Sudan University of Science& Technology

College of postgraduate

Design of Robot for Sampling an Oil Refinery

تصميم روبوت لأخذ عينات في مصفاة بترول

A thesis Submitted for Partial Fulfillment for the Requirement of M.Sc. Degree in Mechatronics Engineering

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الآيــة

قال تعالى

صدق الله العظيم

(سورة طه الأية 114)

Dedication

I dedicate this project to God the almighty my creator, also I dedicate for all those who encouraged me to fly toward my dreams lets soar my family and my friends thanks all.

Acknowledgement

*Gratitude, thanks and appreciation to my supervisor Assistant Dr***. Alaa eldein Awooda** *for his valuable instructions, strong effort, support and patience to accomplish this study.*

My great thanks to the staff of ***Postgraduate College at Sudan University of Science and Technology*** *for their support and help in this study.*

Also, my thanks extend to my colleagues and my family who helped in data collection. Lastly, thanks to all those who helped me directly or indirectly.

Abstract

The current oil industry has moved from the state of automation to the state of automation in order to increase productivity and provide a product of high quality and one of the most important stages of oil production is a stage of conformity with specifications.

The aim of this study is to design a robot by microcontroller that to helps the worker in this field to secure its safety from injury from skin diseases resulting from contact with chemicals and loss of tolerance resulting from noise.

After completing this project, the robot will be able to take oil samples from the pipes in a highly efficient way, which helps to reduce the risks of disease and environmental pollution, reduce work hours and increase productivity.

المستخلص

انتقلت صناعة النفط الحالية من حالة التشغيل الآلي إلى حالة الأتمته وذلك لزيادة الإنتاجيه َوتقديم منتج بجودة عالية ومن أهم مراحله إنتاج النفط هي مرحلة مطابقته للمواصفات.

الهدف من هذه الدراسة هو تصميم روبوت عن طريق المايكروكونترولر ليساعد العامل في هذا المجال على تأمين سلامته من الإصابة من الأمراض الجلدية الناتجة من التلامس بالمواد الكيميائية وفقدان السمح الناتج من الضجيج.

بعد الإنتهاء من هذا المشروع سيتمكن الروبوت من أخذ عينات الزيت من الأنابيب بكفاءة عالية مما يساعد على تقليل مخاطر الإصابة بالأمراض والتلوث البيئي وخفض ساعات العمل وزيادة الإنتاجية.

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List of Symbols

DC	Discreet current
IR	Infrared Ray sensor
V	Volt
A	Ampere
V_s	Source voltage
Gnd	Ground
V_{out}	Output Voltage
AC	Alternating Current
DC	Direct Current
V	Volt
A	Ampere
Ah	Ampere hour
V_s	Source voltage
Gnd	Ground
V_{out}	Output voltage
R	Resistance
ºC	Degree Celsius
MHz	Mega Hertz
KB	Kilo Byte
MIPS	Merit based Incentive Payment System
NPN	Negative Positive Negative
PNP	Positive Negative Positive
NC	Normally Close
NO	Normally Open
RISC	Reduce Instruction Set Computer
AVR	Alf and Vegard RISC processor
USB	Universal Serial Bus
ICSP	Integrated Circuit Serial Programming
I/O	Input/Output
PWM	Pulse Width Modulation
SRAM	Static Random Access Memory
FTDI	Future Technology Devices International
EEPROM	Electrical Erasable Programmable

	Read Only Memory
TX	Transmitter
RX	Receiver
SS	Slave Select
CMOS	Complementary Metal Oxide Semiconductor
SPI	Serial Peripheral Interface
CPU	Central Processing Unit
ADC	Analog to Digital Convertor
MOSI	Multi Output Single Input
MISO	Multi Input Single Output
MCU	Microcontroller Unit
TWI	Two Wire Interface
USART	Universal Synchronous Asynchronous Receive Transmit
LED	Light Emitting Diode
ASC	American Standard Code
IC	Integrated Circuit

Chapter One

Introduction

1.1 Overview

The oil industry and mining has become more dependent than ever on innovation in technology in order to open horizons for production and help to sustain it.

In recent years the used of intelligent robots in the field of oil and gas mining has become essential and helpful in such area, some of advantages of these robots is that can move between the different areas where it is hard and harmful for human since dealing with chemicals solutions, these robot can act as humans in term of handling objects and dealing with chemicals, and moving around different types of surface slides as well as working with high efficiency with less cost compared to workers in refineries , it is essential to rely on them to perform many operations and functions such as automated drilling machines and robots that collect data and take samples of oil and gas .

Workers for manual methods of sampling exposed them to risks and various diseases such as dermatitis, liver and kidney, indigestion and irritation of eyes and cancer and as the health of human is important concern then the use of robot is the best way to maintain the safety of workers.

In this research the robot collects the oil samples from the field through pipeline and the takes them to the inspection units, its used technique of tracking the steps that should follow in order to get the oil and gas samples, the robot brain is a microcontroller based on Atmaga processor, the robot also used a combinations of sensors to track the real world. The robot can handle more than sample at the time, the hardware implemented to design this robot was modeled and simulated by using proteus ISIS software, the robot brain also programmed by using Arduino IDE software. [1]

1.2 Problem Statement

Health hazards when uses many chemical products may suffer occupational disease of lungs, skin, psychological and other organs at levels relying on the amount and length of exposure time. Hazards noise leads to noise –induced hearing loss (NIHL).

In addition to manual control using human can be also inaccurate.

1.3 Proposed Solution

Design a control circuit for a robot to take sample of on oil, this can help to reduce risk and pollution also leads to high efficient and reduce the cost and increase productivities.

1.4 Aim and Objectives

The main aim is to design a robot that with help employee through insuring their safety and reducing working hours. To active this aim

1. A control circuit for the robot is proposed
2. The proposed control circuit is simulated
3. Practical implementation for the proposed system is done

1.5 Methodology

This research is depend on study of the human task managing in oil mining areas a proper data is analyzed and refined to design and program a controlled robot system through selecting a suitable hardware components and choosing suitable programming language.

The robot brain will be a microcontroller based on atmega328, which connected to a several sensors and actuators to derive the robot.

Different robot actions is programmed using Arduino IDE based on object oriented programming language. All this elements is integrated to a model to visualize the real robot.

1.6 Research outline

This research consists of five chapters as following:

Chapter one introduction gives a general overview and outlined the problems statement a long with the proposed solution.

Chapter tow large high light previses and explain different system components.

Chapter three system designs explain the steps towards the design of the Robot.

Chapter four simulation highlight different simulation case and present discussion for the case.

Chapter five conclusion and recommendation, summarize the work done and gives several recommendation for future work.

Chapter Two

Literature Review

2.1 Overview

This chapter explain general robot and structure hardware parts of robot, sensor and motors. And accouters and operations of robot. Previous studies which have been previously done by other researches is also summarized. It very necessary to refer to the variety of sources in order to earns more skills knowledge, and experiences to complete this project, thesis and papers.

2.2 Previous works

In Application of robotics in offshore oil and gas industry-A review Part II by Amit Shukla in 2008 said Demands for oil and gas are increasing with urbanization and industrialization of the world's increasing population. Giant oil fields are declining in their production worldwide and this situation is creating need for search of new conventional and non-conventional fossil reserves. With steep depletion of major onshore and shallow-water-offshore oil fields new search of fossil fuel is moving towards deep-water and ultra-deep water offshore fields. Obviously new reserves are located in extreme, hostile and hard to reach environmental conditions. Exploration, development and production of oil from such difficult offshore fields have many serious challenges to health, safety and environment (HSE) therefore, require sophisticated technological innovations to support increasing energy demand. Biggest oil spill accidents in explosion of Deep water Horizon offshore oil platform are burning example of such challenges which human society cannot risk to repeat.

Therefore, development of advance drilling system, more accurate and intelligent inspection mechanism, faster responsive system in cases of unfortunate incidence and efficient damage control system is need of the safer future. Successful implementation of robotics, in space and manufacturing

industry, is a critical example of how robotic assistance and automation is the only option for safe and cost-effective production of oil in foreseeable future.
Teleoperation of unmanned drilling and production platforms, remote operated vehicles (ROVs), autonomous underwater vehicles (AUVs), under-water welding, welding robots for double hulled ships and under-water manipulator are such key robotic technologies which have facilitated smooth transition of offshore rigs from shallow waters to ultra-deep waters in modern time. Considering the sensitivity of product and difficulty of environment, most of these technologies fall under semi-autonomous category, where human operator is in loop for providing cognitive assistance to the overall operation for safe execution. [2]

In industrial robotics by Prof. Alessandro De Luca robotics in 2016 ISO 8373 definition an automatically controlled, reprogrammable, multipurpose manipulator programmable in three or more axes, which may be either fixed in place or mobile for use in industrial automation applications more general definition ("visionary") intelligent connection between perception and action .

There are several types of robots and very with different place of use , including what is used in industrial place one of these manipulator and other types is legged wheeled robot autonomous underwater vehicle unmanned aerial vehicle

Its frequent in dangerous place for example decontaminating robot used cleaning the main circulating pump housing in the nuclear power plant.

Or repetitive jobs that are boring stressful or labor intensive for humans where it is difficult to enter or deal with them welding robot.

Menial tasks that human don't want to do scrub mate robot. [3]

In autonomous military robotics by Risk, Ethics, and Design in 2008 The motivation for this project comes from the desire for greater safety and reduced exposure for workers in petroleum refining, One of those that needs to protect the workers when we take sample of oil or gasoil or so we get robots, and there are many studies and research talk about this field, whether the protection and health of workers in the oil fields or studies on robots in the oil fields.

Word robot was coined by a Czech novelist Karel Capek in a 1920 play titled Rassum's Universal Robots (RUR)

Definition of robot any machine made by one our members or a reprogrammable, multifunctional manipulator designed to move material, parts, tools or specialized devices through variable programmed motions or Robot (particularly in a military context). A powered machine that senses, thinks (in a deliberative, non-mechanical sense), and acts. [4]

In Series DC Motor Modeling and Identification using the Strejc method. The procedure requires only the measurement of the current consumption and the motor rotors speed. The resulting model is validated comparing the responses of the estimated model against real time responses of an actual motor. [5]

2.3 Robot Base

There are two types of robots base:

1. Fixed Robotic manipulators used in manufacturing they cannot move their base away from the work being done.
2. Mobile bases are typically platforms with wheels or tracks attached instead of wheels or tracks, some robots employ legs in order to move about. [3]

2.4 Robot hardware part

The mobile robot is built with control Arduino , motor (shield - DC - stepper) ,IR sensors, platform consisting of a toy car chassis (or handmade Al sheet chassis),batter . The robot is designed using DC motors controlling wheels. Motor shield to drive DC and Stepper motors.

2.5 Infrared Ray (IR) sensor

A device that emits in order to sense some aspects of the surroundings which detects IR radiation falling on it. The emitter is simply an IR LED (Light Emitting Diode) and the detector is simply an IR photodiode which is sensitive to IR light of the same wavelength is emitted by the IR LED.

When IR light falls on the photodiode, the resistances and output voltages, change in proportion to the magnitude of the IR light received. There are many types of IR sensors that are built and can be built depending upon the application.

Contrast sensors (Used in Line Following Robots), Proximity sensors (Used in Touch Screen phones), and obstruction sensors (Used for counting goods and in Burglar Alarms).

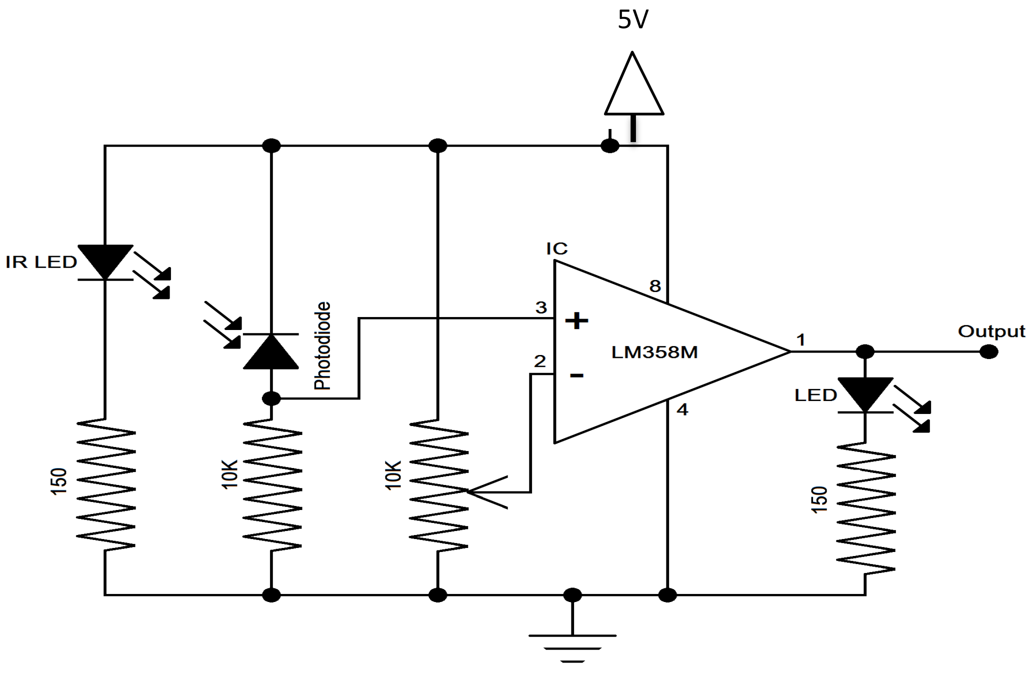


Figure 2.1 IR circuit [6]

The transmitter section includes an IR sensor, which transmits continuous IR rays to be received by an IR receiver module. An IR output terminal of the receiver varies depending upon its receiving of IR rays.

Since this variation cannot be analyzed as such, therefore this output can be fed to a comparator circuit. Here an operational amplifier (op-amp) of LM 339 is used as comparator circuit.

When the IR receiver does not receive a signal, the potential at the inverting input goes higher than that non-inverting input of the comparator IC (LM339). Thus the output of the comparator goes low, but the LED does not glow.

When the IR receiver module receives signal to the potential at the inverting input goes low. Thus the output of the comparator (LM 339) goes high and the LED starts glowing. Resistor R1 (100k), R2 (10k) and R3 (330k) are used to ensure that minimum 10 mA current passes through the IR LED Devices like Photodiode and normal LEDs respectively. Resistor VR2 (preset=5k) is used to adjust the output terminals. Resistor VR1 (preset=10k) is used to set the sensitivity of the circuit Diagram.

After that Reflective Surface If the object is reflective, (White or some other light color), then most of the radiation will get reflected by it, and will get incident on the photodiode. For further understanding, please refer to the left part of the illustration below. Non-reflective Surface If the object is non-reflective, (Black or some other dark color), then most of the radiation will get absorbed by it, and will not become incident on the photodiode. It is similar to there being no surface (object) at all, for the sensor, as in both the cases, it does not receive any radiation. [6]

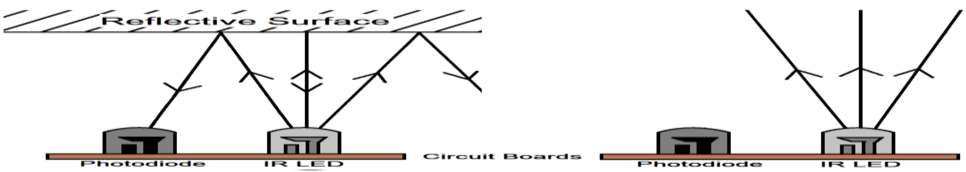


Figure 2.2 IR sensor methods in surface [6]

LM358M is a general purpose Dual Operational Amplifier (Op-Amp).

Knowing the working of an Op-amp here is really of no use to us, as we are not using it as an amplifier as such, so we will only be talking about how we use it here in the IR sensor circuit, what it does, but not much about how it does it.

So basically, we use it to compare two voltages, one is fixed and the other varies with an environmental parameter. If the parameter controlled voltage is higher than the fixed the voltage, then the IC should give one output, and if it is lower than the fixed voltage, then it should give another output. So, we see that the IC gives only two types of outputs, which we design to be 5 Volts and 0 Volts.

This makes our sensor digital. [6]

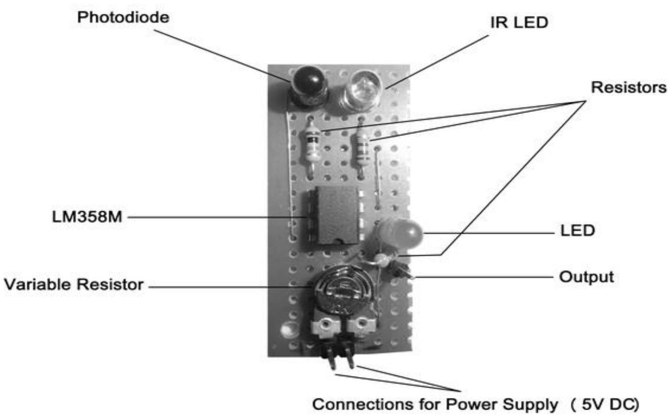


Figure 2.3 IR sensors [6]

2.6 DC motor

A Dc motors is any of a class of rotary electrical machines that converts direct current electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. Nearly all types of Dc motors have some internal, either electromechanical or electronic, to periodically change the direction of current flow in part of the motor.

Dc motors were the first type widely used, since they could be powered from existing direct-current lighting power distribution systems. A DC motors speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of current in its field winding. Small Dc motors are used in tools, toys, and appliances.

The universal motor can operate on direct but is a lightweight brushed motor used for portable power tools and appliances , Larger Dc motors are used in propulsion of electric vehicles , elevator and or in driver for steel rolling mills .

A simple DC motor has a stationary set of magnets in the stator and an armature with one or more winding of insulated wire wrapped around a soft iron core that concentrates the magnetic field. The winding usually have multiple turns around the core, and in large motors there can be several parallel current paths.

The ends of the wire winding are connected to a commutator. The commutator allows each armature coil to be to a commutator.

The commutator allows each armature coil to be energized in turn and connect the rotating coils with the external power supply through brushes .(Brushless DC motors have electronic that switch the DC current to each coil on and off and have no brushes .

Figure 2.4 DC motor [7]

2.7 Main Type of DC Motors

Different types of DC motors can be found:

2.7.1 Permanent Magnet DC Motors

The permanent magnet motors uses a permanent magnet to create field flux. This type of DC motors provides greats starting torque and has good speed regulation, but torque is limited so they are typically found on low horsepower applications. [7]

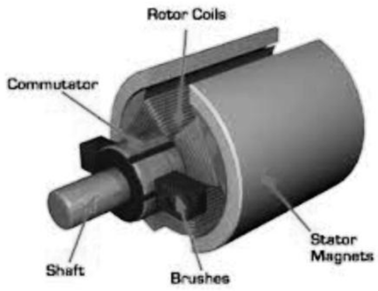


Figure 2.5 Permanent Magnet DC Motors [7]

2.7.2 Serial DC motors

Series DC motors, as well as series universal motors, are a kind electric motors with one voltage supply and the field winding connected in series with the rotor winding. This series connection results in a motor with very high starting torque. However, torque decreases as the speed builds up due to an increment of the back or counter electromotive force EMF.

This is why series DC motors have poor speed regulation. That is, increasing the motors load tends to slow its speed which in turns reduces the back EMF and increases the torque to accommodate the load. A limitation of these motors is that the sense of rotation is fixed for most of their applications. In order to change the direction of torque and rotation, it is necessary to change the polarity of the current flow.

Despite the fact series DC motors generate high torques with very low current consumption and small dimensions they are commonly used open loop for short periods of time. This is mainly, as mention above, because they have poor speed. Regulation, Nonetheless, this kind of motors can be fully exploited if good closed loop controllers are designed.

However, in general many control strategies to this kind of motors are based or depend on dynamic cancellations requiring good models. [7]

In a serial DC motors, the field is wound with a few turns of a large wire carrying the full armature current. Typically, series DC motors create a large amount of starting. [7]

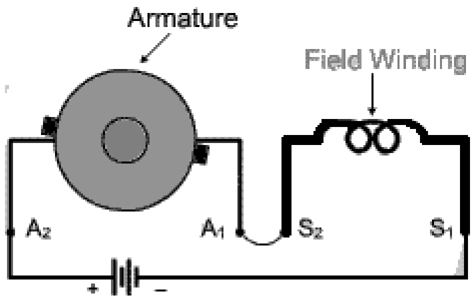


Figure 2.6 Serial DC motors [7]

2.7.3 Shunt DC motors

In shunt DC motors the field is connected in parallel (shunt) with the armature winding. These motors offer great speed regulation due to the fact that the shunt field can be excited separately from the armature winding, which also offers simplified reversing controls. [7]

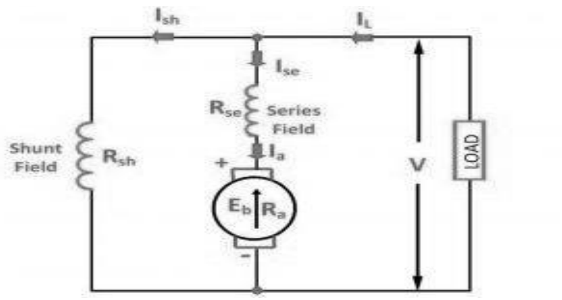


Figure 2.7 shunt DC motor [7]

2.7.4 Compound DC motors

Compound DC motors, like shunt Dc motors, have a separately excited shunt field. Compound DC motors have good starting torque but may experience control problems in variable speed driver application s.

Between the 4 types of DC motors, the potential applications are numerous. Each type of DC motors has its strengths and weaknesses.

Understanding these can help you understand which types may be good for your application. [7]

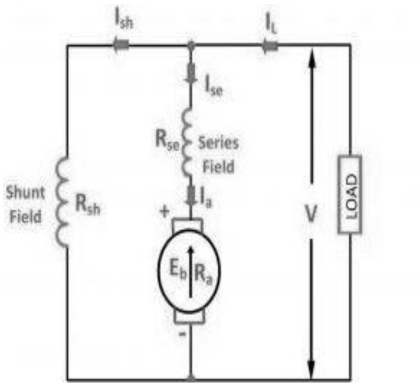


Figure2.8 Compound DC motors [7]

2.8 DC motor driver

The motor driver is based on the popular L298 chip. It has a peak current of 2A per motor and can be controlled via TTL from any microcontroller with 3.3-5 v inputs. The 0n-board 78M055V regulator can be used to supply logic power of ~450 mA to the board or external microcontroller with supply of 7-35V.

Motor connections , power and ground are made easily using the screw terminals while logic connections are provided on a 0.1 " header for easy connection using jumper leads.

LED's are provided to show motor direction and power supply. [7]

Motor Drivers get extremely hot sometimes, and proper dissipation is necessary. Notice the large 'heat sink' in the module above.

Another important factor many overlook is the current rating of the driver. Current rating may not be the technically correct term, but I mean to say the maximum current it allows to pass through it. It should be high if we need more current to drive our motors. [7]

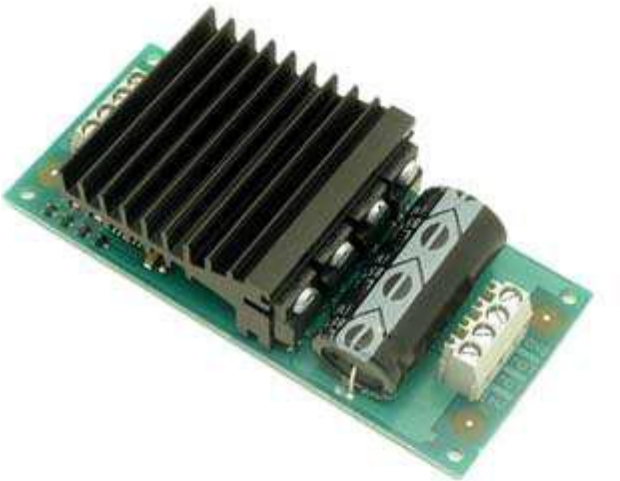


Figure 2.9 Driver motor [7]

2.8.1 Specifications of deriver L298

- Input Voltage rang Vs: +5 V - +35 V. If the on board regulator is used to supply external components then the supply range is +7 V ~ +35 V.
- Peak current: 2A per motor. In practice this will depend on ambient conditions and air flow. Maximum power consumption in total is 200 W.
- Logic voltage Vss:+5V ~+7V (power Taking form board : +5V)
- Power consumption for logical part : 0~36mA
- Control signal input voltage rang :
  - Low :-0.3V ≤Vin ≤1.5V
  - High 2.3V ≤ Vin ≤Vss
- Enable signal input voltage range :
  - Low :-0.3V ≤Vin ≤1.5V(control signal invalid)
  - High: 2.3V ≤ Vin ≤Vss(control signal)
- Maximum power consumption :20W(temperature T=75°C)
- Storage temperature : 25°C to +130°C
- Dinmenesions:55m*39 *33mm
- Weight: 35g. [8]

2.9 Actuators (Motors and wheels)

The movement system is an important part of a robot and its objective is how to move robot from one point to another point.

This system has some details which show us how to use motors and wheels. There are many kinds of motors and wheels. Our choice is dependent on the robot function, power, speed, and precision. [6]

2.10 Stepper motor

The stepper motors is presented. A stepper motor (or step motor) is a brushless DC Electric motor that divides a full rotation into a number of equal steps. The motor's position can then be commanded to move and hold at one of these steps without any feedback sensor (an open loop controller), as long as the motor is carefully sized to the application.

DC brushed motors rotate continuously when DC voltage is applied to their terminals. The stepper motor is known by its important property to convert a train of input pulses (typically square wave pulses) into a precisely defined increment in the shaft position. Each pulse moves the shaft through a fixed angle. Stepper Motors effectively have multiple "toothed" electromagnets arranged around a central gear-shaped piece of iron. The electromagnets are energized by an external control circuit, such as a microcontroller. To make the motor shaft turn, first, one electromagnet is given power, which magnetically attracts the gear's teeth. [9]

A stepper motor can be a good choice whenever controlled movement is required. They can be used to advantage in applications where you need to control rotation angle, speed, position and synchronism.

Because of the inherent advantages listed previously, stepper motors have found their place in many different applications. Some of these include printers, plotters, high end office equipment, hard disk drives, medical equipment, fax machines, automotive and many more. [9]

It’s have the advantage of precise angular movement. You can tell a motor to rotate by, say, 45 degrees. Then knowing the diameter of the wheel, you can easily calculate the distance your bot has moved! All you need to do is to remember the signals you gave to the motor, and your track will be mapped. [7]

Figure 2.10 stepper motor [9]

2.11 Motor Shield

Motor shield kit is one of our most beloved kits, which is why we decided to make something even better. We have upgraded the shield kit to make the best easiest way to drive DC and Stepper motors.

Place the assembled shield on top of the header-ed Arduino so that all of the short parts of the header are sticking through the outer set of pads.

This shield will make quick work of your next robotics project can kept the ability to drive up to 4 DC motors or 2 stepper motors, but added many improvements:

Instead of a L293D Darlington driver, we now have the TB6612 MOSFET drivers with 1.2A per channel current capability (you can draw up to 3A peak for 16 p prox. 20ms at a time). It also has much lower voltage drops across the motor so you get more torque out of your batteries, and there are built-in fly back diodes as well. [10]

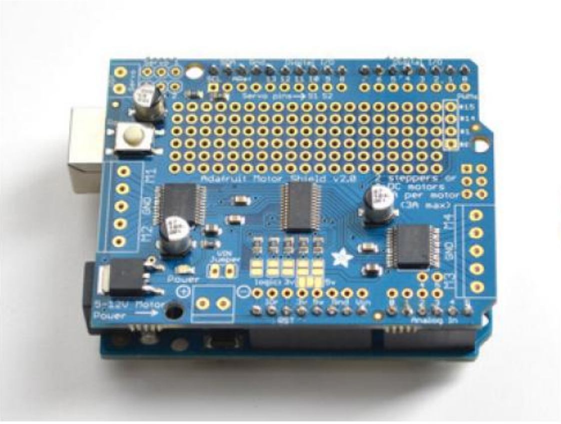


Figure 2.11 shield top of Arduino [10]

2.12 wheels

We can use three wheels. Two of them are joined to the motors and installed rear the robot and the other wheel is free and installed front of the robot as a passive caster.

Wheel selection is very important. You can get them in any hobby robotics or toy store. Many online retailers sell them as well. The height of the center of the wheel should align with the motor shaft. It should have some degree of friction, which depends on how the surface of the arena is made. Some come with a readymade bushing so can be conveniently screwed in place. Look out for these! How you place your wheels and how many depend on your mechanical design.

If you have a wheel that's a little too small, you can always paste surgical tape (the cloth ones) or rubber bands around it to increase diameter and improve friction. This is also useful as a last minute addition, so keep some with you when you take your bot to battle. [10]

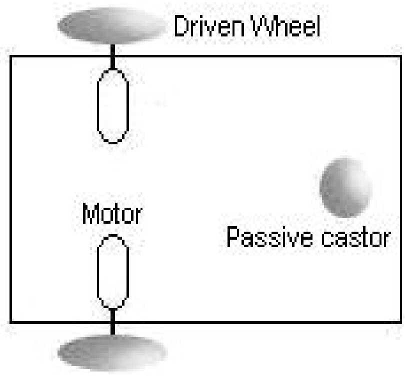


Figure 2.12 wheels and DC motor [10]

2.13 Power supply

The power supply is two types Internal or on-board Supply or External Supply There is no fixed stipulation (unless specified for a competition) of which one you should use, just a matter of preference and resources available.

The voltage should be equal to the rating of the motor (which is assumed to be the highest in your circuit) and should be stepped down to power the other circuit components.

Internal or on-board supply requires batteries, which have to be rechargeable because you'll run through alkaline batteries faster than you know it. If you get rechargeable ones, you'll need a charger too. The current capacity, the weight and the rating of the battery also has to be accounted for. If you're using alkaline batteries you can make a pack out of them by connecting them in series and parallel. New technologies like Lithium Polymer and old ones like Nickel Metal Hydride are easily available, though may seem a little expensive.

Remember PWM will make the motors draw currents in bursts of a few milliseconds apart. Some battery technologies cannot handle drawing so much current in such little time. [8]

A voltage regulator IC connected to a 9v battery would look something like this.

An External supply will consist of an AC to DC adapter. These come in various current and voltage ratings, and some even contain a variable regulator. You'll need to make a long cable to connect this to your robot, which can be cumbersome at times.

A word of caution, do be very careful with voltages in your circuit. You could damage many components. [8]

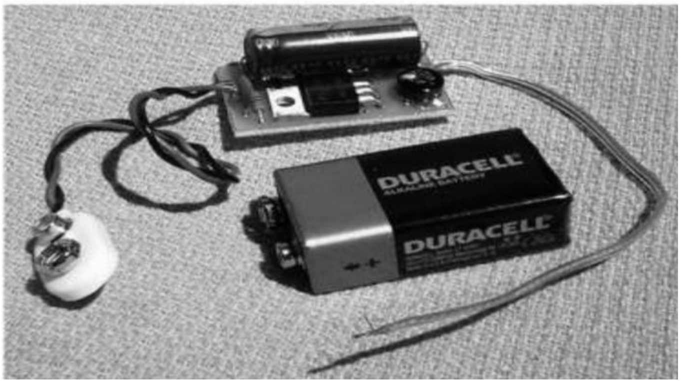


Figure 2.13 power supply [8]

2.14 The Chassis and Body

There are some good materials for designing robots such as wood, plastic, aluminum and brass alloys.

We must pay attention to the resistance, weight and mechanical ability for choosing one of them. There are some agents that we can use them to choose a good body, ability to perforate, incision, flexibility.

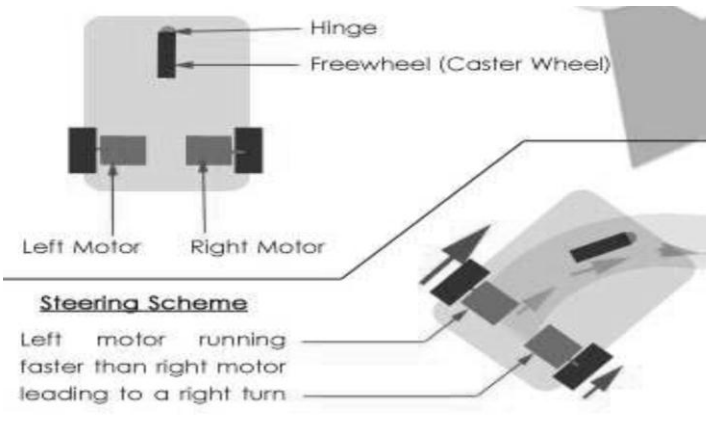


Figure 2.14 chassis and body [10]

2.15 Arduino

Arduino started in 2005 as a project for students at the Interaction Design Institute Ivrea in Ivrea, Italy. By that time, program students used a "BASIC Stamp"

The name "Arduino" comes from a bar in Ivrea, where few of the founders of the project used to meet. The bar itself was called after Arduino, Margrave of Ivrea from 1002 to 1014 ,it is an open – source single board microcontroller, intended to formulate a process of exploiting electronics in multidisciplinary projects more accessible .

An Arduino board consists of an Atmel 8-bit AVR microcontroller with complementary components that facilitate programming and incorporation into other circuits. And an important aspect of the Arduino is its standard connectors, which means users connect the CPU board to a variety of interchangeable add-on modules called as shields. Some shields communicate with the Arduino board directly over various pins, but most of the shields are individually addressable via an I^2C serial bus—so many shields can be stacked and used in parallel alignment. Official Arduinos have used the megaAVR series of chips, which is Atmega8, Atmega168, Atmega328, Atmega1280, and Atmega 2560. A hand ful of other processors have been used by Arduino compatibles. Most boards have include a 5 volt linear regulator and a 16 MHz crystal oscillator (or ceramic resonator in some variants), although some designs like the LilyPad run at 8 MHz and dispense with the onboard voltage regulator due to specific form-factor restrictions. An Arduino microcontroller is also programmed with a boot loader that simplifies uploading of programs to the on-chip flash memory and compared with other devices that typically need an external programmer, which makes using an Arduino more straightforward by allowing the use of an ordinary computer as the programmer. [7]

There are many type for Arduino:

2.16 Arduino Boards

There are many, and manufacturers are constantly releasing new ones with various features. The following section highlights some of the features in the official Arduino boards.

The Uno is the flagship Arduino and will be used heavily. It uses a 16U2 USB-to-serial converter chip and an ATMega 328pas the main MCU. It is available in both DIP and SMD versions (which defines whether the MCU is removable). [2]

2.16.1 Arduino Uno

The Arduino Uno is a microcontroller board based on the Atmega328 (datasheet). It contains 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, USB connection, power jack, 16 MHz ceramic resonator, an ICSP header, and a reset button. It contains everything which is needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.

The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter. Revision 2 of the Arduino Uno board has a resistor pulling 8U2 HWB line to ground, making it easier to put into DFU mode.

Revision 3 of the Arduino Uno board has the following new features1.0 pinout: added SDA and SCL pins that are nearer to the AREF pin and two other new pins placed near to the RESET pin, IOREF that allows the shields to adapt to the voltage provided from the board. In future, shields would be compatible with both the board that uses AVR, which operates with 5V and Arduino Due which operates by 3.3V. The second one is not a connected pin that is reserved for future purposes. [7]

Figure 2.15 Arduino uno [2]

2.16.2 Arduino Leonardo

Uses the 32U4 as the main microcontroller, which has a USB interface built-in. Therefore, it doesn’t need a secondary MCU to perform the serial-to-USB conversion. This cuts down on the cost and enables to do unique things like emulate a joystick or a keyboard instead of a simple serial device. [2]

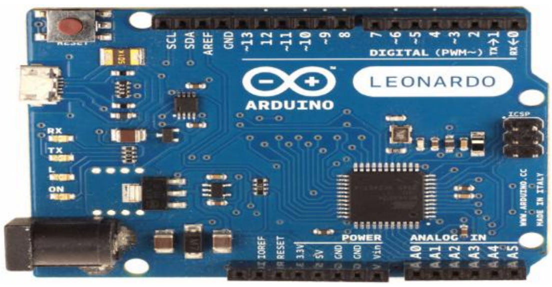


Figure 2.16 Arduino Leonardo [2]

2.16.3 Arduino Due

The Due offers higher-precision ADCs, selectable resolution pulse-width modulation (PWM), Digital-to-Analog Converters (DACs), a USB host connector, and an 84 MHz uses a 32-bit. [2]

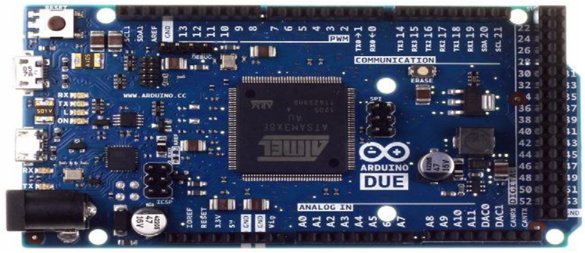


Figure 2.17 Arduino Due [2]

2.16.4 Arduino Mega 2560

It’s as the main MCU, which has 54 general I/Os to enable you to interface with many more devices. The Mega also has more ADC channels, and has four hardware serial interfaces. [2]

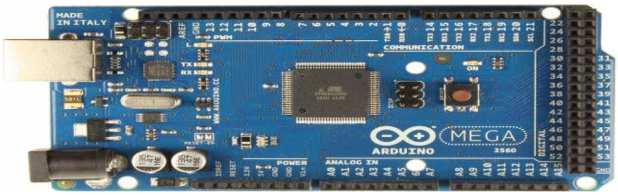


Figure 2.18 Arduino Mega 2560 [2]

2.16.5 Arduino Nano

Is designed to be mounted right into a breadboard socket. Its small form factor makes it perfect for use in more finished projects.. [2]

Figure 2.19 Arduino Nan [2]

2.16.6 Arduino Mega ADK

Is very similar to the Mega 2560, except that it has USB host functionality, allowing it to connect to an Android phone so that it can communicate with apps that you write. [2]

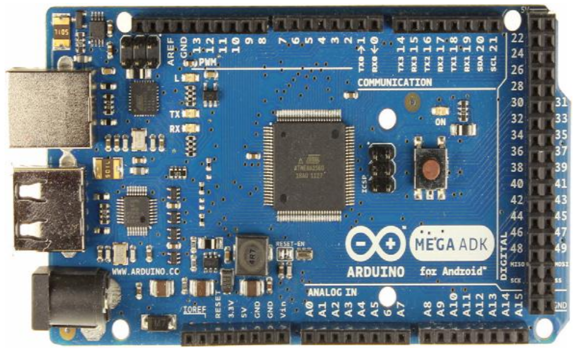


Figure 2.20 Arduino Mega ADK [2]

2.16.7 LilyPad Arduino

Is unique because it is designed to be sewn into clothing. Using conductive thread, you can wire it up to sewable sensors, LEDs, and more. To keep size down, you need to program it using an FTDI cable. [2]

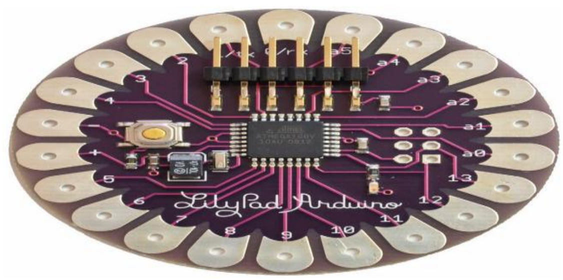


Figure 2.21 LilyPad Arduino [2]

2.17 oil and gas refineries

Oil and gas refineries present challenging environments in which to work and operate, especially in places like the Middle East where temperatures can reach 50 ○C and sand storms which can reduce visibility to a few meters. In addition, there can be gas or steam leaks which present health and safety hazards to the workers. At present, continuous operation of these plants requires that human workers venture out into these conditions in order to observe and report on the conditions within the plant. The goal of this work is to design, fabricate, assemble, and test an inspection robot in an effort to reduce the exposure and risks to human operators while increasing the flexibility and range of remote observations provided by a mobile robot.

Oil or “black gold” is still the largest source of power used by the industry sector

Basically robots are designed in such way that they remove human intervention from lab our intensive and hazardous work environment sometimes they are also used to take a samples form the pipe because exposure to chemical leads to danger and disease. [11]

2.18 Use of robots – safety issues

Robots are designed in such way that they remove human intervention from labour intensive and hazardous work environment, sometimes they are also used to explore inaccessible work places which are generally impossible to access by humans. The inspection of pipe comes in same category because they carry toxic chemicals, fluids and most of the time has small internal diameter or bends which become inaccessible to human. The complex internal geometry and hazard content constraints of pipes demand robots for inspection of such pipes in order to check corrosion level of pipe, recovery of usable parts from pipe interior, sampling of sludge and scale formation on pipe internal surface. [12]

Chapter Three

Research Methodology

3.1 Overview

This chapter describes, discusses and justifies the research approached, methods and techniques used in this research work. General methodology frameworks followed by specific sub framework of all phases and way forward to achieve research objective are presented and explained.

3.2 System Overview

A black diagram of case study is shown in figure 3.2 describes the system components and how they are connected together " which includes the input devices and output devices so the controller processes the input value and gives the output.

The block diagram contains interface tools for user in input and output

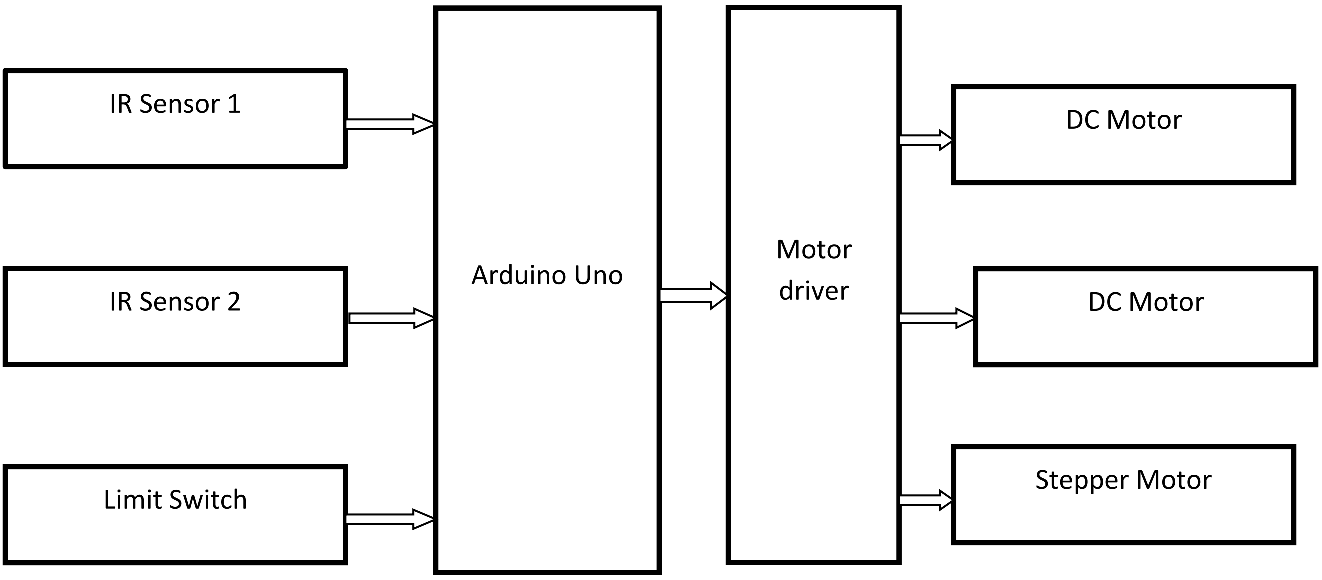


Figure 3.1 Block diagram of the case study

The robot move s directly through the Arduino, which operates the motor driver connected with him, its pushes the wheels through two DC motors.

And when the robot enter the field of sampling its stops by IR sensor1 receiver and then the farmers begins to rise by stepper motor until they enter the field of the IR sensor2 connected receiver in the plant then the farmers come back again and the robot moves again.

3.3 Circuit diagram of the overall system

The circuit diagram illustrates all components used and how connected.

In this circuit U1 is connected to the controller, which represents the movement of the robot by two DC motors, and then starts the IR sensor, which is connected by the controller A0, which affects the movement of the robot to stop as well as moving the robot farmers by stepper motor linked by the controller U2 and then stop taking In-kind by IR sensor, which works to return the robot growers and move the robot again.

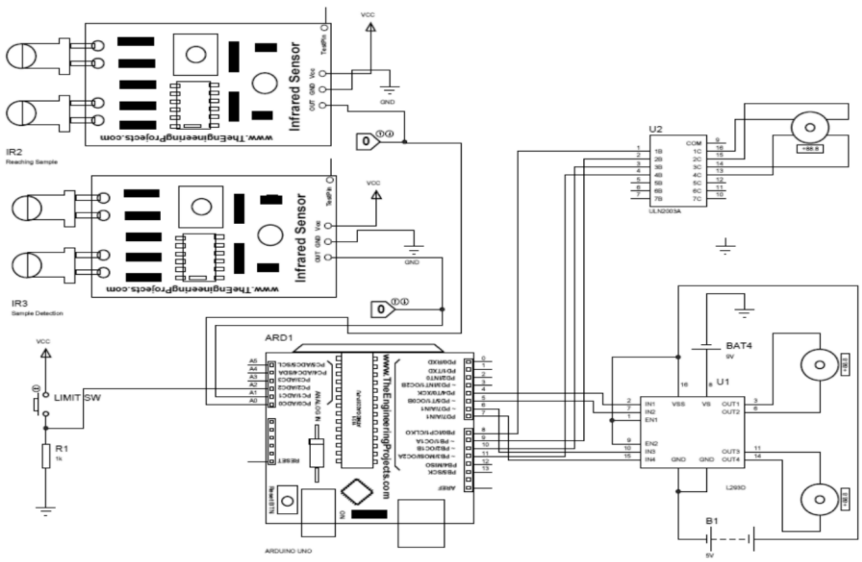


Figure 3.2 simulation of the overall system

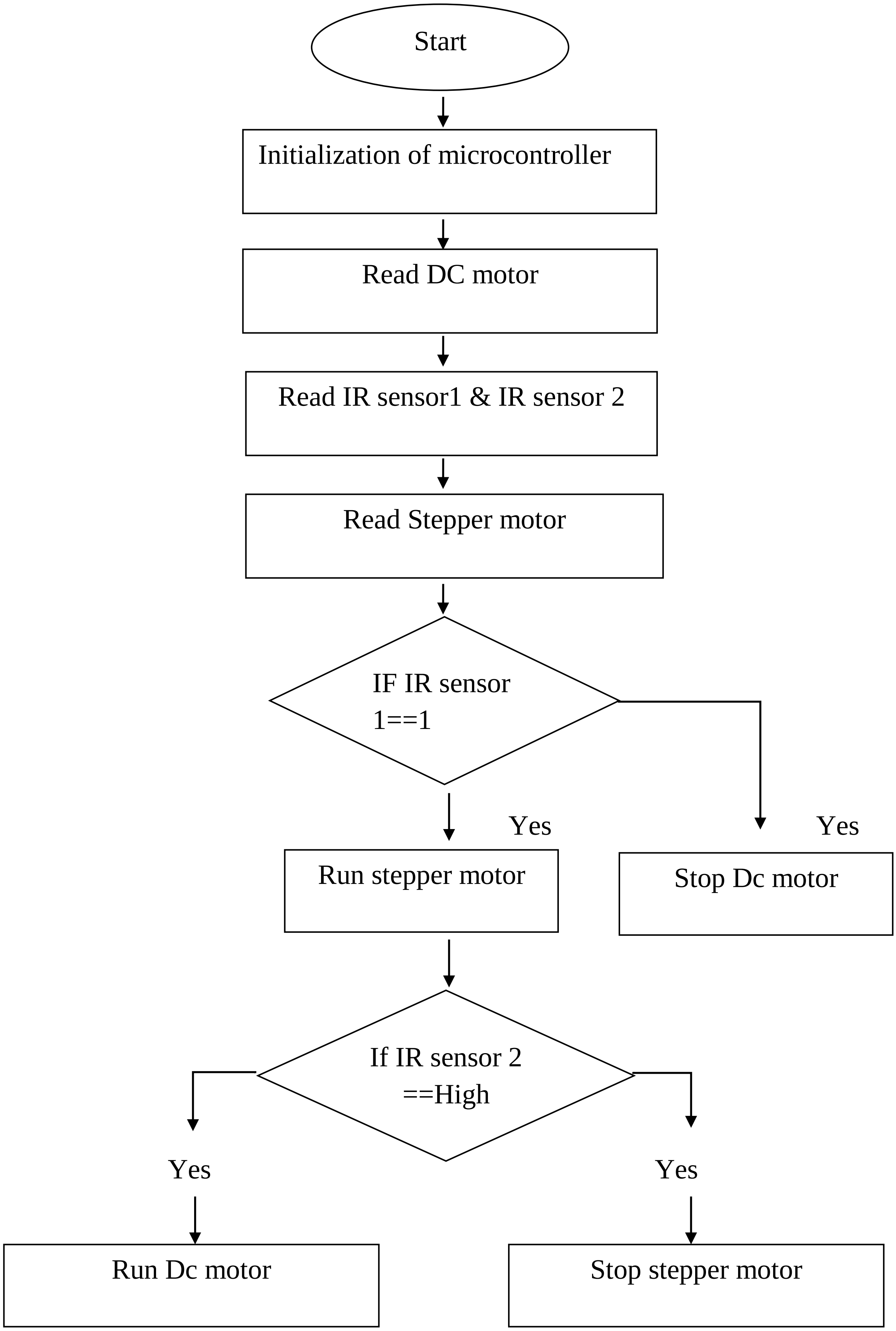


Figure 3.3 Flow chart

3.4 Circuit components

The components include IR sensors and drivers motor control unit and other component.

3.4.1 Microcontroller (Arduino)

is open source electronic prototyping platform based on flexible easy to use hardware and software ,.And it provides easy way to interact with a computer physically the Arduino Uno is suitable for the research because it is high performance , low power consumption .

3.4.2 IR sensor

IR based wireless communication technology is implemented along with Arduino- uno single board microcontroller. Here, The IR sensor is in-built in remote which send the coded infrared signal (as chosen by the user) to the IR module at the receiving section.

The IR Receiver module is connected to the controlling unit   Arduino uno.

The IR Receiver module passes the RC5coded data to the Arduino board. The Arduino uno board then compares the received RC5code with the codes stored in it and then decode it. On the basis of decoded data/signal it produces the relevant outputs.

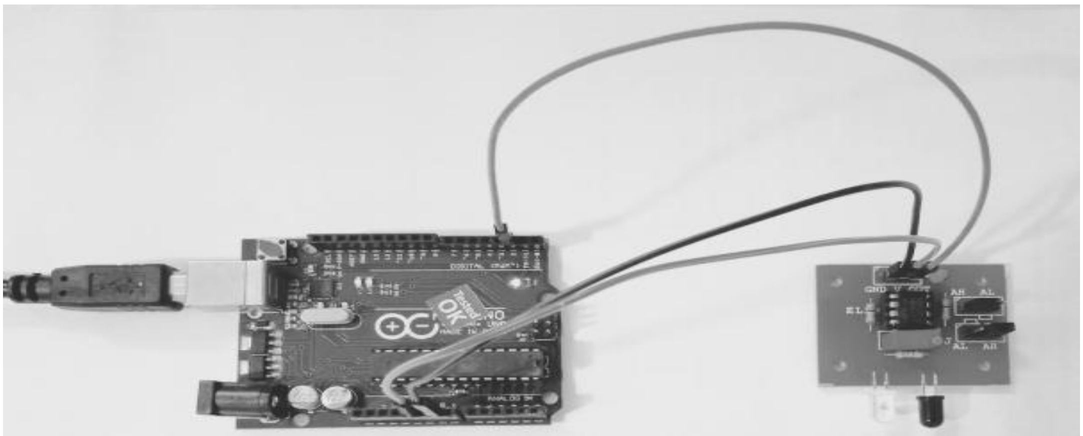


Figure 3.4 IR sensor connect with Arduino [10]

3.4.3 DC motor in the Arduino

PWM, or pulse width modulation is controller for speed of DC motor, is technique of rapidly pulsing the power on and off. The percentage of time spent cycling the on /off ration.

To control a DC motor is relatively simple since the motion is totally determined by the voltage provided voltage need supply to motor, thus driver use to amplify the signal.

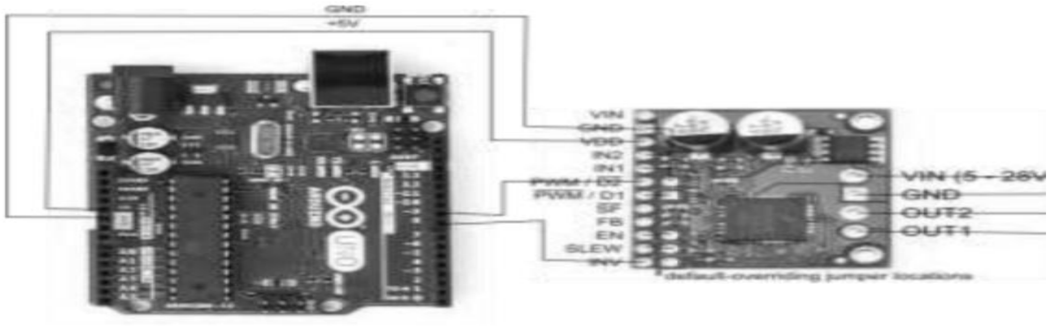


Figure 3.5 Controller DC motor with Arduino [8]

3.4.4 Controlling Stepper motor with Arduino

The driver (or amplifier) converts the indexer command signals the power necessary to energize the motor winding. Usually the driver require two/three signals pulse, direction and enable control (this signal can be left unconnected if not used).

Pulse signal is a sequence of pulse whose frequency determines the moving speed of the motor. Direction signal is a level signal usually at the either +5V or 0V. When the controller the stepper motor need only provide a pulse and direction signal this consider simple generated by the output pins of Arduino.

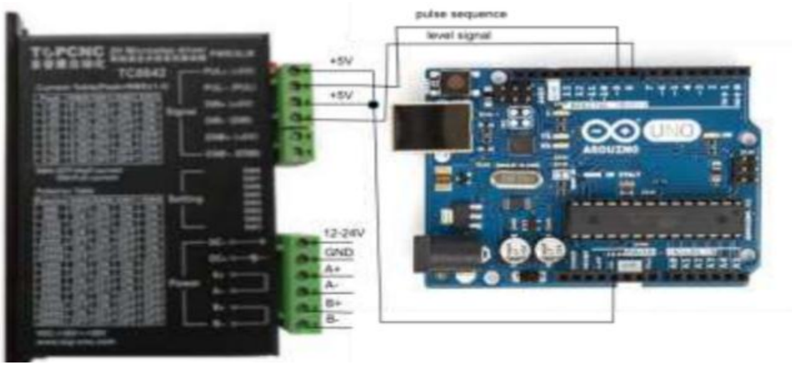


Figure 3.6Controlling Stepper motor with Arduino [10]

Chapter Four

System Implementation and testing

4.1 System simulation

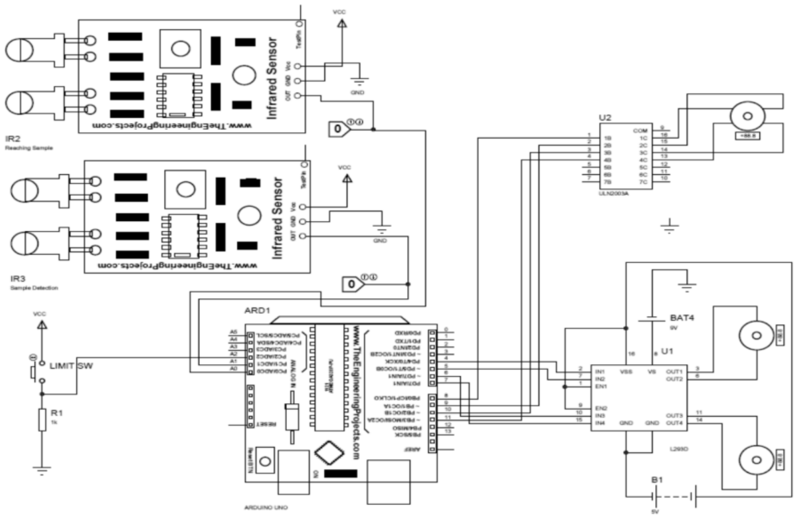


Figure 4.1 System simulation

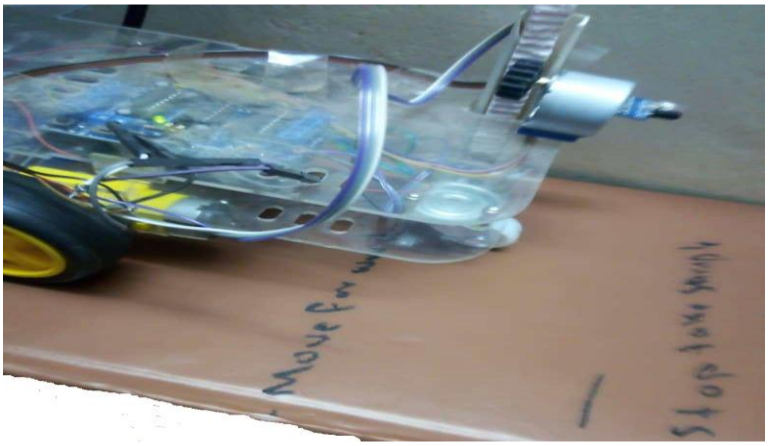
4.2 System Implementation

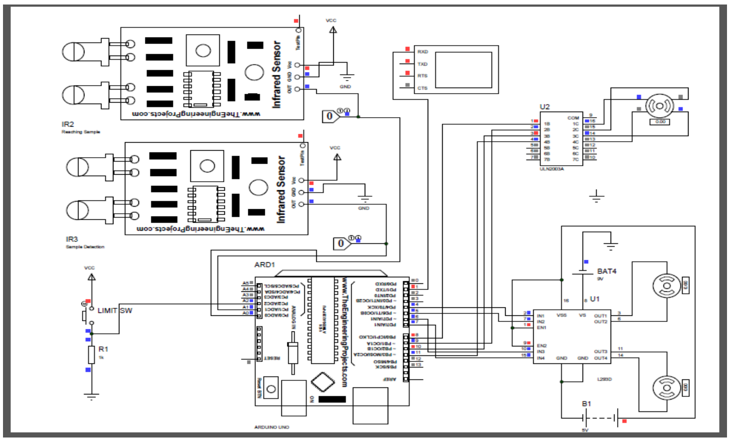
Demonstrates the components of the robot which are Arduino uno , two IR sensor one used in control of robot and other used in arm of robots ,Dc motor to moves of robot and stepper motor .

Figure 4.2 Complete robot designs

Case 1: robot move forward

In this case, when the current reaches, the robot moves directly through the Ardino.





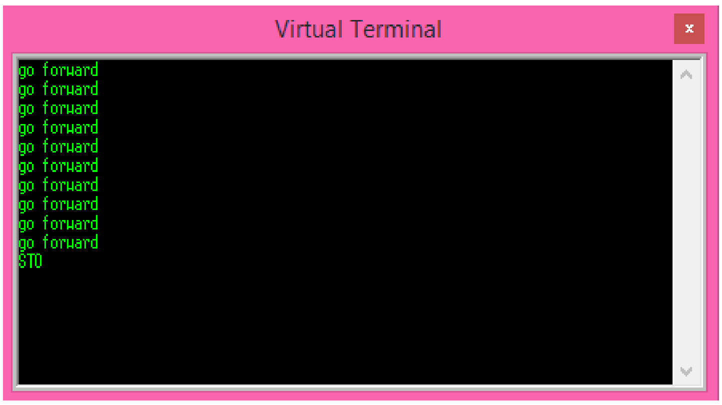


Figure 4.3 robot moves forward

Case 2: Robot stopped to take sample

In this case the robot stops in the sample place as a result of the effect of the first IR sensor.

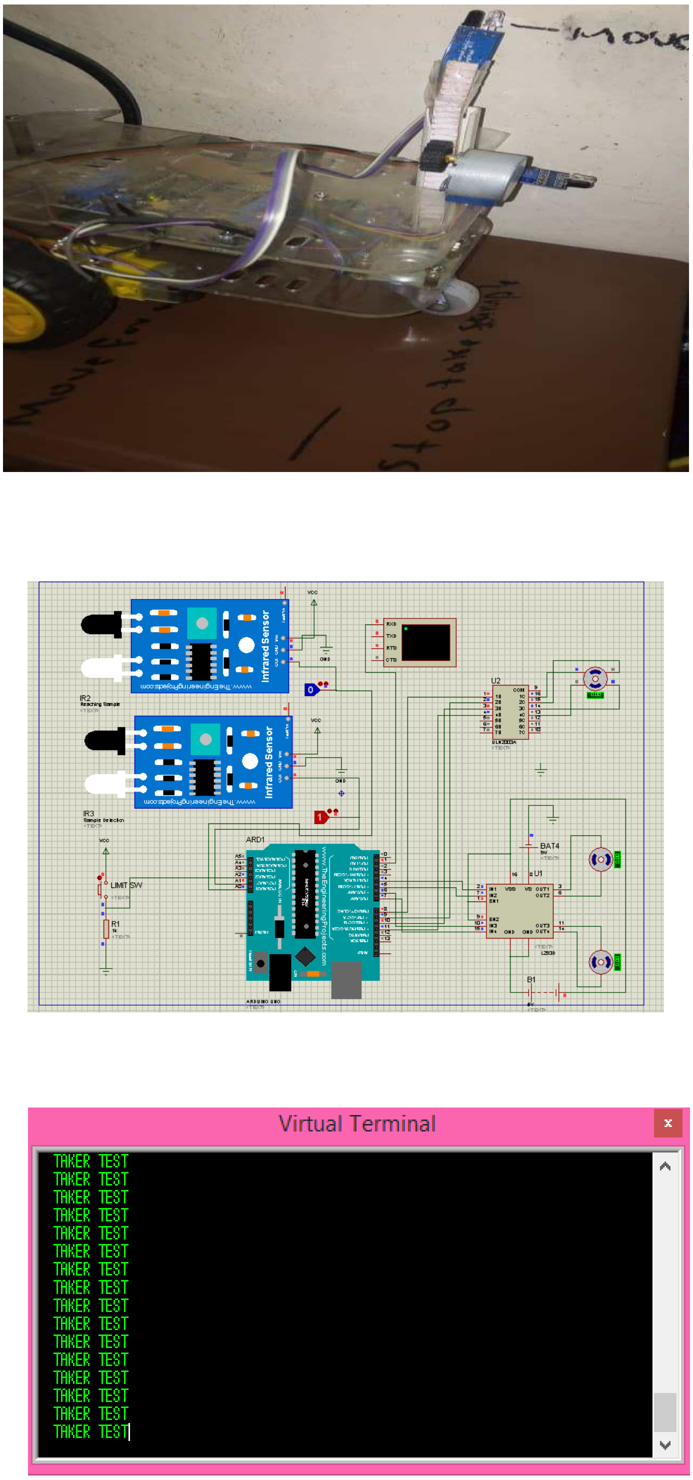
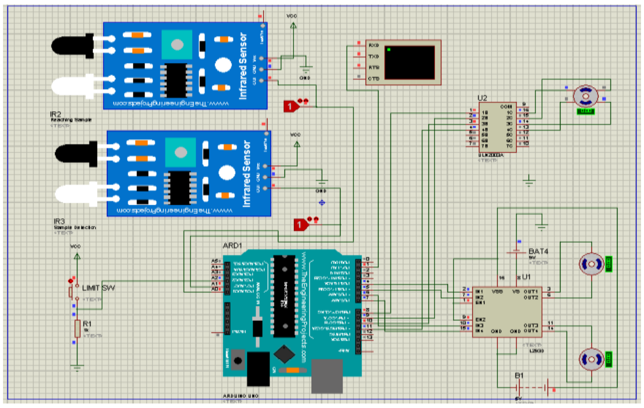


Figure 4.4 robot stopped to take sample

Case 3: robot arm move up

In this case, the robot's scarecrow rises directly to take the sample.



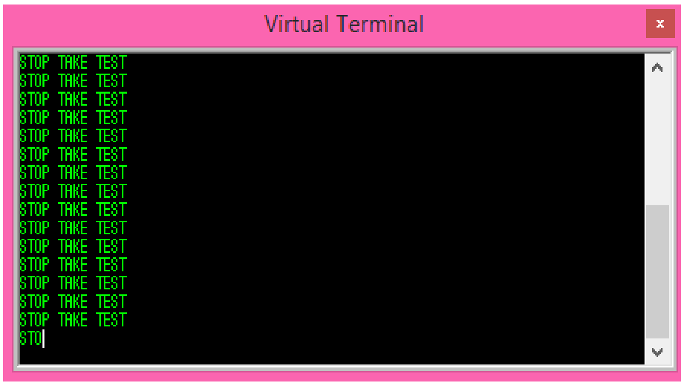


Figure 4.5 robot arm move up

Case 4: robot arm move down

In this case, the arm decreases after taking the sample as a result of the effect of the IR sensor 2.

Figure 4.6 robot arm move down

Chapter Five

Conclusion & Recommendations

This chapter describes the conclusion of the research and the recommendation

5.1 Conclusions

Robot moves directly by DC motor when to enter the sample site and stops automatically by IR sensor one after that starts the robot growers through the stepper motor.

The study concluded that the robot design was able to solve the problems that workers are exposed to from correct problems that lead to cancers, by taking samples using micro-control, which helps to reduce environmental pollution

5.2 Recommendations

- The robot can be connected to GPS to operate in a wider range.
- Farmers and body can also be developed to take more than one sample per cycle.
- Robot can evolve to analyze the sample immediately and send the results to the laboratory to know that it conforms to the specifications or not by adding an analysis device in the farmers and a link to the unit.
- The ESP can be added to the Arduino to connect with the main administrator mobile.
- Used more developed the robot to work for all oil refinery.

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Appendix

Appendix: (A)

```
#include <Stepper.h>
const int stepsPerRevolution = 200;
Stepper myStepper(stepsPerRevolution, 8, 9, 10, 11);
int motOnein1=4;
int motOnein2=5;
int motTwoin1=6;
int motTwoin2=7;
int left=3;
int right=12;
int center=13;
int buttonPin=2;
int leftValue=0;
int rightValue=0;
int centerValue=0;
int State = HIGH;
int buttonState;
int lastButtonState = LOW;
int stateFlag;
int reading;
unsigned long lastDebounceTime = 0;
unsigned long debounceDelay = 50;
void setup()
```

```
{
  myStepper.setSpeed(0);
  Serial.begin(9600);
  pinMode(motOnein1, OUTPUT);
  pinMode(motOnein2, OUTPUT);
  pinMode(motTwoin1, OUTPUT);
  pinMode(motTwoin2, OUTPUT);
  pinMode(left, INPUT_PULLUP);
  pinMode(right, INPUT_PULLUP);
  pinMode(center, INPUT_PULLUP);
  pinMode(buttonPin, INPUT_PULLUP);
  stateFlag = State;
}
void loop()
{
  sensorEvent();
 while(stateFlag == 0)
   {
   while(centerValue == 1 && rightValue == 1 && leftValue == 1)
     {
      Serial.println("go forward");
      FORWARD();
      break;
     }
```

```
  while(centerValue == 1 && rightValue == 1 && leftValue == 0)
   {
     Serial.println(" Turn right");
     FORWARDTURNRIGHT();
     break;
  }
while(centerValue == 1 && rightValue == 0 && leftValue == 1)
  {
     Serial.println(" Turn left");
     FORWARDTURNLEFT();
     break;
  }
break;
 }
while(stateFlag == 1)
 {
   while(centerValue == 1 && rightValue == 1 && leftValue == 1)
     {
       Serial.println("STOP TAKE TEST");
       BACKWARD();
       break;
     }
  while(centerValue == 1 && rightValue == 1 && leftValue == 0)
   {
```

```
    Serial.println(" Turn right FOR TAKER TEST");
    BACKWARDTURNRIGHT();
    break;
   }
   void getSample()
{
  myStepper.step(stepsPerRevolution);
  delay(500);
  myStepper.step(-stepsPerRevolution);
  delay(500);
}
 while(centerValue == 1 && rightValue == 0 && leftValue == 1)
  {
    Serial.println(" Turn left FOR TAKER TEST");
    BACKWARDTURNLEFT();
    break;
  }
  while(centerValue == 0 && rightValue == 0 && leftValue == 0)
  {
    Serial.println("  TAKER TEST");
    BACKWARDTURNLEFT();
    break;
 }
   break;
```

```
 }
 }
}
 if ((millis() - lastDebounceTime) > debounceDelay)
     {
        if (reading != buttonState)
          {
              buttonState = reading;
              if (buttonState == HIGH)
                {
                   State = !State;
                }
          }
     }
void getSample()
{
  myStepper.step(stepsPerRevolution);
  delay(500);
  myStepper.step(-stepsPerRevolution);
  delay(500);
}
void sensorEvent()
{
  leftValue=digitalRead(left);
```

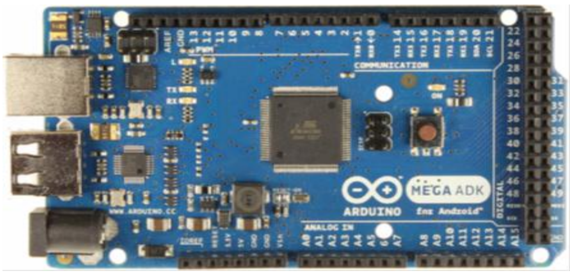
```
  rightValue=digitalRead(right);
  centerValue=digitalRead(center);
  reading = digitalRead(buttonPin);
  if (reading != lastButtonState)
    {
      lastDebounceTime = millis();
    }
    //if ((millis() - lastDebounceTime) > debounceDelay)
     // {
      //  if (reading != buttonState)
        //  {
          //     buttonState = reading;
            //   if (buttonState == HIGH)
              //   {
                //    State = !State;
                 //}
       // }
    // }

  stateFlag = State;
  lastButtonState = reading;
}
//void getSample()
//{
```

```
  //myStepper.step(stepsPerRevolution);
  //delay(500);
  //myStepper.step(-stepsPerRevolution);
  //delay(500);
//}
void FORWARD()
{
  digitalWrite(motOnein1,HIGH);
  digitalWrite(motOnein2,LOW);
  digitalWrite(motTwoin1,LOW);
  digitalWrite(motTwoin2,HIGH);
}
void FORWARDTURNLEFT()
{
 digitalWrite(motOnein1,HIGH);
  digitalWrite(motOnein2,HIGH);
  digitalWrite(motTwoin1,LOW);
  digitalWrite(motTwoin2,HIGH);
  }
  void FORWARDTURNRIGHT()
{
  digitalWrite(motOnein1,LOW);
  digitalWrite(motOnein2,HIGH);
  digitalWrite(motTwoin1,HIGH);
```

```
  digitalWrite(motTwoin2,HIGH);
  }
////////////////////////////////////////////////////////////
  void BACKWARD()
{
  digitalWrite(motOnein1,LOW);
  digitalWrite(motOnein2,HIGH);
  digitalWrite(motTwoin1,HIGH);
  digitalWrite(motTwoin2,LOW);
  }
void BACKWARDTURNLEFT()
{
 digitalWrite(motOnein1,HIGH);
  digitalWrite(motOnein2,HIGH);
  digitalWrite(motTwoin1,LOW);
  digitalWrite(motTwoin2,HIGH);
  }
void BACKWARDTURNRIGHT()
{
  digitalWrite(motOnein1,LOW);
  digitalWrite(motOnein2,HIGH);
  digitalWrite(motTwoin1,HIGH);
  digitalWrite(motTwoin2,HIGH);
  }
```

```
////////////////////////////////////////////////////
 void STOP()
{
 digitalWrite(motOnein1,HIGH);
 digitalWrite(motOnein2,HIGH);
 digitalWrite(motTwoin1,HIGH);
 digitalWrite(motTwoin2,HIGH);
 }
```

Appendix: (B)



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The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip.

Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter.

Revision 2 of the Uno board has a resistor pulling the 8U2 HWB line to ground, making it easier to put into DFU mode.

Revision 3 of the board has the following new features:

1.0 pinout: added SDA and SCL pins that are near to the AREF pin and two other new pins placed near to the RESET pin, the IOREF that allow the shields to adapt to the voltage provided from the board. In future, shields will be compatible both with the board that use the AVR, which operate with 5V and with the Arduino Due that operate with 3.3V. The second one is a not connected pin, that is reserved for future purposes.

Stronger RESET circuit.

Atmega 16U2 replace the 8U2.

"Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform; for a comparison with previous versions, see the index of Arduino boards.

Summary

Microcontroller	ATmega328
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limits)	6-20V
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 bootloader
SRAM	2 KB (ATmega328)
EEPROM	1 KB (ATmega328)
Clock Speed	16 MHz

Schematic & Reference Design

EAGLE files: arduino-uno-Rev3-reference-design.zip (NOTE: works with Eagle 6.0 and newer)

Schematic: arduino-uno-Rev3-schematic.pdf

Note: The Arduino reference design can use an Atmega8, 168, or 328, Current models use an ATmega328, but an Atmega8 is shown in the schematic for reference. The pin configuration is identical on all three processors.

Power:

The Arduino Uno can be powered via the USB connection or with an external power supply. The power source is selected automatically.

External (non-USB) power can come either from an AC-to-DC adapter (wall-wart) or battery. The adapter can be connected by plugging a 2.1mm center-positive plug into the board's power jack. Leads from a battery can be inserted in the Gnd and Vin pin headers of the POWER connector.

The board can operate on an external supply of 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may be unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts.

The power pins are as follows:

- ❖ **VIN**. The input voltage to the Arduino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.
- ❖ **5V**.This pin outputs a regulated 5V from the regulator on the board. The board can be supplied with power either from the DC power jack (7 - 12V), the USB connector (5V), or the VIN pin of the board (7-12V). Supplying voltage via the 5V or 3.3V pins bypasses the regulator, and can damage your board. We don't advise it.
- ❖ **3V3**. A 3.3 volt supply generated by the on-board regulator. Maximum current draw is 50 mA
- ❖ **GND**. Ground pins.

Memory:

The ATmega328 has 32 KB (with 0.5 KB used for the bootloader). It also has 2 KB of SRAM and 1 KB of EEPROM (which can be read and written with the EEPROM library).

Input and Output

Each of the 14 digital pins on the Uno can be used as an input or output, using pinMode(), digitalWrite(), and digitalRead() functions. They operate at 5 volts. Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20-50 kOhms. In addition, some pins have specialized functions:

Serial: 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL Serial chip.

External Interrupts: 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the attachInterrupt() function for details.

PWM: 3, 5, 6, 9, 10, and 11. Provide 8-bit PWM output with the analogWrite() function.

SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication using the SPI library.

LED: 13. There is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.

The Uno has 6 analog inputs, labeled A0 through A5, each of which provide 10 bits of resolution (i.e.1024 different values). By default they measure from ground to 5 volts, though is it possible to change the upper end of their range using the AREF pin and the analog Reference() function. Additionally, some

Pins have specialized functionality:

TWI: A4 or SDA pin and A5 or SCL pin. Support TWI communication using the Wire library.

There are a couple of other pins on the board:

AREF. Reference voltage for the analog inputs. Used with analogReference().

Reset. Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board.

See also the mapping between Arduino pins and ATmega328 ports. The mapping for the Atmega8, 168, and 328 is identical.

Communication

The Arduino Uno has a number of facilities for communicating with a computer, another Arduino, or other microcontrollers. The ATmega328 provides UART TTL (5V) serial communication, which is available on digital pins 0 (RX) and 1 (TX). An ATmega16U2 on the board channels this serial communication over USB and appears as a virtual com port to software on the computer. The 16U2 firmware uses the standard USB COM drivers, and no external driver is needed. However, on Windows, a .inf file is required. The Arduino software includes a serial monitor which allows simple textual data to be sent to and from the Arduino board. The RX and TX LEDs on the board will flash when data is being transmitted via the USB-to-serial chip and USB connection to the computer (but not for serial communication on pins 0 and 1).

A SoftwareSerial library allows for serial communication on any of the Uno s digital pins.

The ATmega328 also supports I2C (TWI) and SPI communication. The Arduino software includes a Wire library to simplify use of the I2C bus; see the documentation for details. For SPI communication, use the SPI library.

Programming

The Arduino Uno can be programmed with the Arduino software (download). Select "Arduino Uno from the Tools > Board menu (according to the microcontroller on your board). For details, see the reference and tutorials.

The ATmega328 on the Arduino Uno comes preburned with a bootloader that allows you to upload new code to it without the use of an external hardware programmer. It communicates using the original STK500 protocol (reference, C header files).

You can also bypass the bootloader and program the microcontroller through the ICSP (In-Circuit Serial Programming) header; see these instructions for details.

The ATmega16U2 (or 8U2 in the rev1 and rev2 boards) firmware source code is available. The ATmega16U2/8U2 is loaded with a DFU bootloader, which can be activated by:

On Rev1 boards: connecting the solder jumper on the back of the board (near the map of Italy) and then resetting the 8U2.

On Rev2 or later boards: there is a resistor that pulling the 8U2/16U2 HWB line to ground, making it easier to put into DFU mode.

You can then use Atmel s FLIP software (Windows) or the DFU programmer (Mac OS X and Linux) to load a new firmware. Or you can use the ISP header with an external programmer (overwriting the DFU bootloader). See this user-contributed tutorial for more information.

Automatic (Software) Reset

Rather than requiring a physical press of the reset button before an upload, the Arduino Uno is designed in a way that allows it to be reset by software running on a connected computer. One of the hardware flow control lines (DTR) of the ATmega8U2/16U2 is connected to the reset line of the ATmega328 via a 100 nanofarad capacitor. When this line is asserted (taken low), the reset line drops long enough to reset the chip. The Arduino software uses this capability to allow you to upload code by simply pressing the upload button in the Arduino environment. This means that the bootloader can have a shorter timeout, as the lowering of DTR can be well-coordinated with the start of the upload.

This setup has other implications. When the Uno 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). For the following half-second or so, the bootloader is running on the Uno. 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 tothe 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 Uno contains a trace that can be cut to disable the auto-reset. The pads on either side of the trace can be soldered together to re-enable it. It's labeled "RESET-EN". You may also be able to disable the auto-reset by connecting a 110 ohm resistor from 5V to the reset line; see this forum thread for details.

USB Overcurrent Protection

The Arduino Uno has a resettable polyfuse that protects your computer s USB ports from shorts and overcurrent. Although most computers provide their own internal protection, the fuse provides an extra layer of protection. If more than 500 mA is applied to the USB port, the fuse will automatically break the connection until the short or overload is removed.

Physical Characteristics

The maximum length and width of the Uno PCB are 2.7 and 2.1 inches respectively, with the USB connector and power jack extending beyond the former dimension. Four screw holes allow the board to be attached to a surface or case. Note that the distance between digital pins 7 and 8 is 160 mil ،("0.16) .not an even multiple of the 100 mil spacing of the other pins.

Appendix : (C)

Pin Name	Description
VCC	Power Supply Input
GND	Power Supply Ground
OUT	Active High Output

Sensor Module Features

5VDC Operating voltage

I/O pins are 5V and 3.3V compliant

Range: Up to 20cm

Adjustable Sensing range

Built-in Ambient Light Sensor

20mA supply current

Mounting hole

Brief about IR Sensor Module

IR Sensor Module Brief

The IR sensor module consists mainly of the IR Transmitter and Receiver, Opamp, Variable Resistor (Trimmer pot), output LED in brief.

IR LED Transmitter

IR LED emits light, in the range of Infrared frequency. IR light is invisible to us as its wavelength (700nm – 1mm) is much higher than the visible light range. IR LEDs have light emitting angle of approx. 20-60 degree and range of approx. few centimeters to several feets, it depends upon the type of IR transmitter and the manufacturer. Some transmitters have the range in kilometers. IR LED white or transparent in colour, so it can give out amount of maximum light.

Photodiode Receiver

Photodiode acts as the IR receiver as its conducts when light falls on it. Photodiode is a semiconductor which has a P-N junction, operated in Reverse Bias, means it start conducting the current in reverse direction when Light falls on it, and the amount of current flow is proportional to the amount of Light. This property makes it useful for IR detection. Photodiode looks like a LED, with a black colour coating on its outer side; Black colour absorbs the highest amount of light.

LM358 Opamp

LM358 is an Operational Amplifier (Op-Amp) is used as voltage comparator in the IR sensor. The comparator will compare the threshold voltage set using the preset (pin2) and the photodiode's series resistor voltage (pin3).

Photodiode's series resistor voltage drop > Threshold voltage = Opamp output is High Photodiode's series resistor voltage drop < Threshold voltage = Opamp output is Low When Opamp's output is high the LED at the Opamp output terminal turns ON (Indicating the detection of Object).

Variable Resistor

The variable resistor used here is a preset. It is used to calibrate the distance range at which object should be detected.

Pin Configuration

Pin Name	**Description**
VCC	Power Supply Input
GND	Power Supply Ground
OUT	Active High Output
IR	Sensor Module Features
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