CHAPTER ONE

Introduction

1.1 General:

The national security is a matter of concern to all government and due to the technology revolution the world become having the power of protecting incents from wars and covers their country boarders.

The usage of sensors integrated with the weapons gives the weapons many features such as accuracy and efficiency, many sensors attached to weapons in order to give the soldiers the ability to have a night vision or even to detect other soldiers to avoid friendly fire problems [1].

Furthermore the usage of Heavy Machine Gun (HMG) which is a larger class of machine gun generally recognized to refer to two separate stages of machine gun development can be hard because of the weight and dangerous output that can hit the soldiers more over by using remote controlled heavy guns can reduce the loss of soldiers during attacks.

In thisstudy an open control theory is used to control rocket launchers and missile position , also a wireless system will be used to increase safety, the mechanism of the work is to use a microcontroller interface board used to control of servo motors in x and y axis and the directions are coming from a transmitter circuit connected to a personal computer that is programmed to emulate the radar readings and calculate the target direction and speed and convert it to an angles to be transmitted to the receiver board , the microcontroller in the receiver board translates the readings to electrical signals to control the motors movements [1,2].

The study is concern in designing missile launcher controlled using wireless technology.

1.2 Problem definition:

- Dangerous to be used by soldiers.
- The number of solders losses during the attacks becomes higher than the previous decades.
- Reduced Accuracy and increased human mistakes.
- There is no data logger in the existing systems.

1.3 Objectives:

1-To design and implement missile launcher based on microcontroller and wireless communication control.

2- to Test proposed system.

1.4 Methodology:

The thesisis designed and implemented through five phases:

In Phase one the project system model will be simulated through simulation programs to insure that the components values are correct while phase two includes the design of Printed Circuit Board and the assembling of components, in phase three the testing and calibration will be done while phase four includes the results and comparisons of each experiment and tests done in the project while phase five includes notes of conclusion, recommendation and future work.

1.5 Thesis layout:

This thesis is divided into five chapters, in chapter one gives an introduction to the study,it includes the problems, objectives and methodology.

Chapter two illustrates the rocket launcher theory and types.Chapter three introduces the methodology and study requirements.

Chapter four presents the design and simulation was included, while the fifth chapter includes the conclusion and recommendations along with the reference.

CHAPTER TWO

Literature Review

2.1 Rocket launcher:

A rocket launcher is any device that launches a rocket-propelled projectile, although the term is often used in reference to mechanisms that are portable and capable of being operated by an individualto detect unauthorized access to a secure door. If the beam is broken, the detector triggers some remote alerting device [4].

2.1.1Shoulder-fired:

The rocket launchers category includes shoulder-fired missile weapons, any weapon that fires a rocket-propelled projectile at a target yet is small enough to be carried by a single person and fired while held on one's shoulder. Depending on the country or region, people might use the terms "bazooka" or "RPG" as generalized terms to refer to such weapons, both of which are in fact specific types of rocket launchers. The bazooka is an American anti-tank weapon which was in service in 1942–1957, while the RPG is a Soviet anti-tank weapon [4].

Other forms of shoulder-launched rocket weapons include anti-tank guided missile, a guided missile primarily designed to hit and destroy heavily-armored vehicles, as well as Man-portable air-defense systems (MANPADS), which provides shoulder-launched surface-to-air missiles. A smaller variation is the gyro jet, a small arms rocket launcher with ammunition slightly larger than that of a .45-caliber pistol.

Recoilless rifles are sometimes confused with rocket launchers. However, the recoilless rifle merely fires a large projectile, not a projectile that continues to propel itself after leaving the barrel of the weapon.

2.1.2Rocket pod:

A rocket pod is a launcher that contains several unguided rockets held in individual tubes, designed to be used by attack aircraft or attack helicopters for close air support. In many cases, rocket pods are streamlined to reduce aerodynamic drag and shown in figure (2.1)

Figure 2.1 Su-20 aircraft with UB-32 rocket pods

The first pods were developed immediately after World War II, as an improvement over the previous arrangement of firing rockets from rails, racks or tubes fixed under the wings of aircraft. Early examples of pod-launched rockets were the US Folding-Fin Aerial Rocket and the French SNEB [4].

2.1.3Large scale

Larger-scale devices which serve to launch rockets include the multiple rocket launcher, a type of unguided rocket artillery system; the transporter erector launcher, a vehicle with an integrated prime mover that can carry, elevate to firing position and launch one or more missiles and various launchers for guided missiles, including ones for surface-to-air missiles, anti-ship missiles, and antisubmarine warfare guided missiles.

The largest scale rocket launcher device currently in existence is a missile launch facility [4].

2.1.4 **Space Gun**:

A space gun is a method of launching an object into space using a large gun, or cannon. It provides a method of non-rocket space launch.

In the Project HARP a U.S. Navy 16 in (410 mm) 100 caliber gun was used to fire a 180 kg (400 lb) slug at 3600 m/s or 12,960 km/h (8,050 mph), reaching an apogee of 180 km (110 mi), hence performing a suborbital spaceflight. However, a space gun has never been successfully used to launch an object into orbit.

2.1.5 Technical issues:

The large gun force experienced by a ballistic projectile would likely mean that a space gun would be incapable of safely launching humans or delicate instruments, rather being restricted to freight, fuel or ruggedized satellites.

Atmospheric drag also makes it more difficult to control the trajectory of any projectile launched, subjects the projectile to extremely high forces, and causes severe energy losses that may not be easily overcome [4].

2.1.6 Quick launch:

After cancellation of SHARP, lead developers John Hunter founded the Jules Verne Launcher Company in 1996 and the Quick launch company. He now seeks to raise $500 million to build one that could refuel a propellant depot or send bulk materials into space [4]

Ram accelerators have also been proposed as an alternative to light gas guns. Other proposals use electromagnetic techniques for accelerating the payload, such as coil guns and rail guns.

2.2Sensor:

A **sensor** (also called **detector**) is a converter that measures a physical quantity and converts it into a signal which can be read by an observer or by an (today mostly electronic) instrument and shown in figure (2.2).

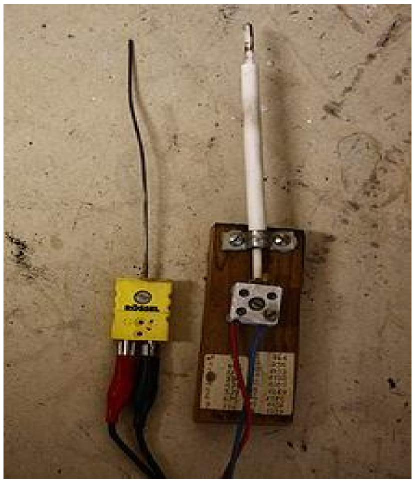


Figure 2.2 Thermocouple sensor

For example, a mercury-in-glass thermometer converts the measured temperature into expansion and contraction of a liquid which can be read on a calibrated glass tube. A thermocouple converts temperature to an output voltage which can be read by a voltmeter. For accuracy, most sensors are calibrated against known standards [5].

Sensors are used in everyday objects such as touch-sensitive elevator buttons (tactile sensor) and lamps which dim or brighten by touching the base. There are also innumerable applications for sensors of which most people are never aware. Applications include cars, machines, aerospace, medicine, manufacturing and robotics.

A sensor is a device, which responds to an input quantity by generating a functionally related output usually in the form of an electrical or optical signal. A sensor's sensitivity indicates how much the sensor's output changes when the measured quantity changes. For instance, if the mercury in a thermometer moves 1 cm when the temperature changes by 1 °C, the sensitivity is 1 cm/°C (it is basically the slope Dy/Dx assuming a linear characteristic). Sensors that measure very small changes must have very high sensitivities. Sensors also have an impact on what they measure; for instance, a room temperature thermometer inserted into a hot cup of liquid cools the liquid while the liquid heats the thermometer. Sensors need to be designed to have a small effect on what is measured; making the sensor smaller often improves this and may introduce other advantages. Technological progress allows more and more sensors to be manufactured on a microscopic scale as micro sensors using MEMS technology. In most cases, a micro sensor reaches a significantly higher speed and sensitivity compared with macroscopic approaches [5].

2.2.1Classification of measurement errors

if a sensor measures temperature and has a voltage output was called Infrared Sensor and shown in figure (2.3)

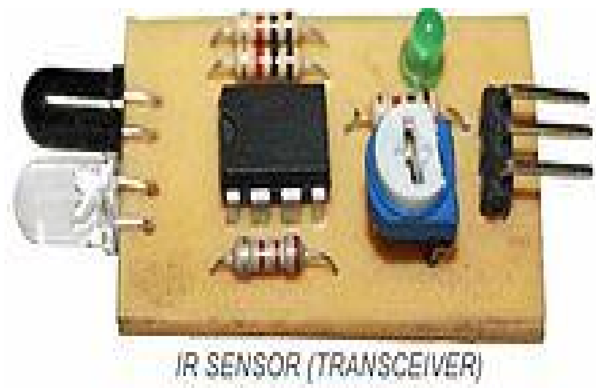


Figure2.3 Infrared Sensor

A good sensor obeys the following rules:

- Is sensitive to the measured property only
- Is insensitive to any other property likely to be encountered in its application
- Does not influence the measured property

Ideal sensors are designed to be linear or linear to some simple mathematical function of the measurement, typically logarithmic. The output of such a sensor is an analog signal and linearly proportional to the value or simple function of the measured property. The sensitivity is then defined as the ratio between output signal and measured property. For example, if a sensor measures temperature and has a voltage output, the sensitivity is a constant with the unit [V/K]; this sensor is linear because the ratio is constant at all points of measurement .

For an analog sensor signal to be processed, or used in digital equipment, it needs to be converted to a digital signal, using an analog-to-digital converter [5].

2.2.2 Sensor deviations:

If the sensor is not ideal, several types of deviations can be observed:

- The sensitivity may in practice differ from the value specified. This is called a sensitivity error, but the sensor is still linear.
- Since the range of the output signal is always limited, the output signal will eventually reach a minimum or maximum when the measured property exceeds the limits. The full scale range defines the maximum and minimum values of the measured property.
- If the output signal is not zero when the measured property is zero, the sensor has an offset or bias. This is defined as the output of the sensor at zero input.
- If the sensitivity is not constant over the range of the sensor, this is called non linearity. Usually this is defined by the amount the output differs from ideal behavior over the full range of the sensor, often noted as a percentage of the full range.
- If the deviation is caused by a rapid change of the measured property over time, there is a dynamic error. Often, this behavior is described with a bode plot showing sensitivity error and phase shift as function of the frequency of a periodic input signal.
- If the output signal slowly changes independent of the measured property, this is defined as drift (telecommunication).
- Long term drift usually indicates a slow degradation of sensor properties over a long period of time.
- Noise is a random deviation of the signal that varies in time.
- Hysteresis is an error caused by when the measured property reverses direction, but there is some finite lag in time for the sensor to respond, creating a different offset error in one direction than in the other.

- If the sensor has a digital output, the output is essentially an approximation of the measured property. The approximation error is also called digitization error.
- If the signal is monitored digitally, limitation of the sampling frequency also can cause a dynamic error, or if the variable or added noise changes periodically at a frequency near a multiple of the sampling rate may induce aliasing errors.
- The sensor may to some extent be sensitive to properties other than the property being measured. For example, most sensors are influenced by the temperature of their environment.

All these deviations can be classified as systematic errors or random errors. Systematic errors can sometimes be compensated for by means of some kind of calibration strategy. Noise is a random error that can be reduced by signal processing, such as filtering, usually at the expense of the dynamic behavior of the sensor [5].

2.2.3 Resolution:

The resolution of a sensor is the smallest change it can detect in the quantity that it is measuring. Often in a digital display, the least significant digit will fluctuate, indicating that changes of that magnitude are only just resolved. The resolution is related to the precision with which the measurement is made. For example, a scanning tunneling probe (a fine tip near a surface collects an electron tunneling current) can resolve atoms and molecules [6].

2.2.4 Types:

Sensors in Nature:

All living organisms contain biological sensors with functions similar to those of the mechanical devices described. Most of these are specialized cells that are sensitive to :

- Light, motion, temperature, magnetic fields, gravity, humidity, moisture, vibration, pressure, electrical fields, sound, and other physical aspects of the external environment
- Physical aspects of the internal environment, such as stretch, motion of the organism, and position of appendages (proprioception)
- Environmental molecules, including toxins, nutrients, and pheromones
- Estimation of biomolecules interaction and some kinetics parameters
- Internal metabolic milieu, such as glucose level, oxygen level, or osmolality
- Internal signal molecules, such as hormones, neurotransmitters, and cytokines
- Differences between proteins of the organism itself and of the environment or alien creatures.

2.2.5Biosensor:

In biomedicine and biotechnology, sensors which detect analyses thanks to a biological component, such as cells, protein, nucleic acid or biomimetic polymers, are called biosensors. Whereas a non-biological sensor, even organic (=carbon chemistry), for biological analyses is referred to as sensor or nanosensor (such a micro cantilevers). This terminology applies for both in vitro and in vivo applications. The encapsulation of the biological component in biosensors, presents a slightly different problem that ordinary sensors; this can either be done by means of a semipermeable barrier, such as a dialysis membrane or a hydrogel, or a 3D polymer matrix, which either physically constrains the sensing macromolecule or chemically constrains the macromolecule by bounding it to the scaffold [6].

2.3DC Motor

A DC motor is a mechanically commutated electric motor powered from Direct Current (DC). The stator is stationary in space by definition and therefore the current in the rotor is switched by the commentator to also be stationary in space. This is how the relative angle between the stator and rotor magnetic flux is maintained near 90 degrees, which generates the maximum torque.

DC motors have a rotating armature winding (winding in which a voltage is induced) but non-rotating armature magnetic field and a static field winding (winding that produce the main magnetic flux) or permanent magnet. Different connections of the field and armature winding provide different inherent speed/torque regulation characteristics. The speed of a DC motor can be controlled by changing the voltage applied to the armature or by changing the field current. The introduction of variable resistance in the armature circuit or field circuit allowed speed control. Modern DC motors are often controlled by power electronics systems called DC drives [6].

The introduction of DC motors to run machinery eliminated the need for local steam or internal combustion engines, and line shaft drive systems. DC motors can operate directly from rechargeable batteries, providing the motive power for the first electric vehicles. Today DC motors are still found in applications as small as toys and disk drives, or in large sizes to operate steel rolling mills and paper machines.

2.4Photoelectric sensor

A **photoelectric sensor**, or photo eye, is a device used to detect the distance, absence, or presence of an object by using a light transmitter, often infrared, and a photoelectric receiver. They are used extensively in industrial manufacturing. There are three different functional types: opposed (through beam), retro-reflective, and proximity-sensing (diffused) and shown in figure (2.4)

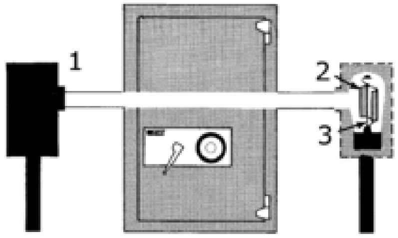


Figure 2.4 Conceptual through-beam system

2.4.1Types:

A self-contained photoelectric sensor contains the optics, along with the electronics. It requires only a power source. The sensor performs its own modulation, demodulation, amplification, and output switching. Some self-contained sensors provide such options as built-in control timers or counters. Because of technological progress, self-contained photoelectric sensors have become increasingly smaller.

Remote photoelectric sensors used for remote sensing contain only the optical components of a sensor. The circuitry for power input, amplification, and output switching are located elsewhere, typically in a control panel. This allows the sensor, itself, to be very small. Also, the controls for the sensor are more accessible, since they may be bigger.

When space is restricted or the environment too hostile even for remote sensors, fiber optics may be used. Fiber optics is passive mechanical sensing components. They may be used with either remote or self-contained sensors. They have no electrical circuitry and no moving parts, and can safely pipe light into and out of hostile environments [5].

2.4.2Sensing modes:

An opposed (through beam) arrangement consists of a receiver located within the line-of-sight of the transmitter. In this mode, an object is detected when the light beam is blocked from getting to the receiver from the transmitter.

A retro reflective arrangement places the transmitter and receiver at the same location and uses a reflector to bounce the light beam back from the transmitter to the receiver. An object is sensed when the beam is interrupted and fails to reach the receiver.

A proximity-sensing (diffused) arrangement is one in which the transmitted radiation must reflect off the object in order to reach the receiver. In this mode, an object is detected when the receiver sees the transmitted source rather than when it fails to see it.

Some photo eyes have two different operational types, light operate and dark operate. Light operate photo eyes become operational when the receiver "receives" the transmitter signal. Dark operate photo eyes become operational when the receiver "does not receive" the transmitter signal [6].

The detecting range of a photoelectric sensor is its "field of view", or the maximum distance the sensor can retrieve information from, minus the minimum distance. A minimum detectable object is the smallest object the sensor can detect. More accurate sensors can often have minimum detectable objects of minuscule size.

2.5 ULN2804

The **ULN2804** is a high voltage, high current Darlington array comprised of eight NPN Darlington pairs. The device features open-collector outputs with suppression diodes for inductive loads and is ideally suited for interfacing between low-level logic circuitry and high power loads [6].

Typical loads including relays DC motors, filament lamps, LED displays, printer hammers and high power buffers show in figure (3.4).

2.5.1Future of ULN2804:

- Eight Darlington with common emitters
- TTL, PMOS or CMOS Compatible inputs
- Peak output current to 500mA
- Output voltage to 50V
- Clamp diodes for transient suppression

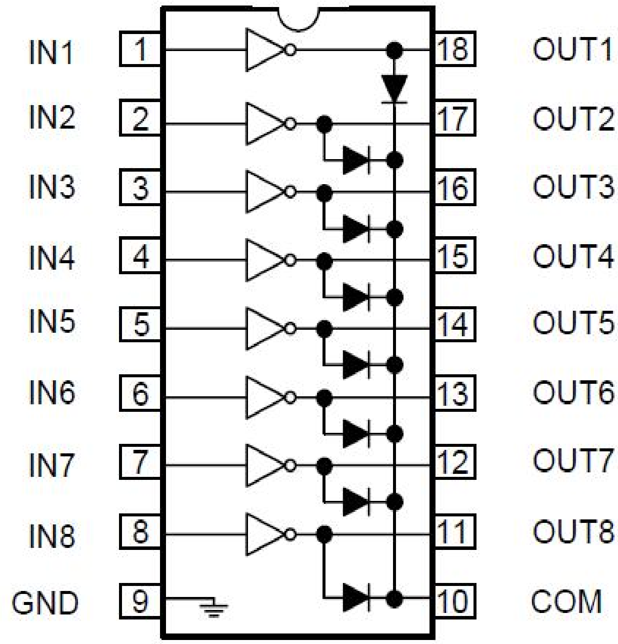
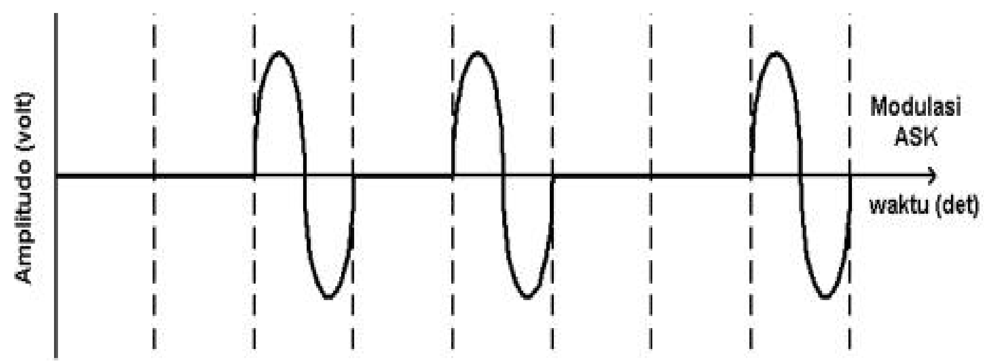


Figure (2.5) ULN2804

2.6Amplitude Shift Keying:

The amplitude shift keying is a technique of digital modulation it vary in amplitude to the maximum whenever digital one input detected and it goes to minimum amplitude whenever the logic 0 detected and the following figure is illustrating the signal of the amplitude shift keying[5].



ASK modulator/Demodulator :

The modulator and demodulator is small devices consists of modulation circuit and demodulation circuit with the techniques of digital modulation and ASK modulation type and it is used to transmit and receive a digital data from transmitter to the receiver [5].

2.6.1Demodulator

The ST-RX02-ASK is an ASK Hybrid receiver module Show figure (3.5)

Figure 2.6 Demodulator

ASK Demodulator:

- An effective low cost solution for using at 315/433.92 MHZ.
- The circuit shape of ST-RX02-ASK is L/C.
- Receiver Frequency: 315 / 433.92 MHZ
- Typical sensitivity: -105dBm
- Supply Current: 3.5mA
- IF Frequency:1MHz.

2.6.2 Modulator:

The ST-TX01-ASK is an ASK Hybrid transmitter module show in fig (3.6).

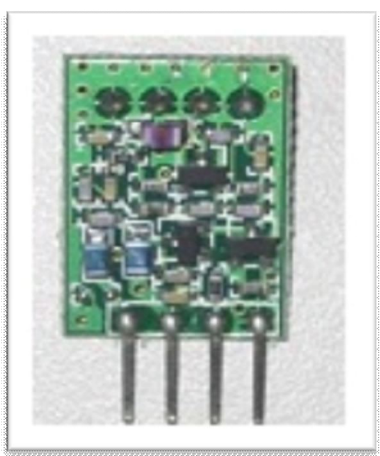


Figure (2.7) ASK Modulator

ST-TX01-ASK are designed by the Saw Resonator, with an Effective low cost, small size, and simple-to-use for designing. Frequency Range 315 / 433.92 MHZ, Supply Voltage: 3~12V.Circuit Shape: Saw

2.7 Light-Emitting Diode

Light-Emitting Diode (**LED**) is a semiconductor light source.LEDs is used as indicator lamps in many devices and is increasingly used for other lighting. Introduced as a practical electronic component in 1962early LEDs emitted low-intensity red light, but modern versions are available across the visible, ultraviolet, and infrared wavelengths, with very high brightness.

When a light-emitting diode is forward-biased (switched on), electrons are able to recombine with electron holes within the device, releasing energy in the form of photons. This effect is called electroluminescence and the color of the light (corresponding to the energy of the photon) is determined by the energy gap of the semiconductor. LEDs are often small in area (less than 1 mm^2), and integrated optical components may be used to shape its radiation pattern.

LEDs present many advantages over incandescent light sources including lower energy consumption, longer lifetime, improved robustness, smaller size, and faster switching. LEDs powerful enough for room lighting are relatively expensive and require more precise current and heat management than compact fluorescent lamp sources of comparable output [6].

Light-emitting diodes are used in applications as diverse as replacements for aviation lighting, automotive lighting (in particular brake lamps, turn signals, and indicators) as well as in traffic signals. LEDs have allowed new text, video displays, and sensors to be developed, while their high switching rates are also useful in advanced communications technology. Infrared LEDs are also used in the remote control units of many commercial products including televisions, DVD players, and other domestic appliances [6].

2.8 Voltage Regulator:

A voltage regulator is an electrical regulator designed to automatically maintain a constant voltage level. A voltage regulator may be a simple "feed-forward" design or may include negative feedback control loops. It may use an electromechanical mechanism, or electronic components. Depending on the design, it may be used to regulate one or more AC or DC voltages show in figure (2.8)

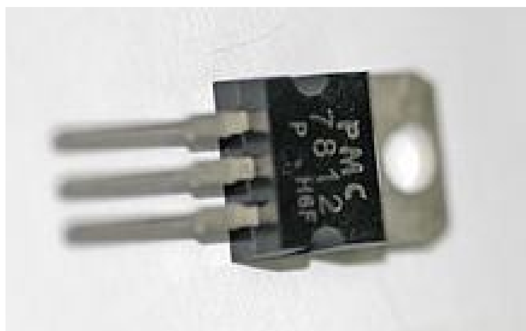


Figure 2.8 Voltage regulator

Electronic voltage regulators are found in devices such as computer power supplies where they stabilize the DC voltages used by the processor and other elements. In automobile alternators and central power station generator plants, voltage regulators control the output of the plant. In an electric power distribution system, voltage regulators may be installed at a substation or along distribution lines so that all customers receive steady voltage independent of how much power is drawn from the line [7].

CHAPTER THREE

Design and Modeling

3.1 Introduction

Missile launchers is an electromechanical system used for detecting nations from air force attacks, these systems developed based on many technologies such as programmable logic controllers , microcontrollers and electronic circuits[1].

In this study an open control theory is used to control rocket launchers and missile position , also a wireless system will be used to increase safety, the mechanism of the work is to design a microcontroller interface board used to control of servo motors in x and y axis and the directions are coming from a transmitter circuit connected to a personal computer that is programmed to emulate the radar readings and calculate the target direction and speed and convert it to an angles to be transmitted to the receiver board , the microcontroller in the receiver board translates the readings to electrical signals to control the motors movements[1].

In this chapter the methodology was included along with the block diagram, flowchart and the components description that used in the project, also the circuit diagram that used to simulate the system.

3.2Transmitter of System

The following Figure (3.1) illustrates the system block diagram which is consist of a transmitter (control circuit), that consist of a joystick capable of directing the foreword, backward, up and down to the microcontroller.

the microcontroller accepts a digital input from joystick and through encoder block it includes the signal after converting it from parallel to serial and then add an address to the transmitted signal, then the signal is ready to be transmitted through the modulator that modulate the signal using amplitude shift keying digital modulation techniques. The antenna length was chosen to be 3 feet tall according to datasheet.

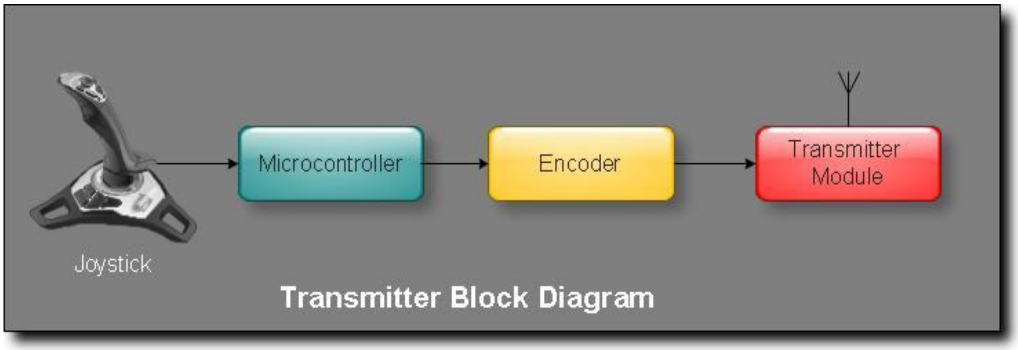


Figure 3.1 Transmitter Block Diagram

The transmitter circuit is consist from microcontroller (Atmega16L) Encoder ULN2804 and LCD and four switch and External Oscillator shown in figure (3.2)

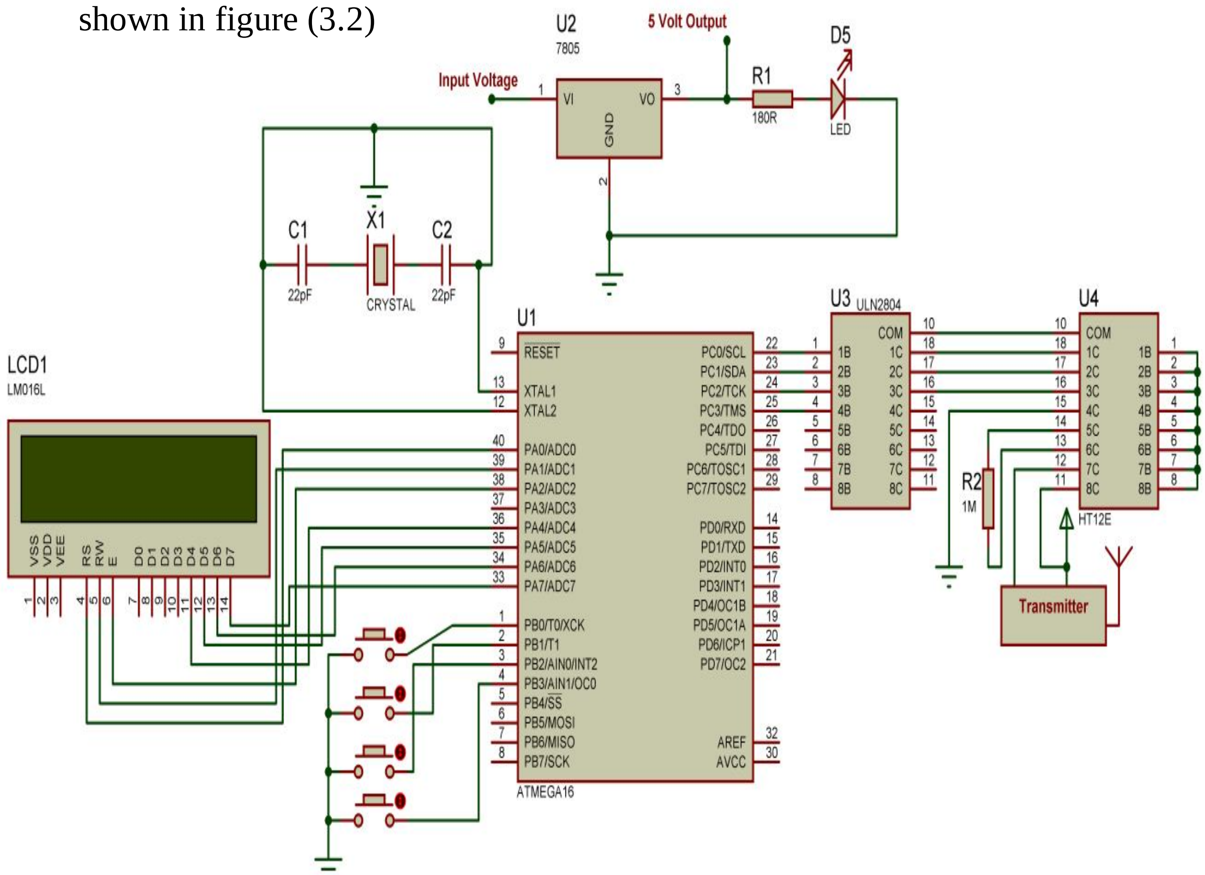


Figure3.2 Transmitter Circuit Diagram

The flowchart of transmitter which read the axis (X axis ,y axis) and then move the system according the instruction set and shown in figure (3.3)

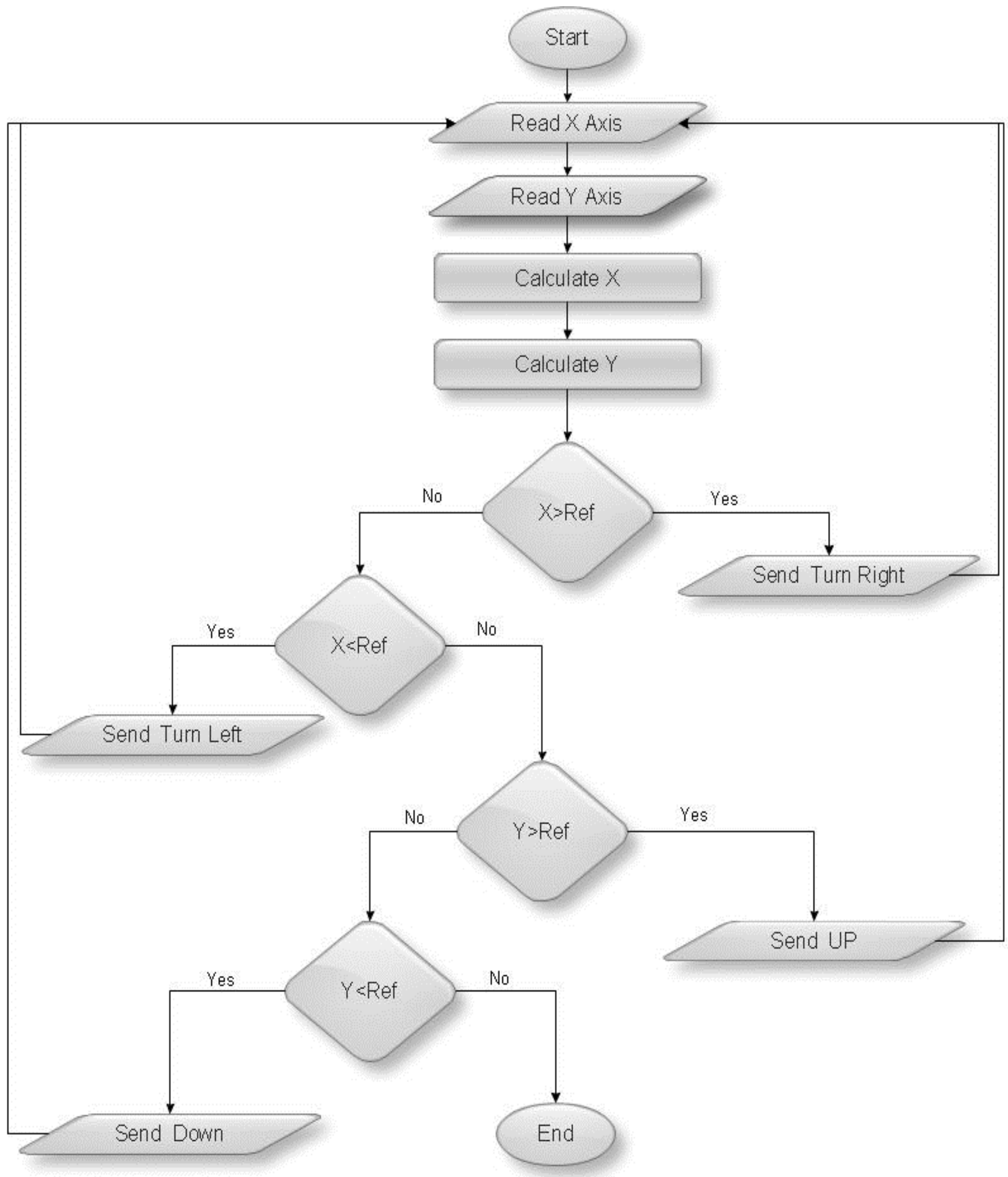


Figure 3.3 Transmitter Flowchart

3.3 Receiver of System

In the receiver model receive data to the decoder that check the received signal address to be compared with the decoder reference address if they match the decoder convert the signal from serial to parallel to the entered to the microcontroller and display the commends on the LCD and control the movement and shown in figure(3.4)

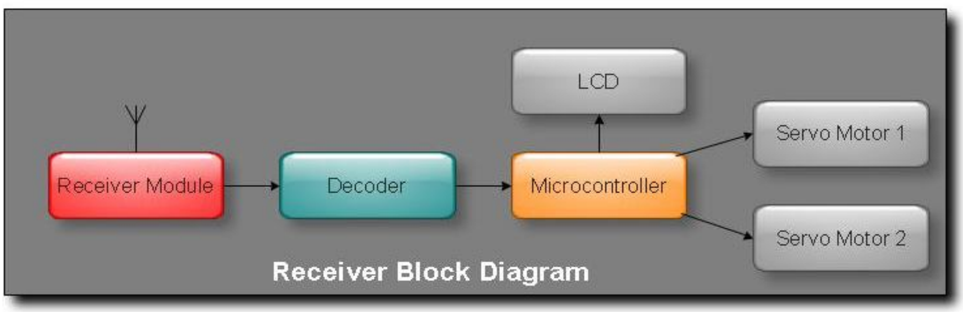


Figure 3.4 Receiver Block Diagram

The Receiver circuit consist from tow servomotor Decoder and receiver module and shown in figure (3.5)

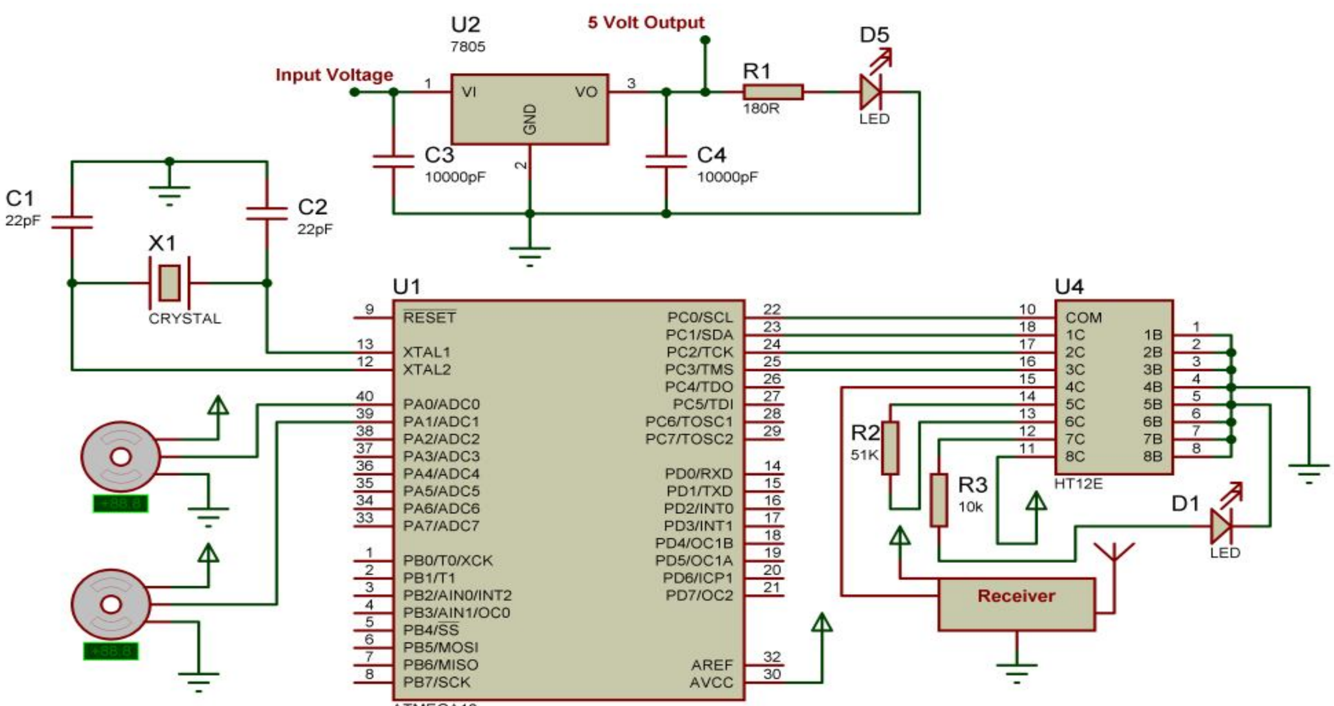


Figure 3.5 Receiver Circuit Diagram

The flowchart of Receiver which read the code on receiver and then move the motor left right up down according the key pres and shown in figure (3.6)

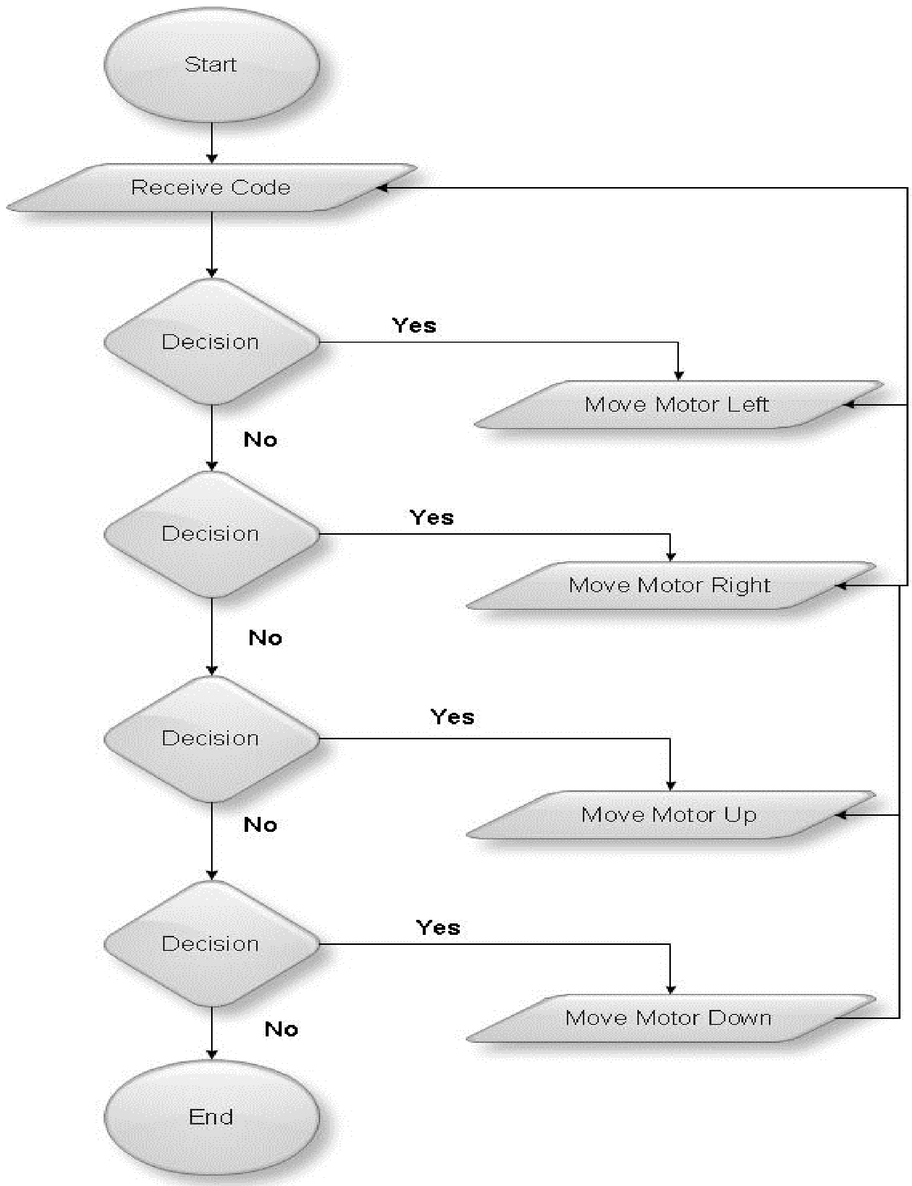


Figure 3.6 Receiver Flowchart

3.4 Printed circuit board:

A **printed circuit board** (**PCB**) mechanically supports and electrically connects electronic components using conductive tracks, pads and other features etched from copper sheets laminated onto a non-conductive substrate. PCBs can be single sided (one copper layer), double sided (two copper layers) or multi-layer (outer and inner layers). Multi-layer PCBs allow for much higher component density. Conductors on different layers are connected with plated-through holes called vias. Advanced PCBs may contain components - capacitors, resistors or active devices - embedded in the substrate.

FR-4 glass epoxy is the primary insulating substrate upon which the vast majority of rigid PCBs are produced. A thin layer of copper foil is laminated to one or both sides of an FR-4 panel. Circuitry interconnections are etched into copper layers to produce printed circuit boards. Complex circuits are produced in multiple layers.

Printed circuit boards are used in all but the simplest electronic products. Alternatives to PCBs include wire wrap and point-to-point construction. PCBs require the additional design effort to lay out the circuit, but manufacturing and assembly can be automated.

Manufacturing circuits with PCBs is cheaper and faster than with other wiring methods as components are mounted and wired with one single part. Furthermore, operator wiring errors are eliminated.

When the board has only copper connections and no embedded components, it is more correctly called a printed wiring board (PWB) or etched wiring board. Although more accurate, the term printed wiring board has fallen into disuse. A PCB populated with electronic components is called a printed circuit assembly (PCA), printed circuit board assembly or PCB assembly (PCBA). The IPC preferred term for assembled boards is circuit card assembly (CCA), and for assembled backplanes it is backplane assemblies. The term PCB is used informally both for bare and assembled boards.

3.5 System Design:

Initially PCBs were designed manually by creating a photo mask on a clear Mylar sheet, usually at two or four times the true size. Starting from the schematic diagram the component pin pads were laid out on the Mylar and then traces were routed to connect the pads. Rub-on dry transfers of common component footprints increased efficiency.

- The sweeping curves in the traces are evidence of freehand design using self-adhesive tape.

Traces were made with self-adhesive tape. Pre-printed non-reproducing grids on the Mylar assisted in layout. To fabricate the board, the finished photo mask was photo lithographically reproduced onto a photoresist coating on the blank copper-clad boards.

Nowadays PCBs are designed with dedicated layout software, generally in the following steps:

1. Schematic capture through an Electronic Design Automation (EDA) tool.
2. Card dimensions and template are decided based on required circuitry and case of the PCB.
3. The positions of the components and heat sinks are determined.
4. Layer stack of the PCB is decided, with one to tens of layers depending on complexity. Ground and power planes are decided. A power plane is the counterpart to a ground plane and behaves as an AC signal ground while providing DC power to the circuits mounted on the PCB. Signal interconnections are traced on signal planes. Signal planes can be on the outer as well as inner layers. For optimal EMI performance high frequency signals are routed in internal layers between power or ground planes.

5. Line impedance is determined using dielectric layer thickness, routing copper thickness and trace-width. Trace separation is also taken into account in case of differential signals. Micro strip, strip line or dual strip line can be used to route signals.
6. Components are placed. Thermal considerations and geometry are taken into account. Vies and lands are marked.
7. Signal traces are routed. Electronic design automation tools usually create clearances and connections in power and ground planes automatically.
8. Gerber files are generated for manufacturing.

PCB manufacturing consists of many steps.

3.6 PCB CAM:

Manufacturing starts from the PCB fabrication data generated by Computer Aided System(CAD). The Gerber or Excellent files in the fabrication data are never used directly on the manufacturing equipment but always read into theComputer Aided Manufacturing (CAM) software. CAM performs the following functions:

1. Input of the Gerber data
2. Verification of the data; optionally DFM
3. Compensation for deviations in the manufacturing processes (e.g. scaling to compensate for distortions during lamination)
4. Penalization
5. Output of the digital tools (copper patterns, solder resist image, legend image, drill files, automated optical inspection data, electrical test files.

3.7Penalization:

Penalization is a procedure whereby a number of PCBs are grouped for manufacturing onto a larger board - the panel. Usually a panel consists of a single design but sometimes multiple designs are mixed on a single panel. There are two types of panels: assembly panels - often called arrays -

and bare board manufacturing panels. The assemblers often mount components on panels rather than single PCBs because this is efficient. The bare board manufactures always uses panels, not only for efficiency, but because of the requirements the plating process. Thus a manufacturing panel can consist of a grouping of individual PCBs or of arrays, depending on what must be delivered.

The panel is eventually broken apart into individual PCBs; this is called detangling. Separating the individual PCBs is frequently aided by drilling or routing perforations along the boundaries of the individual circuits, much like a sheet of postage stamps. Another method, which takes less space, is to cut V-shaped grooves across the full dimension of the panel. The individual PCBs can then be broken apart along this line of weakness. Today detangling is often done by lasers which cut the board with no contact. Laser penalization reduces stress on the fragile circuits.

3.8 Lamination:

Multi-layer printed circuit boards have trace layers inside the board. This is achieved by laminating a stack of materials in a press by applying pressure and heat for a period of time. This results in an inseparable one piece product. For example, a four-layer PCB can be fabricated by starting from a two-sided copper-clad laminate, etch the circuitry on both sides, then laminate to the top and bottom pre-preg and copper foil. It is then drilled, plated, and etched again to get traces on top and bottom layers.

3.9 Drilling:

Holes through a PCB are typically drilled with small-diameter drill bits made of solid coated tungsten carbide. Coated tungsten carbide is recommended since many board materials are very abrasive and drilling must be high RPM and high feed to be cost effective. Drill bits must also remain sharp so as not to mar or tear the traces.

Drilling with high-speed-steel is simply not feasible since the drill bits will dull quickly and thus tear the copper and ruin the boards. The drilling is performed by automated drilling machines with placement controlled by a drill tape or drill file. These computer-generated files are also called numerically controlled drill (NCD) files or "Excellent files". The drill file describes the location and size of each drilled hole.

Holes may be made conductive, by electroplating or inserting metal eyelets (hollow), to electrically and thermally connect board layers. Some conductive holes are intended for the insertion of through-hole-component leads. Others, typically smaller and used to connect board layers, are called vies.

When very small vies are required, drilling with mechanical bits is costly because of high rates of wear and breakage. In this case, the vies may be laser drilled—evaporated by lasers. Laser-drilled vies typically have an inferior surface finish inside the hole. These holes are called micro vies.

It is also possible with controlled-depth drilling, laser drilling, or by pre-drilling the individual sheets of the PCB before lamination, to produce holes that connect only some of the copper layers, rather than passing through the entire board. These holes are called blind vies when they connect an internal copper layer to an outer layer, or buried vies when they connect two or more internal copper layers and no outer layers.

The hole walls for boards with two or more layers can be made conductive and then electroplated with copper to form plated-through holes. These holes electrically connect the conducting layers of the PCB. For multi-layer boards, those with three layers or more, drilling typically produces a smear of the high temperature decomposition products of bonding agent in the laminate system. Before the holes can be plated through, this smear must be removed by a chemical de-smear process, or by plasma-etch. The de-smear process ensures that a good connection is made to the copper layers when the hole is plated through. On high reliability boards a process called etch-back is performed chemically with a potassium permanganate based etchant or plasma. The etch-back removes resin and the glass fibers so that the copper layers extend into the hole and as the hole is plated become integral with the deposited copper.

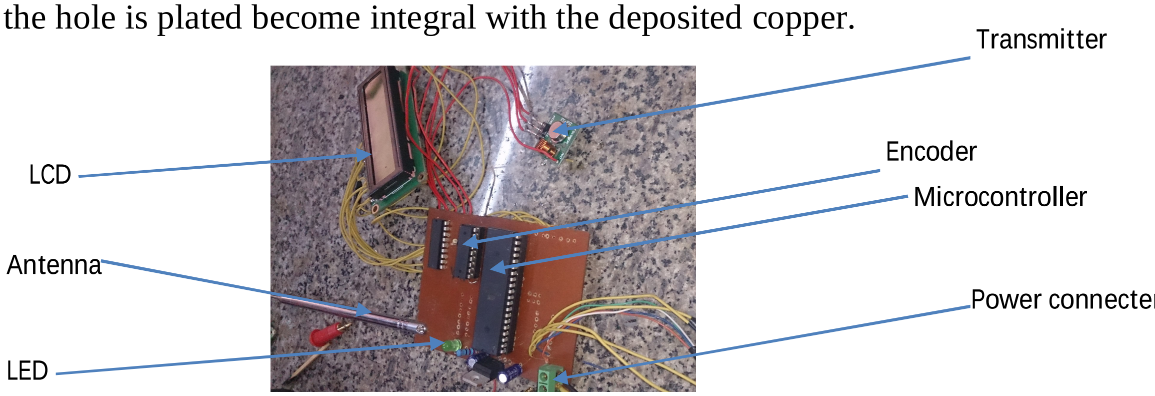


Figure 3.7transmitter components on PCB

3.10 Economical View:

The usage of the SMD components is very expensive compared with the DIP components and the PCB fabrication and design is expensive if the circuit designed is not classified as a production due to the high cost of the first design

Table (3.1) System and Existing Solution:

Cost	**Reasonable**	**High Cost**
Power Consumption	**Low**	**Low**
Mobility	**Yes**	**No**
Complexity	**No**	**Yes**
Size	**Small**	**Large**
Weight	**Light**	**Light**
Dependency	**Non**	**Non**
Customizable	**Yes**	**No**
Response Time	**High**	**High**

CHAPTER FOUR

System testing

In this chapter the results and discussion was included along with the circuit description and the main function of the components used in the circuit.

4.1Details of System Design:

The design principles are based on simple phenomena the tracking system has an antenna which contains a receiver, a delay circuit and a base transmitter.

The receiver is placed at the center point of the antennawhenever the receiver receives a signal with adequate strength; a logic high pulse is generated by a mono-stable configured around a 555 Timer.

To avoid interference and unnecessary triggering, a time delay is provided IR receiver (photo diode) arranged around the antenna to detect the position of antenna.

All the receivers output are connected to the microcontroller through a signal conditioning circuit for a compatible output to the Microcontroller.

The logic level is continuously checked with proper time delay

As long as the controller senses the logic high the motor will stay at that place assuming the signal is available to the antenna and the position of antenna will display on LCD in degrees and shown in figure(4.1)

Figure 4.1 Motor Direction

Whenever there is no signal or low levellogic appearing, the controller will drive the motor to search a signal i.e. logic high at the controller input port. The controller will continuously repeat this process to track the antenna for a particular signal.

In this studt an IR transmitter is used to transmit the signal which can be received by an IR receiver placed at the origin of the Antenna. This signal is passed through a constable circuit to the photo Diodes which are used to convert the light energy into the electrical energy.

Now signal from photo diodes is fed to the Microcontroller by the help of Voltage Comparator through Signal Conditioning Circuit. Simultaneously an Interrupt Signal is given to the Microcontroller through OR Gate which is also operated by the Voltage comparator.

To activate DTMF encoder the input is given by the Microcontroller for the purpose of wireless communication. Relay is used to shorting the DTMF encoder.

FM transmitter is used to transmit the encoded signal through a simple antenna.

At the receiving station a FM receiver is used to receive the signal transmitted from the transmitter station and given to the DTMF decoder to decode the DTMF signal and the output is given to the Microcontroller as an Input signal through Signal Conditioning Circuit.

Table (4.1) Parameters:

Attribute	**Value**
V out range	**5v**
Vin – V out difference	**6v-36v**
Operation temperature	**15 °C – 70 °C -**
Output Imax	**Output Imax1.5 A(with proper heat)**
Minimum Load Current	**3.5mA typical, 12 mA maximum**

4.2 Working Mechanism:

While switching on circuits, the microcontroller on the transmitter side waits or joystick entry and read title of project shown in figure (4.2)

Figure 4.2 thesistitle on LCD

the user select one of the directions of the movement, once user hit the button a 5 volt enters to the microcontroller in a specific Pin (A0 or example) then the microcontroller knows that the 1000 binary code was received , the code inside the microcontroller has a subroutine with an a conditional statement will be executed, this code activate the transmission of 1000 binary code through the encoder that convert the code from parallel mode to serial mode to be delivered to the transmitter that works with 8MHz frequency with amplitude shit keying digital modulation technique, one the signal is travelled through open space the receiver receives the signal and demodulate it and pass it digitally to the decoder to be address compared and convert to parallel signal to the receiver microcontroller to control the motor A rotation.

There are four control switch connected in transmitter to control of the motor movement.

When the User presses on switch one the transmittermodule read the signal and takes serial input and transmits these signals through RF.

The transmitted signals are received by the receiver module placed away from the source of transmission and read on LCD shown in figure (4.3)

Figure 4.3 Motormovement

While switching on circuits, the microcontroller on the transmitter side waits or joystick entry, the user select one of the directions of the movement. Once user hit the button a 5 volt enters to the microcontroller in a specific Pin (A0 or example) then the microcontroller knows that the a binary code should be transmitted through a truth table that configured

The received code executed inside the microcontroller with a specific subroutine with an a conditional statement will be executed, this code activate the transmission of 1000 binary code through the encoder that convert the code from parallel mode to serial mode to be delivered to the transmitter that works with 8 MHz frequency with amplitude shit keying digital modulation technique, one the signal is travelled through open space the receiver receives the signal and demodulate, a delay time can be occur during the signal travelling and the motor reach its right position.

The microcontroller sends activation to the motor direction to start moving towards the angle that desired so the delay of each step.

4.3 System Implementation:

The project consist of two boxes the 1st box represent the transmitter circuit and the other box represent the receiver box are shown in figure (4.4)

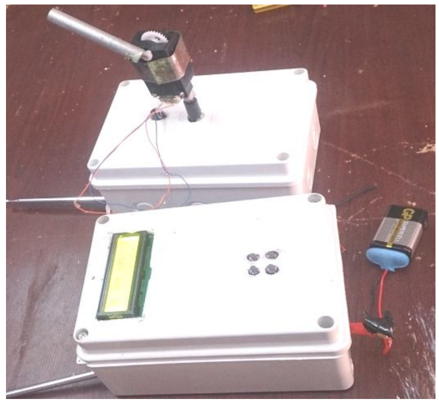


Figure4.4Maincircuit

4.3.1 Transmittercircuit:

The visual components to the end user is the liquid crystal display and joystick, while the end user press up or any direction button the switch passes a ground to the microcontroller to PORT B that configured to accept the direction button signal and shown in figure (4.5)

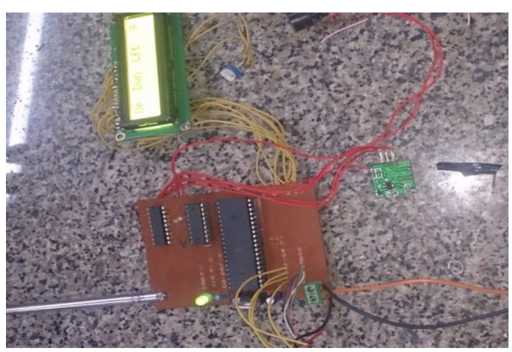


Figure 4.5 Transmitter circuit

The microcontroller accept the signal and through a conditional statements the microcontroller passes a control signal formed in binary format consist of four bits to the current amplifier ULN2804 to amplify the current to the encoder that add an address to each bit and form it into a serial out to be transmitted though one channel to the receiver through the transmitter module.

4.3.2 Receiver circuit:

The visual components to the end user is the two motors, while the end user press up or any direction button the switch passes a ground to the microcontroller to PORT B that configured to accept the direction button signal on the transmitter the microcontroller accept the signal and through a receiver module through decoderto the microcontroller passes a control signal formed in binary format consist of four bits, the microcontroller send a control signal to the motors through the integrated circuit L293, that drives the motor direction and shown in figure (4.6)

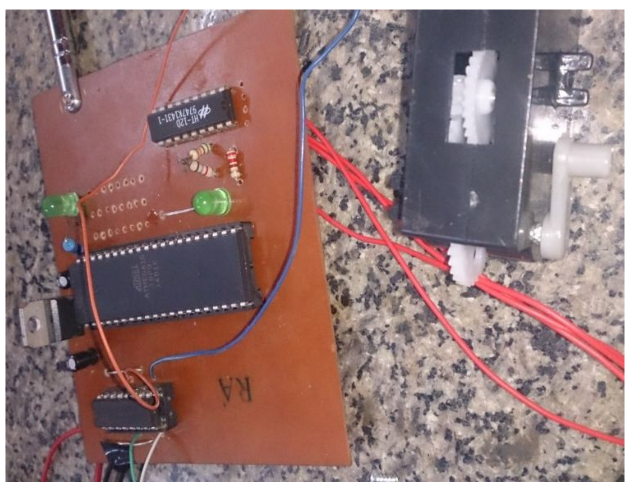


Figure 4.6 receiver circuit

CHAPTER FIVE

Conclusion andRecommendations

5.1 Conclusion:

The circuit was designedof control any heavy weapons from a distance to reduce the risk factor, and the usage of the sensors which can be used to reduce the procedures of the Movement and the complex procedures to detect the position of the target.Moreover this kind of technology exists in united states helicopter that known as apache aircrafts and it has a full dash board control through the head set of the pilot including the weapons and radars.

In this thesis the same technology was used to control the weapon directions and determine the actual displacement of hand.

This done by using microcontroller which read the sensor output and execute a subroutine saved inside the microcontroller to send a code to move the weapon.

5.2 Recommendation:

1- Using satellite communication to remote control from a distance that reaches miles.
2- Securing the data transmitted.
3- Repeating the data send through a physical repeaters.
4- Using GSM system to control missile.
5- Using a Sensor for firing Missile.

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Appendix A

```
#include <mega16.h>

#include <delay.h>

 //Declare your global variables here

int s1,s2,s3,s4;

void main(void)

}

 //Declare your local variables here

 //Input/Output Ports initialization

 //Port A initialization

 //Func7=In Func6=In Func5=In Func4=In Func3=In Func2=In Func1=In Func0=In

 //State7=T State6=T State5=T State4=T State3=P State2=P State1=P State0=P

PORTA=0x0F;

DDRA=0x00;

 //Port B initialization

 //Func7=In Func6=In Func5=In Func4=In Func3=In Func2=In Func1=In Func0=In

 //State7=T State6=T State5=T State4=T State3=T State2=T State1=T State0=T

PORTB=0x00;

DDRB=0x00;

 //Port C initialization

 //Func7=In Func6=In Func5=In Func4=In Func3=Out Func2=Out Func1=Out Func0=Out
```

```
//State7=T State6=T State5=T State4=T State3=0 State2=0 State1=0 State0=0
PORTC=0x00;
DDRC=0x0F;
//Port D initialization
//Func7=In Func6=In Func5=In Func4=In Func3=In Func2=In Func1=In Func0=In
//State7=T State6=T State5=T State4=T State3=T State2=T State1=T State0=T
PORTD=0x00;
DDRD=0x00;
//Timer/Counter 0 initialization
//Clock source: System Clock
//Clock value: Timer 0 Stopped
//Mode: Normal top=FFh
//OC0 output: Disconnected
TCCR0=0x00;
TCNT0=0x00;
OCR0=0x00;
//Timer/Counter 1 initialization
//Clock source: System Clock
//Clock value: Timer 1 Stopped
//Mode: Normal top=FFFFh
//OC1A output: Discon.
//OC1B output: Discon.
//Noise Canceler: Off
```

```
 //Input Capture on Falling Edge
 //Timer 1 Overflow Interrupt: Off
 //Input Capture Interrupt: Off
 //Compare A Match Interrupt: Off
 //Compare B Match Interrupt: Off
TCCR1A=0x00;
TCCR1B=0x00;
TCNT1H=0x00;
TCNT1L=0x00;
ICR1H=0x00;
ICR1L=0x00;
OCR1AH=0x00;
OCR1AL=0x00;
OCR1BH=0x00;
OCR1BL=0x00;
 //Timer/Counter 2 initialization
 //Clock source: System Clock
 //Clock value: Timer 2 Stopped
 //Mode: Normal top=FFh
 //OC2 output: Disconnected
ASSR=0x00;
TCCR2=0x00;
TCNT2=0x00;
OCR2=0x00;
 //External Interrupt(s) initialization
```

```
 //INT0: Off
 //INT1: Off
 //INT2: Off
MCUCR=0x00;
MCUCSR=0x00;
 //Timer(s)/Counter(s) Interrupt(s) initialization
TIMSK=0x00;
 //Analog Comparator initialization
 //Analog Comparator: Off
 //Analog Comparator Input Capture by Timer/Counter 1: Off
ACSR=0x80;
SFIOR=0x00;
while (1)
}
s1=PINB.0;
s2=PINB.1;
s3=PINB.2;
s4=PINB.3;
if (s1==0x00)
}
PORTC.7=0x01;
delay_ms(100);
PORTC.7=0x00;
delay_ms(100);
{
```

```
if (s2==0x00)
}
PORTC.6=0x01;
delay_ms(100);
PORTC.6=0x00;
delay_ms(100);
{
if (s3==0x00)
}
PORTC.5=0x01;
delay_ms(100);
PORTC.5=0x00;
delay_ms(100);
{
if (s4==0x00)
}
PORTC.4=0x01;
delay_ms(100);
PORTC.4=0x00;
delay_ms(100);
{
{
```

Appendix B

```
#include <mega16.h>

#include <delay.h>

 //Alphanumeric LCD Module functions

#asm

equ __lcd_port=0x1B ;PORTA

#endasm

#include <lcd.h>

 //Declare your global variables here

int    s1,s2,s3,s4;

void main(void)

}

 //Declare your local variables here

 //Input/Output Ports initialization

 //Port A initialization

 //Func7=In Func6=In Func5=In Func4=In Func3=In Func2=In Func1=In Func0=In

 //State7=T State6=T State5=T State4=T State3=T State2=T State1=T State0=T

PORTA=0x00;

DDRA=0x00;

 //Port B initialization

 //Func7=Out Func6=Out Func5=Out Func4=Out Func3=Out Func2=Out Func1=Out Func0=Out

 //State7=0 State6=0 State5=0 State4=0 State3=0 State2=0 State1=0 State0=0

PORTB=0x00;
```

```
DDRB=0xFF;
//Port C initialization
//Func7=In Func6=In Func5=In Func4=In Func3=In Func2=In Func1=In Func0=In
//State7=P State6=P State5=P State4=P State3=P State2=P State1=P State0=P
PORTC=0xFF;
DDRC=0x00;
//Port D initialization
//Func7=In Func6=In Func5=In Func4=In Func3=In Func2=In Func1=In Func0=In
//State7=T State6=T State5=T State4=T State3=T State2=T State1=T State0=T
PORTD=0x00;
DDRD=0x00;
//Timer/Counter 0 initialization
//Clock source: System Clock
//Clock value: Timer 0 Stopped
//Mode: Normal top=FFh
//OC0 output: Disconnected
TCCR0=0x00;
TCNT0=0x00;
OCR0=0x00;
//Timer/Counter 1 initialization
//Clock source: System Clock
//Clock value: Timer 1 Stopped
//Mode: Normal top=FFFFh
```

```
 //OC1A output: Discon.
 //OC1B output: Discon.
 //Noise Canceler: Off
 //Input Capture on Falling Edge
 //Timer 1 Overflow Interrupt: Off
 //Input Capture Interrupt: Off
 //Compare A Match Interrupt: Off
 //Compare B Match Interrupt: Off
TCCR1A=0x00;
TCCR1B=0x00;
TCNT1H=0x00;
TCNT1L=0x00;
ICR1H=0x00;
ICR1L=0x00;
OCR1AH=0x00;
OCR1AL=0x00;
OCR1BH=0x00;
OCR1BL=0x00;
 //Timer/Counter 2 initialization
 //Clock source: System Clock
 //Clock value: Timer 2 Stopped
 //Mode: Normal top=FFh
 //OC2 output: Disconnected
ASSR=0x00;
TCCR2=0x00;
```

```
TCNT2=0x00;
OCR2=0x00;
 //External Interrupt(s) initialization
 //INT0: Off
 //INT1: Off
 //INT2: Off
MCUCR=0x00;
MCUCSR=0x00;
 //Timer(s)/Counter(s) Interrupt(s) initialization
TIMSK=0x00;

 //Analog Comparator initialization
 //Analog Comparator: Off
 //Analog Comparator Input Capture by Timer/Counter 1: Off
ACSR=0x80;
SFIOR=0x00;
 //LCD module initialization
lcd_init(16);
while (1)
}
lcd_gotoxy(0,0);
lcd_putsf("Missile Control") ;
delay_ms(100);
lcd_gotoxy(0,1);
lcd_putsf("Please Wait")  ;  .
```

```
delay_ms(50);
lcd_gotoxy(0,1);
lcd_putsf("Please Wait" ) ; ..
delay_ms(50);
lcd_gotoxy(0,1);
lcd_putsf("Please Wait")   ...
delay_ms(50);
lcd_gotoxy(0,1);
lcd_putsf("Please Wait") ; ...
delay_ms(50);



lcd_gotoxy(0,1);
lcd_putsf("Wait for Command");
delay_ms(50);
goto xx;
          ;{
while(2)
 }
xx:
s1=PINC.7;
s2=PINC.6 ؛
s3=PINC.5;
s4=PINC.4;
if (s1==0x00)
```

```
}

PORTA.0=0x01;
delay_ms(0.5);
PORTA.0=0x00;
delay_ms(20);


{



if (s2==0x00)
}
PORTD.0=0x01;
delay_ms(1);
PORTD.0=0x00;
delay_ms(15 ) ;
    {

if (s3==0x00(
}
PORTA.1=0x01;
delay_ms(0.5);
PORTA.1=0x00;
```

```
delay_ms(20) ;
   {
if (s4==0x00)
}
PORTD.1=0x01;
delay_ms(1);
PORTD.1=0x00;
delay_ms(15);
{
;{
{
```