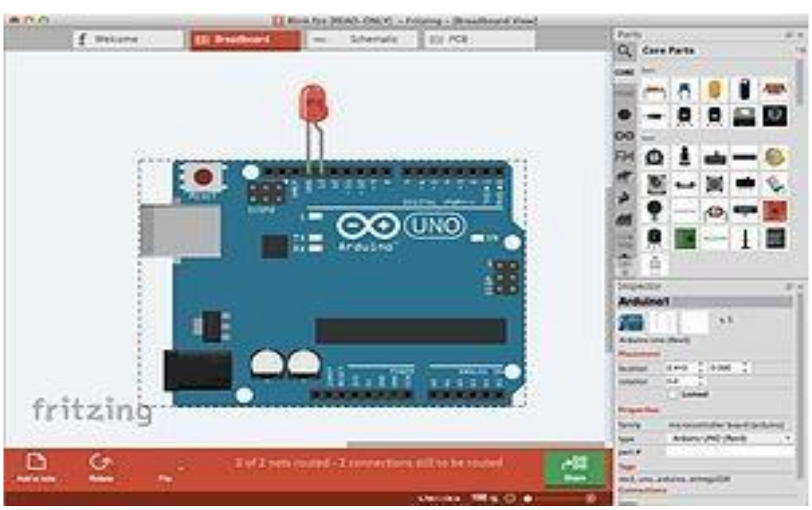

Figure 4.1: Fritzing breadboard view

The software is created in the spirit of the Processing programming language and the Arduino microcontroller [5] and allows a designer, artist, researcher, or hobbyist to document their Arduino-based prototype and create a PCB layout for manufacturing. The associated website helps users share and discuss drafts and experiences as well as to reduce manufacturing costs. Fritzing can be seen as an electronic design automation (EDA) tool for non-engineers: the input metaphor is inspired by the environment of designers (the breadboard-based prototype), while the output is focused on accessible means of production. As of December 2, 2014, Fritzing has made a code view option, where one can modify code and upload it directly to an Arduino device.[6]

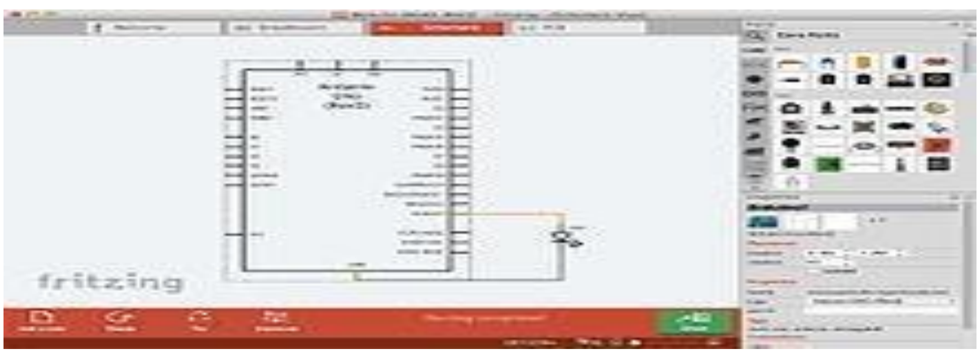

Figure 4.2: Fritzing Schematic view

Design the transmitter circuit by fritzing.

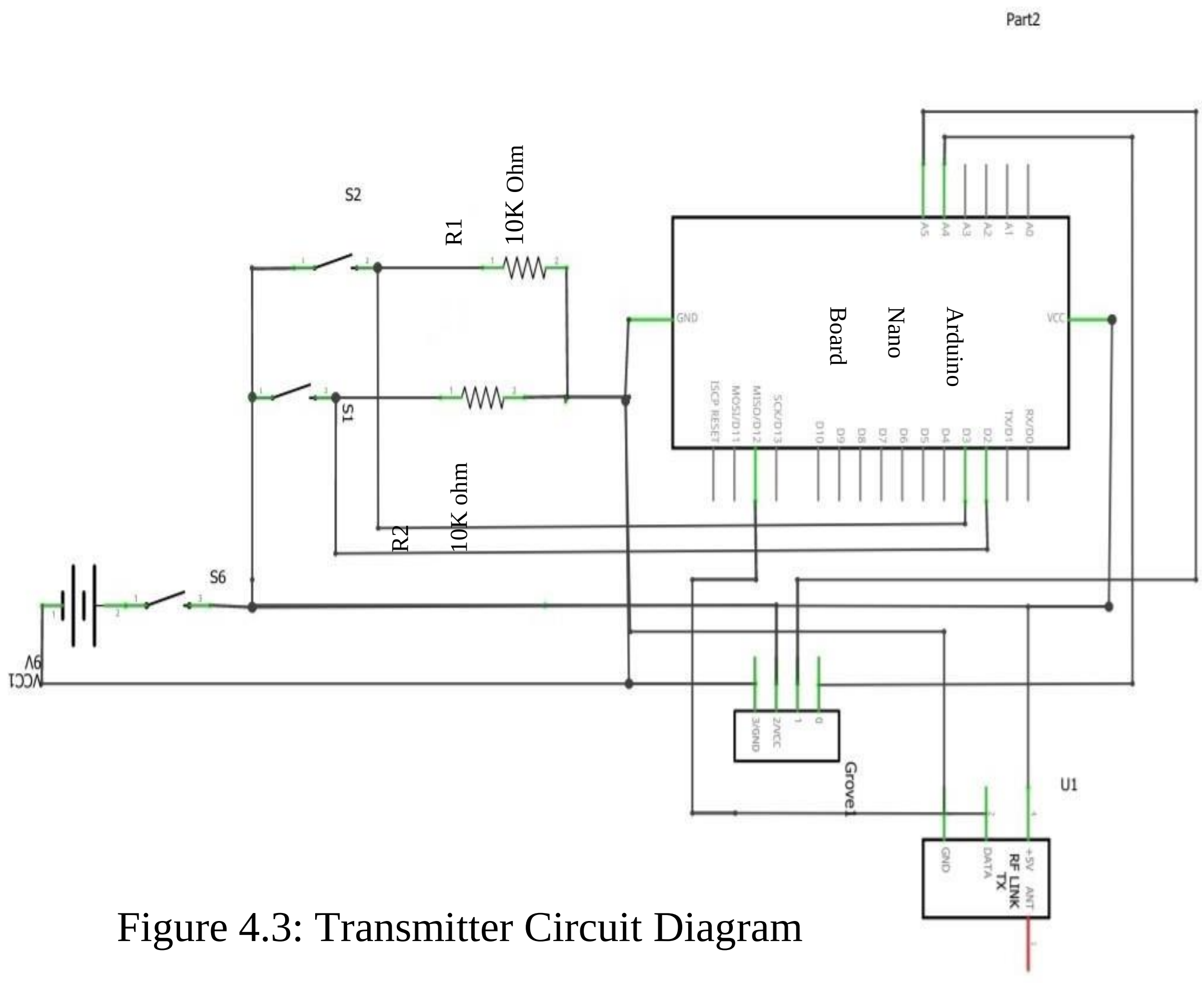

Figure 4.3: Transmitter Circuit Diagram

Design the receiver circuit by fritzing

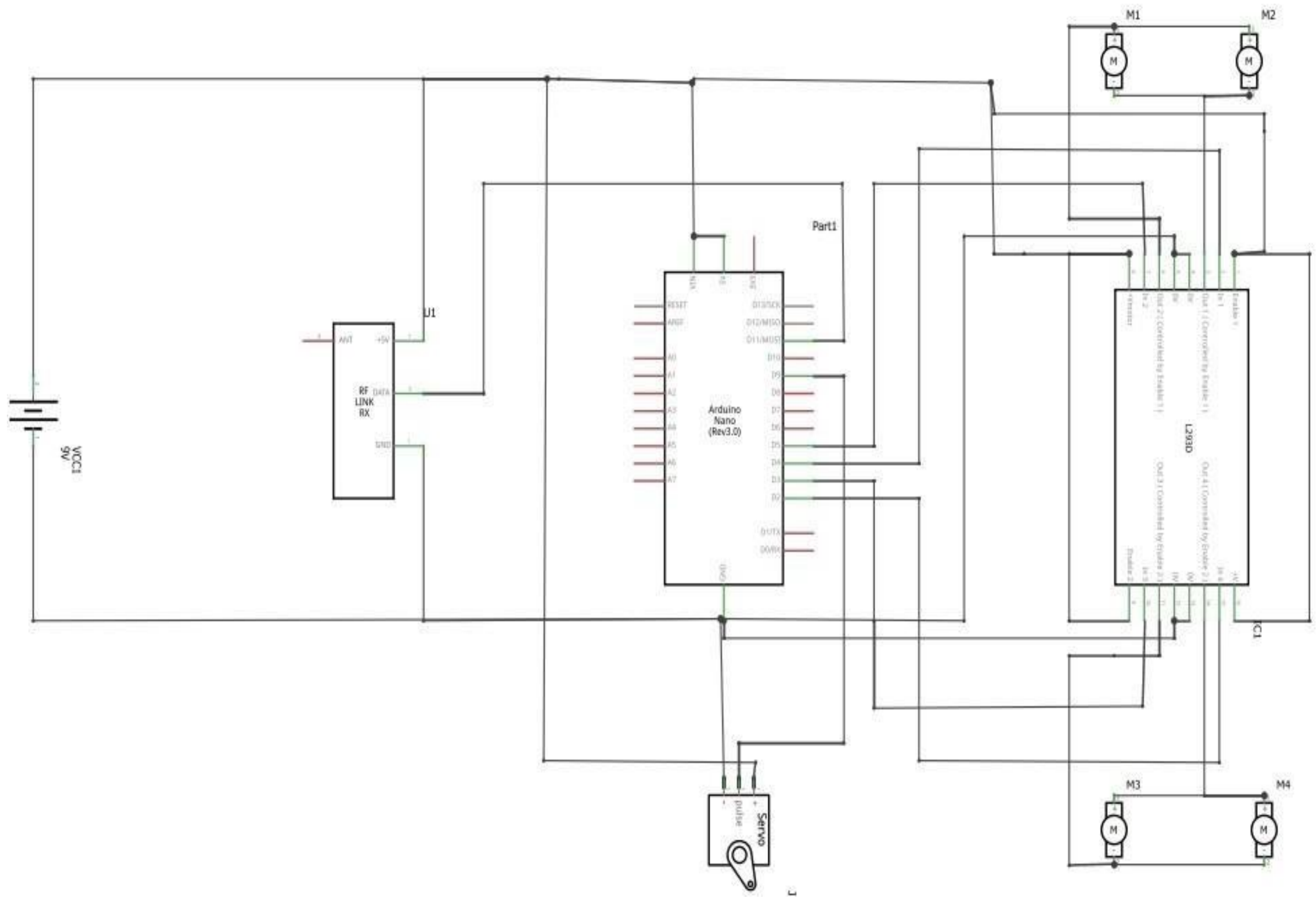

Figure 4.4: Reciever Circuit Diagram

4.2.1 Adriano Programming

When you start the Arduino application on your computer, it opens with an empty sketch. Fortunately, the application ships with a wide range of useful examples. So, from the File menu, open the Blink example as show in Figure (4.1).

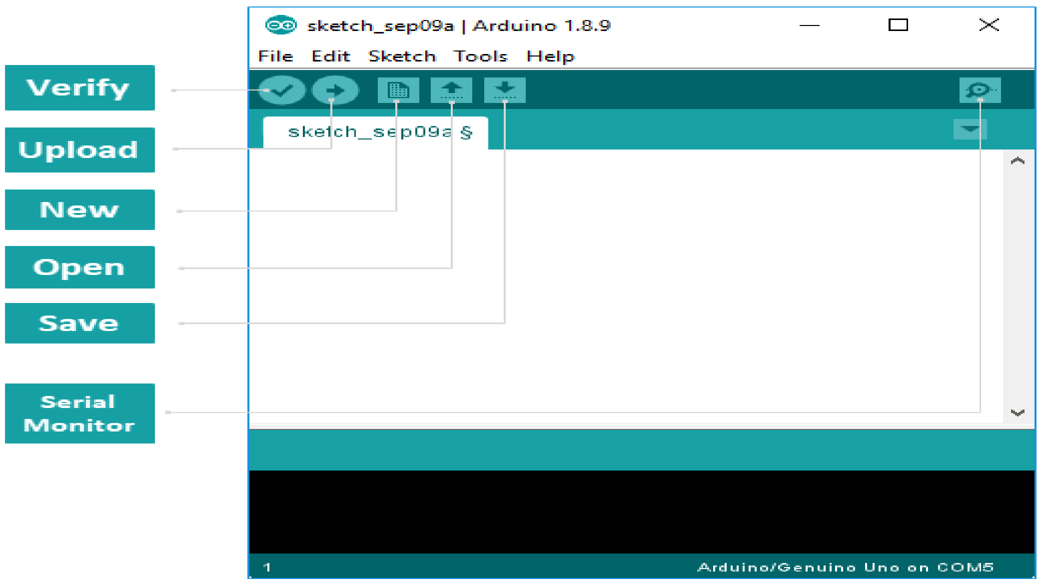

Figure 4.5: Arduino interface

Before you can upload a sketch, you must tell the Arduino application what type of board you are using and which serial port you are connected to. Figure 4.2.

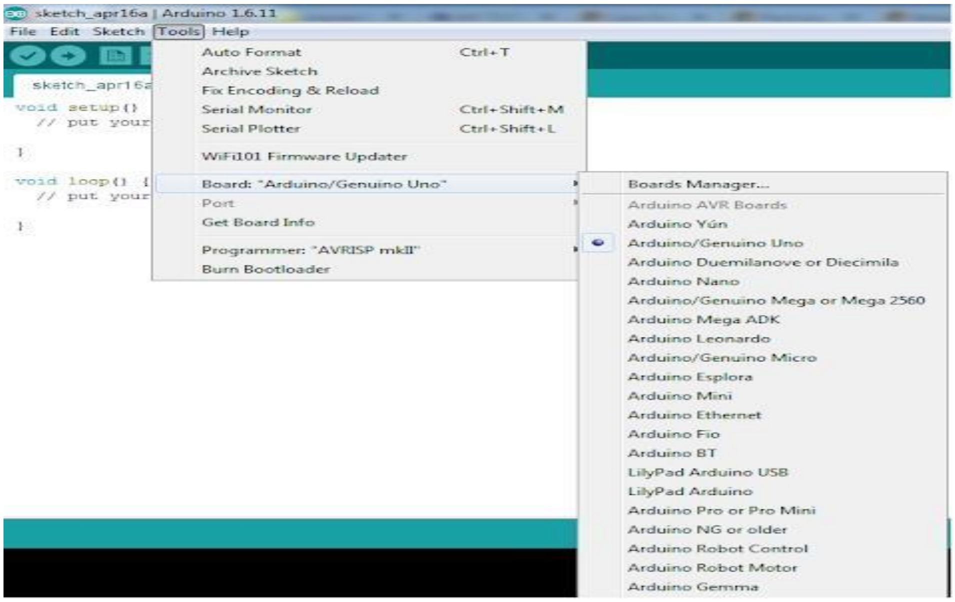

Figure 4.6: Selecting the board type

4.2.2 Implementation of Design

It drives the DC motors and is used to drive induction loads. L293D is a 16-pin IC which can control a set of two DC motors simultaneously in

any direction. It means that you can control two DC motors with a single L293D IC. Dual H-bridge Motor Driver integrated circuit (IC).

Figure4.7: Dc Motor

They are attached to the chassis with the help of screws and then connected to the DC motors for movement.
RF module (radio frequency module) is a (usually)small electronic device used to transmit and/or receive radio signals between two devices. In an embedded system it is often desirable to communicate with another device wirelessly.

Figure4.8: 4 wheels and wires

The motion of the robot car depends on the motion of the glove when the glove in the horizontal possession the robot car will stand still and don't move what so ever. when the front of the glove leans down it's the signal of forward movement. when the front of the glove goes up it's the signal of backward movement. when the glove lean to the right side it's the signal for moving to the right. when the glove lean to the left side it's the signal for moving to the left show in figure4.6.

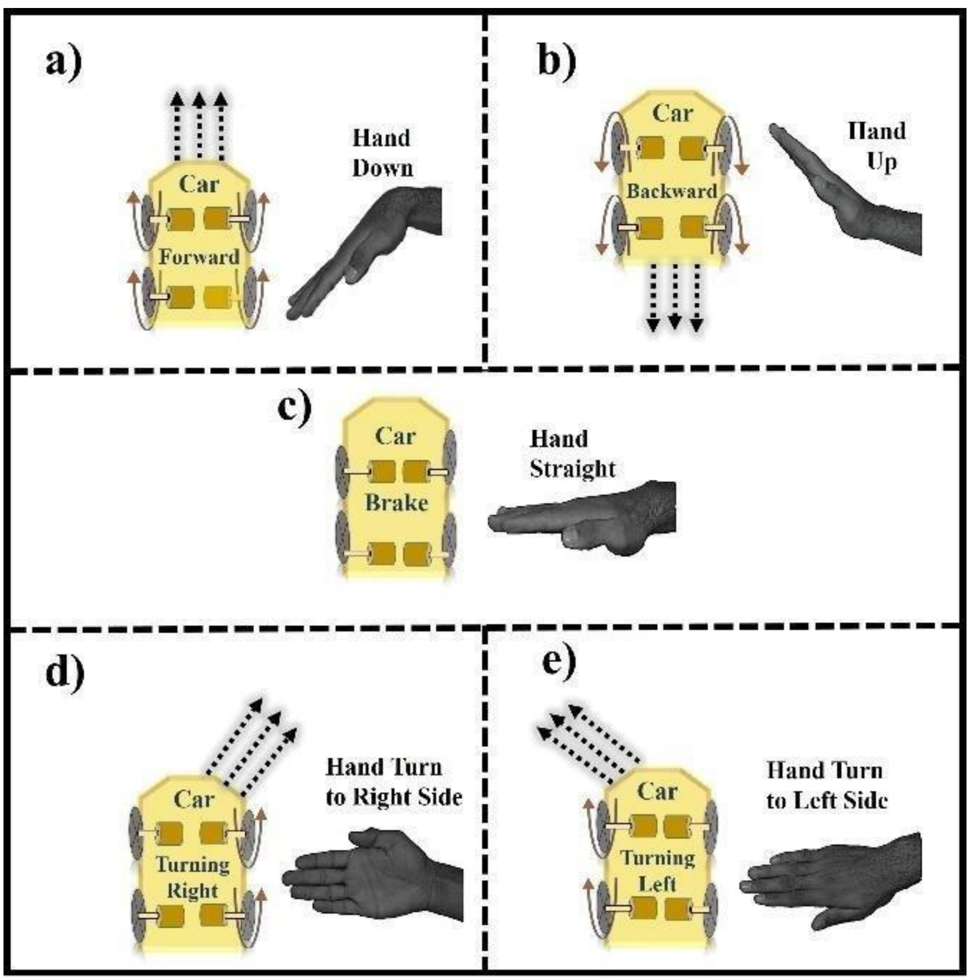

Figure 4.9: Various gestures for movement of car

4.3 Operation

four wheels attached to four motors on top of them there is a wooding shape figure representing the core of the robot car which the rest of the components will take place on. the four motors are powered by batteries the apply of the power for the motors is controlled by the electronic parts of the system which will be determined there controlling process later on in this chapter. A servo motor is placed on top of the robot car controlling a gripper that give the ability to catch and release subjects which make the robot car useful in moving subjects they can be dangerous for a man to deal with single handed. To gain control for the grip a push button is placed on the glove when the push button is ON the grip will catch and keep hold of the subject when the push button is OFF the grip will release the subject. In conclusion the robot car is capable of moving in deferent directions forward; backward; left; right and it’s also capable of catching subjects and moving them from one place to another and this application is useful for handling a problem of moving something that could be explosive or a dangerous chemical substance that could really harm a human being or even take out his life. The human life is the most precious thing in the existence so robot car is made to guarantee his safety.

4.3.1 Transmitter Circuit

To make the connection of the transmitter circuit, it had been obtained transmitting components of the robotic car; two push-button, Arduino Nano, accelerometer sensor, transmitter rf433 module, 9-volt battery, two resistors (10k ohm) and on/off switch.

To connect those components by electronic welding. In the beginning we welded the 9-volt battery and on/off switch in series on the electronic board and made two lines of welding one of them is 5 volt pin of the arduino NANO and the other line is ground line (GND).

These two lines to make a parallel connection between the other components.

To welding the two push- button which will control the servo motor in the two directions. the push-bottom had two tips, it had been welded one of these tips to the 5v of the arduino NANO pin line .

and the other tip we divided it to two parallel lines, one of them attached to one of the input pins of the Arduino Nano and the other it had been welded it in series with a resister 10k ohm and grounded it and did the same for the other push-button.

For the rf433 module of transmitter its purpose is to send the signal that the Arduino Nano had process it. The rf433 module of transmitter has three pins; data pin, vin pin and GND pin. The data pin welded with pin no.11 of the Arduino Nano and vin Pin welded with the line of 5v pin of the arduino NANO of and the GND pin welded with GND line of battery (power supply).

About the accelerometer sensor it had been need for four pins; vin pin, GND pin, SCL pin and SDA pin. the SCL, SDA pins represented the x axis and y axis inputs which the change of one of them make the Arduino Nano provide a response signal and moved this signal to the transmitter module to send it and all that are programmable.

That lead us to the function of the accelerometer which is to sense the motion of it position in the axis. Then it had been weld the vin pin with the 5v pin of the arduino NANO line and GND pin to GND line of power supply. And for SCL, SDA pins welded with A4, A5 pins of the Arduino Nano respectively. After all that it had been put the accelerometer sensor above the Arduino Nano and link both of them above the glove that will be wore in hand.

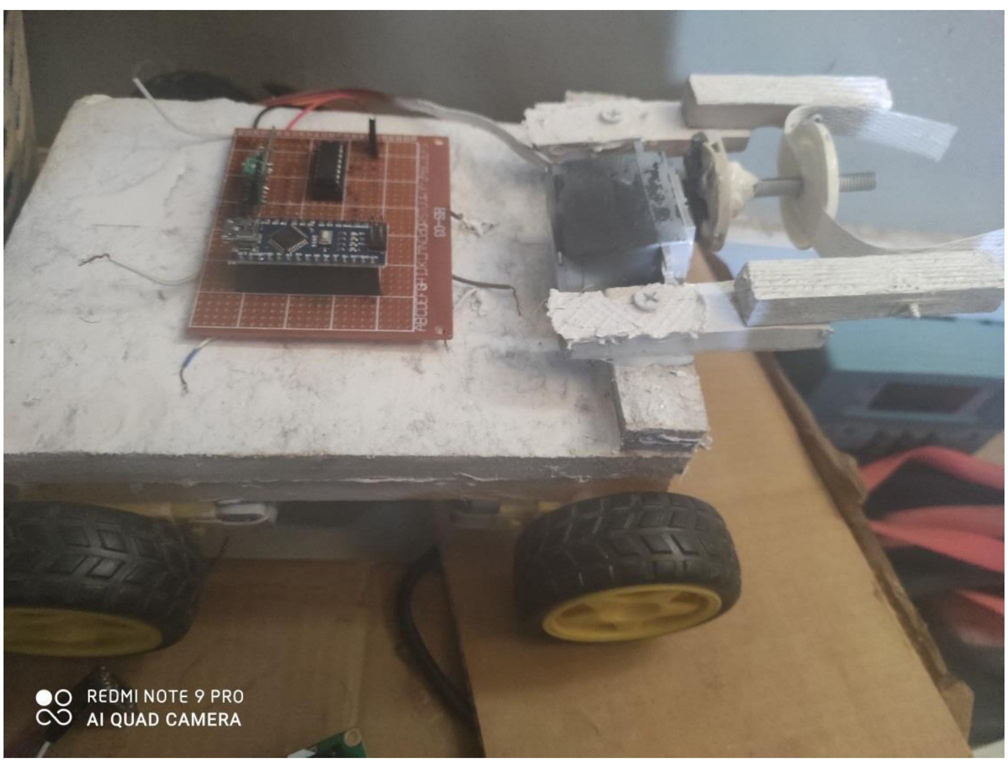

Figure 4.10: Real Transmitter Circuit diagram

4.3.2 Receiver Circuit

To create the receiver circuit, we bring the components; Arduino Nano, L293 chip, servo motor, power supply (battery 9 volt), four DC motors and rf433 receiver module.

Now, to connect these components we in the beginning welded the power supply wires on the electronic board and made two lines, one for vin and the other for ground (GND). Then we attached by welding Arduino Nano and L293 chip orthogonal on the board. we welded the pin vin of the Arduino Nano in point with the vin of the power supply and also for the GND pin of Arduino Nano we welded it with the line GND of the power supply. The L293 IC is known as motor driver and it has 16 pins four of these pins are output connected to the tip of the four DC motors that had we designed, each two motor in one side connected together to made two inputs. And four pins of L293 IC for input welding with D2,D3,D4 and D5 of the Arduino Nano, and four pins shorted in one point represented the vin of the L293 IC then we welded it with the line of vin of the power supply , for the last four pins also we shorted it in one point represented the GND of the L293 IC then welded it with the GND line of the power supply . Thus, for the servo motor which will control the gripper that placed in the front of the robotic car to catch subjects, it has three wires, signal wire, vin wire and GND wire. For the signal wire it welded in point with pin no.9 in the Arduino Nano and the vin wire we welded it in point with the vin line of the power supply and GND wire also we welded it in point with GND line of the power supply.

In last the receiver rf433 module it has three pins ; data pin , vin pin and GND pin , we **welded** the data pin in point with pin no.12 in the Arduino Nano and the vin pin welded in point with the vin line of the power supply , also about GND pin it welded in point with the GND line of the power supply . After we finished from the receiver circuit, we set it above the robotic car.

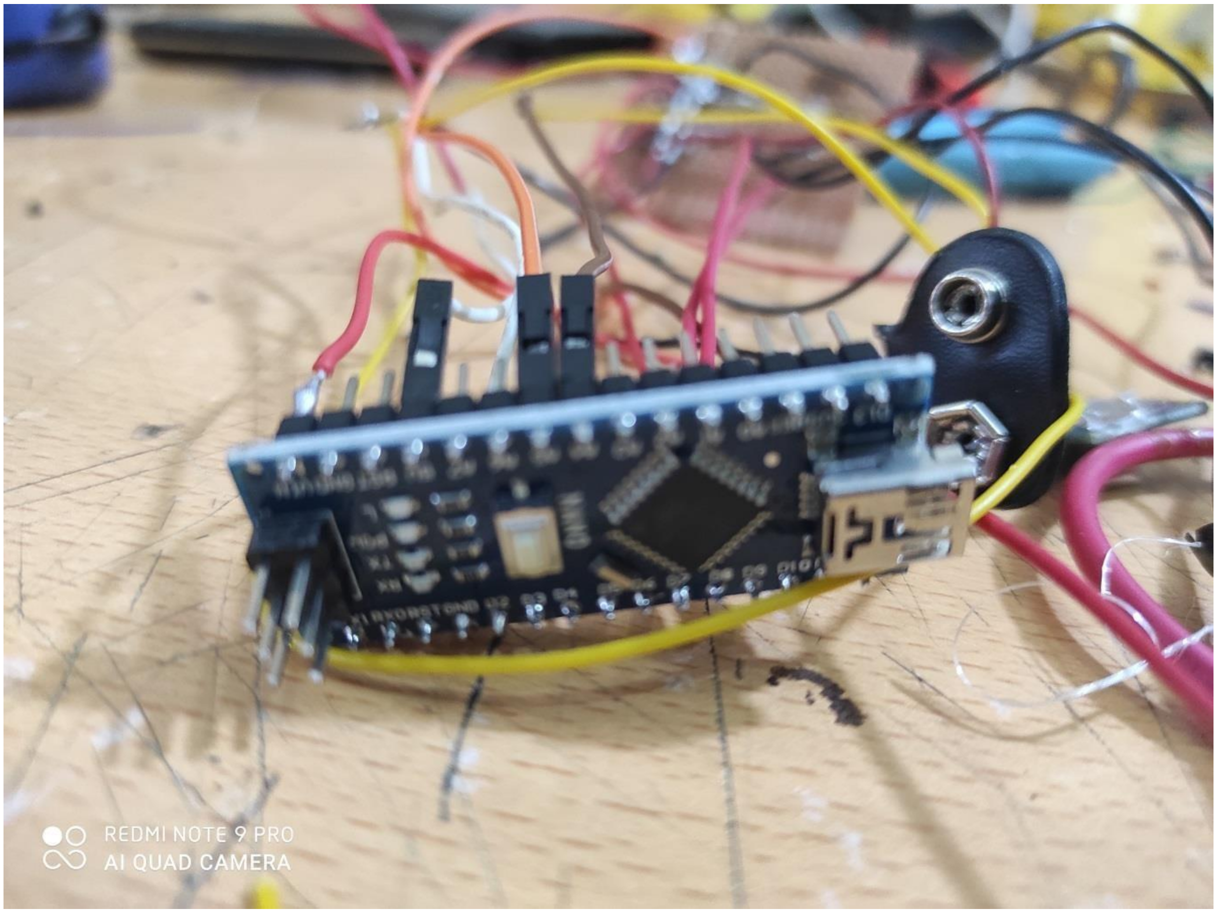

Figure 4.11: Real Receiver Circuit Diagram

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1 Conclusion:

It had been designed a circuit and robotic car models to move subject from place to another one by making a system of transmitter and receiver to control on those after studied all the theoretical and methods sides of the project and after all the steps that has been progressed in to made a model of the connection between the components of the project that has explained in details so far then simulate, test and implement of the project.

5.2 Recommendations:

- the wooden gripper doesn’t bear high pressure change into a robotic arm that is bear high pressure and improve the control movement.
- change the car movement control system using mobile phone.

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Appendix (A)

```
#include <RH_ASK.h>

#include <SPI.h>

#include <MPU6050.h>

#include <SoftwareSerial.h>




MPU6050 mpu;

int16_t ax, ay, az;

int16_t gx, gy, gz;

int valY =0;

int valX = 0;

String str_X;

String str_Y;

String str_out1,str_out2,str_out1,;

RH_ASK rf_driver;
```

```
void setup()
{
Serial.begin(9600);
rf_driver.init();
mpu.initialize();
pinMode(8,INPUT);
pinMode(9,INPUT);

}


void loop()
{
mpu.getMotion6(&ax, &ay, &az, &gx, &gy, &gz);
valY = map(ay, -17000, 17000, 0, 179);
valX = map(ax,-17000,17000,0,179);

if (digitalRead(8)==HIGH)
{
  str_out=1;
```

```
  }
  if (digitalRead(9)==HIGH)
{
  str_out=2;
  }
 Serial.print(valX);
 Serial.print("\t");
 Serial.println(valY);
 str_out1 = valX;
 str_out2=valY;

str_out = str_out1,str_out2

static char *msg = str_out.c_str();
 rf_driver.send((uint8_t *)msg, strlen(msg));
 rf_driver.waitPacketSent();
 delay(500);
}

#include <RH_ASK.h>
#include <SPI.h>
```

```
#include <Servo.h.h>
Servo gripper;



String   str_X;
String   str_Y;
String str_out;
RH_ASK rf_driver;




void setup()
{
  gripper.attach(9);
rf_driver.init();
delay(1000);
Serial.begin(9600);
pinMode(2,OUTPUT) ;
pinMode(3,OUTPUT) ;
pinMode(4,OUTPUT) ;
pinMode(5,OUTPUT) ;
```

```
  digitalWrite(2,LOW);

  digitalWrite(3,LOW);

  digitalWrite(4,LOW);

  digitalWrite(5,LOW);



delay(1000);


}


void loop()

{



   uint8_t buf[5];

   uint8_t buflen = sizeof(buf);

   if (rf_driver.recv(buf, &buflen))

   {

     str_out = String((char*)buf);

     for (int i = 0; i < str_out.length(); i++) {
```

```
      if (str_out.substring(i, i+1) == ",") {
      str_X = str_out.substring(0, i);
      str_Y = str_out.substring(i+1);

      break;

      }
    }
 if ( str_out =="0,0,")
{

  digitalWrite(2,LOW);
   digitalWrite(3,LOW);
   digitalWrite(4,LOW);
   digitalWrite(5,LOW);
  }

if ( str_out =="1,0,")
{
   digitalWrite(2,HIGH);
   digitalWrite(3,LOW);
```

```
  digitalWrite(4,HIGH);
  digitalWrite(5,LOW);



 }

if ( str_out =="2,0,")
{
 digitalWrite(3,LOW);
  digitalWrite(2,HIGH);
  digitalWrite(4,LOW);
  digitalWrite(5,HIGH);

 }

 if ( str_out =="0,1,")
{
  digitalWrite(4,HIGH);
  digitalWrite(3,LOW);
  digitalWrite(2,LOW);
  digitalWrite(5,LOW);
```

```
 }

 if ( str_out =="0,2,")
{
 digitalWrite(5,LOW);
  digitalWrite(3,LOW);
  digitalWrite(4,HIGH);
  digitalWrite(2,LOW);


 }
    Serial.println( str_out);
if ( str_out =="0,3,")
{
 gripper.write(90);;


 }
 if ( str_out =="0,4,")
```

```
{
  gripper.write(0);;



  }

    }

}
```

Appendix (B)

Project budget

Component	Cost
(2) Adriano Nano	2600
Servo Motor	800
4 motor	1000
Microchip -L293D	400
(2) board	600
(2) Resistor 10k ohm	40
(2) push buttons	40
Transmitter RF433	250
Receiver RF433	250
(2) Battery 9v	500
Linear Regulator	300
Accelerometer	400

1