CHAPTER ONE
INTRODUCTION

1.1 General Concepts

Trains represent a large part of the transportation lineage because it provides space for the largest number of passengers at the same time also used in the transport of heavy goods.

In this project , the focus was on passenger trains in terms of the control and operation stopped where adoption turned on and of on humans may cause some disastrous mistakes.

Turn the whole world to the idea of fast trains relative to its time and provided the energy and time accuracy , and the strength of that speed hade to be controlled well hence the idea of automatic control of trains .

1.2 Problem Statement

It does not have a system that is manufactured loop some problems in modern system are some of the problems and difficulties which.

- The person must have and expert very modern control systems.
- Modern system in poor countries components may not be available
- Building fast train paths expensive.
- Systems traditional problems of reliance on the human element in all stages of control.

1.3 Objectives

- Connect all trains by one controller and that be easy to control all trains.
- Design controlled to stop and run the trains.
- Reduce the time spend in the traditional stop.
- Get rid of the human control system in trains.
- Adjust the punctuality of trains.
- Control train speed

- Lock the doors of the train before specified time of the move and opened after specified time of access.
- Sensors placed on doors to ensure that closure in the case of a people to stand on.

1.4 Methodology

To achieve the goals of the project was the work of the following tasks:

- Study has a real railway system to see how they work.

- Models have been the work imitates those systems and designed a system controller.

- According to the characteristics of the control system in model been the work of code running that system to achieve its purpose is required.

1.5 Layout

This project contains five gates : of the first section is an introduction for automatic control of trains and process system, which is designed to control the Models represents those systems, problems methodology targets display for the second section contains a historical view of the trains and their types and their evaluation. Section three talks about the controllers minute ARDUINO in general and in particular. Part IV contains model user and installation of the components of this model. Part V contains the conclusion and recommendations.

CHAPTER TWO

RAILWAYS TECHNOLOGY

2.1 Introduction

There are various types of trains that are designed for particular purposes. The first trains were rope-hauled, gravity powered or pulled by horses. From the early 19th century almost all were powered by steam locomotives. From the 1910s onwards the steam locomotives began to be replaced by less labor-intensive and cleaner (but more complex and expensive) diesel locomotives and electric locomotives, while at about the same time self-propelled multiple unit vehicles of either power system became much more common in passenger service [1].

Wrought iron was a soft material that contained included slag or dross. The softness and dross tended to make iron rails distort and delaminate, and they lasted less than 10 years. Sometimes they lasted as little as one year under high traffic.[2]

The introduction of the Bessemer process, enabling steel to be made inexpensively, led to the era of great expansion of railways that began in the late 1860s. Steel rails lasted several times longer than iron. Steel rails made heaver locomotives possible, allowing for longer trains and improving the productivity of railroads. The Bessemer process introduced nitrogen into the steel, which caused the steel to become brittle with age. The open hearth furnace began to replace the Bessemer process near the end of 19th century, improving the quality of steel and further reducing costs [2].

2.2 Steam Trains

The first full-scale working railway steam locomotive was built in the United Kingdom in 1804 by Richard Trevithick, an English engineer born in Cornwall. (The story goes that it was constructed to satisfy a bet by Samuel Homfray, the local iron master.) This used high pressure steam to drive the engine by one power stroke. The transmission system employed a large flywheel to even out the action of the piston rod. On 21 February 1804 the world's first railway journey took place when Trevithick's unnamed steam locomotive hauled a train along the tramway of the Penydarren ironworks, near Merthyr Tydfil in South Wales. Trevithick later demonstrated a locomotive operating upon a piece of circular rail track in Bloomsbury, London, the "Catch-Me-Who-Can", but never got beyond the experimental stage with railway locomotives, not least because his engines were too heavy for the cast-iron plate way track then in use. Despite his inventive talents, Richard Trevithick died in poverty, with his achievement largely unrecognized [3].

The first commercially successful steam locomotive was Matthew Murray's rack locomotive Salamanca built for the narrow gauge Middleton Railway in 1812. This twin cylinder locomotive was not heavy enough to break the edge-rails track, and solved the problem of adhesion by a cog-wheel using teeth cast on the side of one of the rails. It was the first rack railway.

This was followed in 1813 by the Puffing Billy built by Christopher Blackett and William Hedley for the Wylam Colliery Railway, the first successful locomotive running by adhesion only.

2.3 Electric Railways

The world's first electric tram line opened in Lichter felde near Berlin, Germany, in 1881. It was built by Werner von Siemens (see Gross-Lichter felde Tramway). Seven years later, in January 1888, Richmond, Virginia served as American proving grounds for electric railways Frank Sprague built an electric streetcar system there. By the 1890s, electric power became practical and more widespread, allowing extensive underground railways. Large cities such as London, New York, and Paris built subway systems. When electric propulsion became practical, most street railways were electrified. These then became known as "streetcars," "trolleys," "trams" and "Stassen bah." They can be found around the world [3].

In many countries, these electric street railways grew beyond the metropolitan areas to connect with other urban centers. In the USA, "electric interurban" railroad networks connected most urban areas in the states of Illinois, Indiana, Ohio, Pennsylvania and New York. In Southern California, the Pacific Electric Railway connected most cities in Los Angeles and Orange Counties, and the Inland Empire. There were similar systems in Europe. One of the more notable rail systems connected every town and city in Belgium. One of the more notable tramway systems in Asia is the Hong Kong Tramways, which started operation in 1904 and run exclusively on double-decker trams.

The remnants of these systems still exist, and in many places they have been modernized to become part of the urban "rapid transit" system in their respective areas. In the past thirty years increasing numbers of cities have restored electric rail service by building "light rail" systems to replace the tram system they removed during the mid-20th century.

2.4 Diesel power Train

The first diesel locomotives were low-powered machines, diesel-mechanical types used in switching yards. Diesel locomotives are cleaner, more efficient, and require less maintenance than steam locomotives. They also required less specialized skills in operation and their introduction diminished the power of railway unions in the United States (one of the earliest countries to adopt diesel power on a wide scale). After working through technical difficulties in the early 1900s, diesel locomotives became main stream after World War II. By the 1970s, diesel and electric power had replaced steam power on most of the world's railroads.

2.5 Passenger Train

A passenger train is one which includes passenger-carrying vehicles which can often be very long and fast. It may be a self-powered multiple unit or railcar, or else a combination of one or more locomotives and one or more unpowered trailers known as coaches, cars or carriages. Passenger trains travel between stations or depots, at which passengers may board and disembark. In most cases, passenger trains operate on a fixed schedule and have superior track occupancy rights over freight trains.

Unlike freight trains, passenger trains must supply head-end power to each coach for lighting and heating, among other purposes. This can be drawn directly from the locomotive's prime mover (modified for the purpose), or from a separate diesel generator in the locomotive. For passenger service on remote routes where a head-end-equipped locomotive may not always be available, a separate generator van may be used [4].

Some passenger trains, both long distance and short distanced, may use bi-level (double-decker) cars to carry more passengers per train. Car design and the general safety of passenger trains have dramatically evolved over time, making travel by rail remarkably safe.

2.5.1 High-speed Rail

One notable and growing long-distance train category is high-speed rail. Generally, high speed rail runs at speeds above 200 km/h (120 mph) and often operates on dedicated track that is surveyed and prepared to accommodate high speeds. Japan's ("bullet-train") commenced operation in 1964, and was the first successful example of a high speed passenger rail system.

The fastest wheeled train running on rails is France's TGV , which achieved a speed of 574.8 km/h (357.2 mph), twice the takeoff speed of a Boeing 727 jetliner, under test conditions in 2007. The highest speed currently attained in scheduled revenue operation is 350 km/h (220 mph) on the Beijing–Tianjin Intercity Rail and Wuhan–Guangzhou High-Speed Railway systems in China. The TGV runs at a maximum revenue speed of 300–320 km/h (190–200 mph), as does Germany's Inter-City Express and Spain's AVE

In most cases, high-speed rail travel is time- and cost-competitive with air travel when distances do not exceed 500 to 600 km (310 to 370 mi), as airport check-in and boarding procedures may add as many as two hours to the actual transit time. Also, rail operating costs over these distances may be lower when the amount of fuel consumed by an airliner during takeoff and climb out is considered. As travel distance increases, the latter consideration becomes less of the total cost of operating an airliner and air travel becomes more cost-competitive [5].

Some high speed rail equipment employs tilting technology to improve stability in curves

2.5.2 Double Deck Passenger Trains

In order to achieve much faster operation over 500 km/h (310 mph), innovative Maglev technology has been researched since the early 20th

century. The technology uses magnets to levitate the train above the track, reducing friction and allowing higher speeds. An early prototype was demonstrated in 1913, and the first commercial maglev train was an airport shuttle introduced in 1984.

The Shanghai Maglev Train, opened in 2003, is the fastest commercial train service of any kind, operating at speeds of up to 430 km/h (270 mph). Maglev has not yet been used for inter-city mass transit routes.

2.5.3 Intercity Trains

Passenger trains can be divided into three major groups:

•   Inter-city trains: connecting cities in the fastest time possible, bypassing all intermediate stations

•   Fast trains: calling at larger intermediate stations between cities, serving large urban communities

•   Regional trains: calling at all intermediate stations between cities, serving all line side communities

The distinction between the types can be thin or even non-existent. Trains can run as inter-city services between major cities, then revert to a fast or even regional train service to serve communities at the extremity of their journey. This practice allows marginal communities remaining to be served while saving money at the expense of a longer journey time for those wishing to travel to the terminus station [5].

2.5.4 Regional Trains

Regional trains usually connect between towns and cities, rather than purely linking major population hubs like inter-city trains, and serve local traffic demand in relatively rural area.

2.5.5 Higher-speed Rail

Higher-speed rail is a special category of inter-city trains. The trains for higher-speed rail services can operate at top speeds that are higher than

conventional inter-city trains but the speeds are not as high as those in the high-speed rail services. These services are provided after improvements to the conventional rail infrastructure in order to support trains that can operate safely at higher speeds.

2.5.6 Tram

In the United Kingdom, the distinction between a tramway and a railway is precise and defined in law. In the U.S. and Canada, such street railways are referred to as trolleys or streetcars. The key physical difference between a railroad and a trolley system is that the latter runs primarily on public streets, whereas trains have a right-of-way separated from the public streets. Often the U.S.-style interurban and modern light rail are confused with a trolley system, as it too may run on the street for short or medium-length sections. In some languages, the word tram also refers to interurban and light rail-style networks, in particular Dutch [4].

The length of a tram or trolley may be determined by national regulations Germany has the so-called Bo Strabo standard, restricting the length of a tram to 75 meters, while in the U.S., vehicle length is normally restricted by local authorities, often allowing only a single type of vehicle to operate on the network.

2.5.7 freight Trains

A freight train (also known as goods train) uses freight cars or freight wagons (also known as trucks or goods wagons) to transport goods or materials (cargo) – essentially any train that is not used for carrying passengers. Much of the world's freight is transported by train, and in the United States the rail system is used more for transporting freight than passengers.

Under the right circumstances, transporting freight by train is highly economic, and also more energy efficient than transporting freight by road. Rail freight is most economic when freight is being carried in bulk and over

long distances, but is less suited to short distances and small loads. Bulk aggregate movements of a mere twenty miles (32 km) can be cost effective even allowing for trans-shipment costs. These trans-shipment costs dominate in many cases and many modern practices such as Intermodal container freight are aimed at minimizing these [6].

The main disadvantage of rail freight is its lack of flexibility. For this reason, rail has lost much of the freight business to road competition. Many governments are now trying to encourage more freight onto trains, because of the benefits that it would bring.

There are many different types of freight trains, which are used to carry many different kinds of freight, with many different types of wagons. One of the most common types on modern railways are container trains, where containers can be lifted on and off the train by cranes and loaded off or onto trucks or ships.

CHAPTER THREE
MICRO CONTROLLER

3.1 Introduction

It is a highly integrated chip that contains all the components comprising a controller. Typically this includes a CPU, RAM, ROM and I/O ports. Unlike a general-purpose computer, which also includes all of these components, a microcontroller is designed for a very specific task to control a particular system. As a result, the parts can be simplified and reduced, which cuts down on production cost [7].History of microcontroller

The first computer system on a chip optimized for control applications was the Intel 8048 microcontroller with

both RAM and ROM on the same chip. Most microcontrollers at that time had two variants; one had an erasable EEPROM program memory, which was significantly more expensive than the PROM variant which was only programmable once.

The introduction of EEPROM memory allowed microcontrollers (beginning with the Microchip PIC16x84) to be electrically erased quickly without an expensive package as required for EPROM. The same year, Atmel introduced the first microcontroller using Flash memory. Other companies rapidly followed suit, with both memory types. Now microcontrollers are low cost and readily available for hobbyists, with large online communities around certain processors.

A microcontroller is a single-chip computer .Micro suggests that the device is small, and controller suggests that it is used in control applications. Another term for microcontroller is embedded controller, since most of the microcontrollers are built into (or embedded in) the devices that controlling [7].

Microcontrollers have traditionally been programmed using the assembly language of the target device. Although the assembly language is fast, it has

several disadvantages. An assembly program consists of mnemonics, which makes learning and maintaining a program written using the assembly language difficult. Also, microcontrollers manufactured by different firms have different assembly languages, so the user must learn a new language with every new microcontroller he or she uses.

Microcontrollers can also be programmed using a high-level language, such as BASIC, PASCAL, or C. High-level languages are much easier to learn than assembly languages and also facilitate the development of large and complex programs

Microcontroller applications found in many life filed, for example in Cell phone, watch, recorder, calculators, mouse, keyboard, modem, fax card, sound card, battery charger, door lock, alarm clock, thermostat, air conditioner, TV Remotes, in Industrial equipment like Temperature and pressure controllers, counters and timers.

3.2 Arduino Microcontroller

Arduino is a small microcontroller board with a USB plug to connect to your computer and a number of connection sockets that can be wired up to external electronics, such as motors, relays, light sensors, laser diodes, loudspeakers, microphones, etc. Arduino can either be powered through the USB connection from the computer or from a 9V battery. Arduino can be controlled from the computer or programmed by the computer and then disconnected and allowed to work independently Arduino microcontroller board is shown in figure (3.1).

The Arduino/Genuino Uno has a resettable poly fuse that protects your computer's USB ports from shorts and over current. 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.
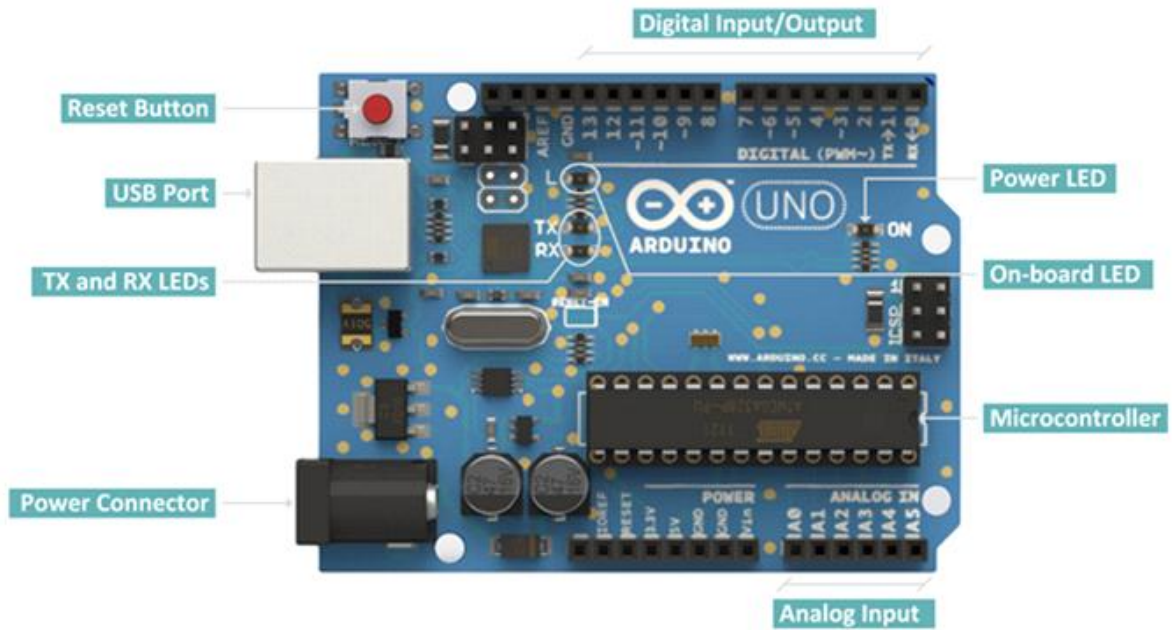
Figure (3.1): Arduino microcontroller board

3.2.1 The Arduino Board

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

Although it might not look like much to the new observer, the Arduino system allows creating devices that can interact with the world. By using an almost unlimited range of input and output devices, sensors, indicators, displays, motors, and more, the exact interactions required to create a functional device can be programmed. For example, artists have created installations with patterns of blinking lights that respond to the movements of passers-by, high school students have built autonomous robots that can detect an open flame and extinguish it, and geographers have designed systems that monitor temperature and humidity and transmit this data back to their offices

via text message. In fact, there are infinite numbers of examples with a quick search on the Internet [8].

By taking a quick tour of the Uno Starting at the left side of the board there are two connectors, as shown in Figure (3.2)
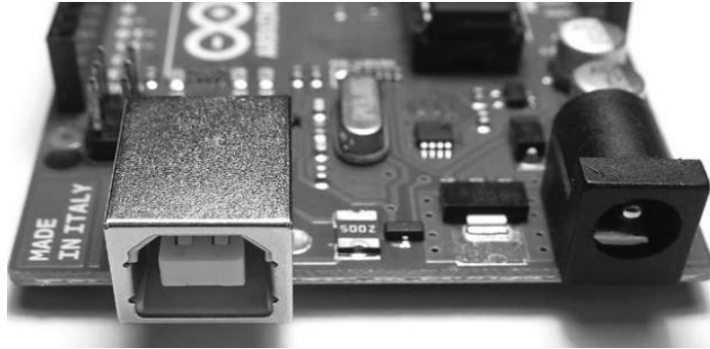

Figure (3.2): The USB and power connectors

On the far left is the Universal Serial Bus (USB) connector. This connects the board to your computer for three reasons; to supply power to the board, to upload the instructions to the Arduino, and to send data to and receive it from a computer. On the right is the power connector, this connector can power the Arduino with a standard mains power adapter.

At the lower middle is the heart of the board: the microcontroller, as Shown in Figure (3.3).

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Figure (3.3): The microcontroller

The microcontrollers represent the "brains" of the arduino. It is a tiny computer that contains a processor to execute instructions, includes various

types of memory to hold data and instructions from our sketches, and provides various avenues of sending and receiving data. Just below the microcontroller are two rows of small sockets, as shown in Figure (3.4).
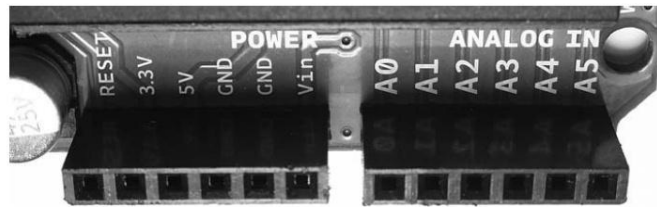

Figure (3.4): The power and analog sockets

The first row offers power connections and the ability to use an external RESET button. The second row offers six analog inputs that are used to measure electrical signals that vary in voltage. Furthermore, pins A4 and A5 can also be used for sending data to and receiving it from other devices. Along the top of the board are two more rows of sockets, as shown in Figure (3.5).
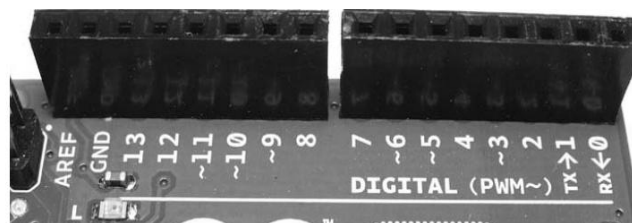

Figure (3.5): The digital input/output pins

Sockets (or pins) numbered 0 to 13 are digital input/output (I/O) pins. They can either detect whether or not an electrical signal is present or generate a signal on command. Pins 0 and 1 are also known as the serial port, which is used to send and receive data to other devices, such as a computer via the

USB connector circuitry. The pins labeled with a tilde (~) can also generate a varying electrical signal, which can be useful for such things as creating lighting effects or controlling electric motors [9].

Next are some very useful devices called light-emitting diodes (LEDs); these very tiny devices light up when a current passes through them. The Arduino board has four LEDs: one on the far right labeled ON, which indicates when the board has power, and three in another group, as shown in Figure (3.6).

The LEDs labeled TX and RX light up when data is being transmitted or received between the Arduino and attached devices via the serial port and USB. The L-LED connected to the digital I/O pin number 13. The little black square part to the left of the LEDs is a tiny microcontroller that controls the USB interface that allow Arduino to send data to and receive it from a computer [9].

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.
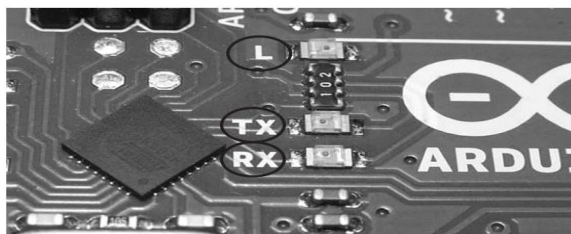

Figure (3.6): The onboard LEDs

3.2.2 Software

The Arduino project provides the Arduino integrated development environment (IDE), which is a cross-platform application written in the programming language Java. It originated from the IDE for the

languages Processing and Wiring. It is designed to introduce programming to artists and other newcomers unfamiliar with software development. It includes a code editor with features such assyntax highlighting, brace matching, and automatic indentation, and provides simple one-click mechanism to compile and load programs to an Arduino board. A program written with the IDE for arduino is called a "sketch".

The Arduino IDE supports the languages C and C++ using special rules to organize code. The Arduino IDE supplies a software library called Wiring from the Wiring project, which provides many common input and output procedures. A typical Arduino C/C++ sketch consist of two functions that are compiled and linked with a program stub

- main( ) into an executable cyclic executive program:

- setup( ): a function that runs once at the start of a program and that can initialize settings.

- loop( ): a function called repeatedly until the board powers off.

After compiling and linking with the GNU tool chain, also included with the IDE distribution, the Arduino IDE employs the program over dude to convert the executable code into a text file in hexadecimal coding that is loaded into the Arduino board by a loader program in the board's firmware [11].

Arduino programs may be written in any programming language with a compiler that produces binary machine code. Atmel provides a development environment for their microcontrollers, AVR Studio and the newer Atmel Studio, which can be used for programming Arduino.

Arduino can be controlled using C/C++ interpreter without the binary code. Two textbooks "Learning Arduino with Ch Programming for the Absolute Beginner" and "Learning Arduino with C Programming" are freely available.

Sample program

The bare minimum code to start a sketch program consists of two functions setup ( ) and loop ( ).

```
Void  setup( ) {
// put your setup code here, to run once at startup
}


Void  loop( ) {
// put your main code here, to run repeatedly
}
```

Most Arduino boards contain an LED and a load resistor connected between pin 13 and ground which is a convenient feature for many tests.

A typical program for a beginning Arduino programmer blinks a on and off. This program is usually loaded in the Arduino board by the manufacturer. In the Arduino environment, a user might write such a program as shown.

```
#define LED_PIN 13              // Pin number attached to LED


void setup( ) {
pinMode(LED_PIN, OUTPUT);       // Enable pin 13 for digital output.
}


void loop() {
digitalWrite(LED_PIN, HIGH);    // Turn on the LED.
delay(1000);                    // Wait one second. (1000 milliseconds)
digitalWrite(LED_PIN, LOW);     // Turn off the LED.
delay(1000);                    // Wait one second.
}
```

3.2.3 Development

Arduino is open-source hardware. The hardware reference designs are distributed under a Creative Commons Attribution Share-Alike 2.5 license and are available on the Arduino website. Layout and production files for some versions of the hardware are also available. The source code for the IDE is released under the GNU General Public License, version 2. Nevertheless an official Bill of Materials of Arduino boards has never been released by the staff of Arduino.

Although the hardware and software designs are freely available under copy left licenses, the developers have requested that the name "Arduino" be exclusive to the official product and not be used for derived works without permission. The official policy document on use of the Arduino name emphasizes that the project is open to incorporating work by others into the official product. Several Arduino-compatible products commercially released have avoided the Arduino name by using -aduino name variants.

3.2.4 Applications

• Xoscillo, an open-source oscilloscope

• Scientific equipment such as the Chemduino

• Arduinome, a MIDI controller device that mimics the Monome

• OBDuino, a trip computer that uses the on-board diagnostics interface found in most modern cars

• Ardupilot, drone software and hardware

• Arduino Phone, a do-it-yourself cell phone

• GertDuino, an Arduino mate for the Raspberry Pi

• Water quality testing platform

• Homemade CNC using Arduino and DC motors with close loop control by homofaciens

• DC motor control using Arduino and H-Bridge

3.2.5 Programming

The Arduino/Genuino Uno can be programmed with the (Arduino Software (IDE)). Select "Arduino/Genuino 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/Genuino Uno comes preprogrammed with a boot loader 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 boot loader and program the microcontroller through the ICSP (In-Circuit Serial Programming) header using Arduino ISP or similar; see these instructions for details.

The ATmega16U2 (or 8U2 in the rev1 and rev2 boards) firmware source code is available in the Arduino repository. The ATmega16U2/8U2 is loaded with a DFU boot loader, 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 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 boot loader). See this user-contributed tutorial for more information.

3.2.6 Power source arduino

The Arduino/Genuine Uno board 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 [10].

The board can operate on an external supply from 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may become unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts. Vin. The input voltage to the Arduino/Genuino 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 [11].

• 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.

• IOREF. This pin on the Arduino/Genuine board provides the voltage reference with which the microcontroller operates. A properly configured shield can read the IOREF pin voltage and select the appropriate power source or enable voltage translators on the outputs to work with the 5V or 3.3V

3.2.7 Memory

The ATmega328 has 32 KB (with 0.5 KB occupied by the boot loader). It also has 2 KB of SRAM and 1 KB of EEPROM (which can be read and written with the EEPROM library).

3.2.8 Input and Output

See the mapping between Arduino pins and ATmega328P ports. The mapping for the Atmega8, 168, and 328 is identical.

Each of the 14 digital pins on the Uno can be used as an input or output, using pin Mode, digital write, and digital read functions. They operate at 5 volts. Each pin can provide or receive 20 mA as recommended operating condition and has an internal pull-up resistor (disconnected by default) of 20-50k ohm. A maximum of 40mA is the value that must not be exceeded on any I/O pin to avoid permanent damage to the microcontroller. 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 attach Interrupt function for details.

• PWM: 3, 5, 6, 9, 10, and 11. Provide 8-bit PWM output with the analog Write 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 driven by digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.

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

- 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. There are a couple of other pins on the board:

- AREF. Reference voltage for the analog inputs. Used with analog Reference.

- 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.

3.2.9 Communication

Arduino/Genuino Uno has a number of facilities for communicating with a computer, another Arduino/Genuino board, 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 (IDE) includes a serial monitor which allows simple textual data to be sent to and from the 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 Software Serial library allows serial communication on any of the Uno's digital pins [10].

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

Automatic (Software) reset Rather than requiring a physical press of the reset button before an upload, the Arduino/Genuino Uno board 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 nano farad capacitor. When this line is asserted (taken low), the reset line drops long enough to reset the chip. The Arduino Software (IDE) uses this capability to allow you to upload code by simply pressing the upload button in the interface toolbar. This means that the boot loader 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 boot loader 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 to the board after a connection is opened. If a sketch running on the board receives one-time configuration or other data when it first starts, make sure that the software with which it communicates waits a second after opening the connection and before sending this data.

The Uno board 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.

3.2.10 Revisions

Revision three of the board has the following new features:

• pin out: 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 with both the board that uses the AVR, which operates with 5V and with the Arduino Due that operates 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.

CHAPTER FOUR

THE COMPONENTS AND CONSTRUCTION

4.1 Introduction

speed trains depend on automatic control which divide to several types, one of this type is control with arduino system.we can divide the system as follow, transmitter and control unit   consist the microcontroller (arduino uno) , two ir sensors , Rf Transmitter and power source (regulated 5 voltage) connected as figure(4.1)
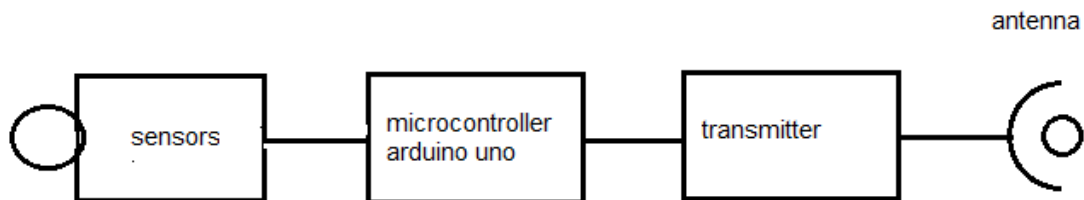

Figure (4.1):TRANSMITTER AND CONTROL UNIT

when the train enter the sensors sensing rang a signal will be send to the microcontroller then the microcontroller according to the code specifications will send signal to transmitter. Receiver and switching unit

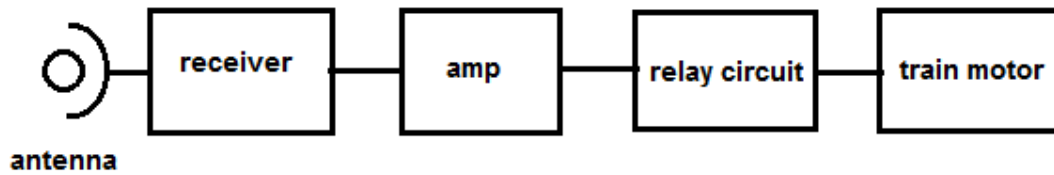it consist receiver and relay circuit which connected with the train motor as shown below figure (4.2)

Figure (4.2) : RECEIVER AND SWITCHING UNIT

when the receiver received a signal it will sent activation signal to the relay then the relay will changed his contacts then the train will be stopped according to the code specifications which it specified by the system operator.

4.2 Requirement

The requirements' of control circuit transmitter and receiver which contain:

4.2.1 Relay

A relay is a kind of "remote controlled switch". From the inception of the electric starter, some kind of remote switch was required in order to provide the power to the starter motor without bringing the heavy, unwieldy wires to the dash and, as a result, making them longer with consequent voltage drop. Having a remote switch allows application and interruption of current to be done at the most electrically efficient point in the circuit, even if it is the most ergonomically least suitable position. At first, starter motors were operated by pulling on a cable which operated the switch, much in the same way that a bonnet (hood) latch is still actuated today .

Basically, inside a relay there is a small electromagnet that requires, in most automotive relays, about 0.25 Amps to operate it. Once this small current is flowing, the electromagnet can pull-in (or if so configured, let-go) a switch

capable, depending on the relay, of controlling many times that current, but usually from 30 Amps to 70 Amps. Not only does the relay deliver more power to the load than could be efficiently achieved with a dash or column switch and its associated wiring but the dash switch and wires can be smaller, lower cost and have longer life owing to the minimal heating and arcing that results from switching, carrying and interrupting only 1/4 Amp

4.2.2 Sensors

There are many deferent of sensors :

Light sensor can be included in the proximity sensor category, and it is a simple sensor that changes the voltage of Photoresistor or Photovoltaic cells in concordance with the amount of light detected. A light sensor is used in very popular applications for autonomous robots that track a line-marked path.

Colors sensor are reflected with different intensity, for example the orange color reflects red light in an amount greater than the green color, and this is the color sensor. This simple sensor is in the same range with light sensor, but with a few extra features that can be useful for applications where the robot has to detect the presence of an object with a certain color, or to detect the types of objects or the surfaces.

The touch sensor can be included in the proximity sensors category and are designed to sense objects at a small distance with or without direct contact. This sensor is designed to detect the changes in the capacitance between the on-board electrodes and the object making contact.

Ultrasonic sensor are designed to generate high frequency sound waves and receive the echo reflected by the target. These sensors are used in a wide

range of applications and are very useful when it is not important the detection of colors, surface texture, or transparency.

An infrared sensor measure the IR light that is transmitted in the environment to find objects by an IR LED. This type of sensor is very popular in navigation for object avoidance, distance measured or line following applications. This sensor is very sensitive to IR lights and sunlight, and this is the main reason that an IR sensor is used with great precision in spaces with low light.

The sonar sensor can be used primarily in navigation for object detection, even for small objects, and generally are used in projects with a big budget because this type of sensor is very expensive. This sensor has high performances on the ground and in water where it can be used for submersed robotics projects.

A laser light is very useful for tracking and detection a target located at a long distance. The distance between sensor and target is measured by calculating the speed of light and the time since light is emitted and until it is returned to the receiver.

A laser sensor is very precise in measurement and in the same time is very expensive.

Image Sensor : Most popular combination for detection and tracking an object or detecting a human face is a webcam and the Open CV vision software. This combination may be the best in detection and tracking applications, but it is necessary to have advanced programming skills and a mini computer like a Raspberry Pi.

Using an image sensor can be built a wide range of applications

IR sensor had been used in this case :

- **IR sensor :**

Infrared technology addresses a wide variety of wireless applications. The main areas are sensing and remote controls. In the electromagnetic spectrum, the infrared portion is divided into three regions: near infrared region, mid infrared region and far infrared region, as shown Figure (4.1)
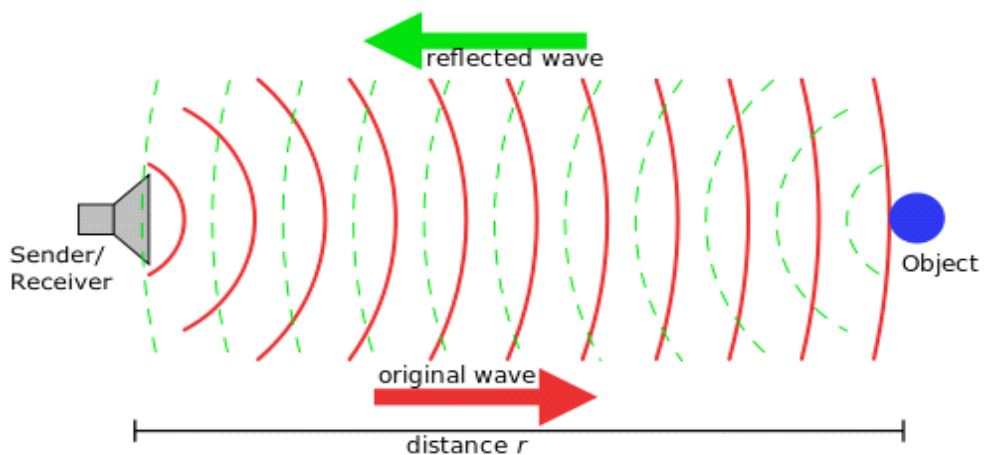

Figure (4.3): IR sensor

- **Types of IR Sensors:**

Infrared sensors can be passive or active. Passive infrared sensors are basically Infrared detectors. Passive infrared sensors do not use any infrared source and detects energy emitted by obstacles in the field of view. They are of two types: quantum and thermal. Thermal infrared sensors use infrared energy as the source of heat and are independent of wavelength. Thermocouples, pyroelectric detectors and bolometers are the common types of thermal infrared detectors.

Quantum type infrared detectors offer higher detection performance and are faster than thermal type infrared detectors. The photosensitivity of quantum type detectors is wavelength dependent. Quantum type detectors are further

classified into two types: intrinsic and extrinsic types. Intrinsic type quantum detectors are photoconductive cells and photovoltaic cells.

Active infrared sensors consist of two elements: infrared source and infrared detector. Infrared sources include an LED or infrared laser diode. Infrared detectors include photodiodes or phototransistors. The energy emitted by the infrared source is reflected by an object and falls on the infrared detector,

- **IR Transmitter**

Infrared Transmitter is a light emitting diode (LED) which emits infrared radiations. Hence, they are called IR LED's. Even though an IR LED looks like a normal LED, the radiation emitted by it is invisible to the human eye.

The picture of a typical Infrared LED is shown below. Figure (4.2)

Figure (4.4): LED

There are different types of infrared transmitters depending on their wavelengths, output power and response time.

A simple infrared transmitter can be constructed using an infrared LED, a current imiting resistor and a power supply. The schematic of a typical IR transmitter is shownbelow,figure(4.3).
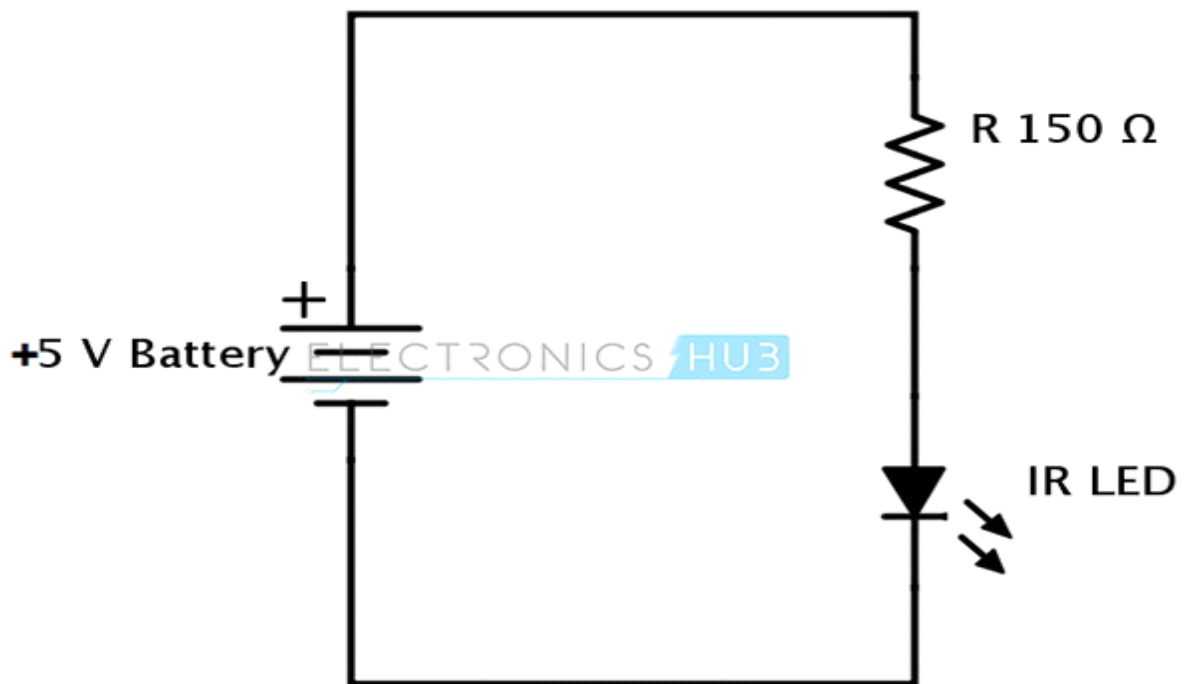
figure (4.5) The schematic of a typical IR transmitter

When operated at a supply of 5V, the IR transmitter consumes about 3 to 5 mA of current. Infrared transmitters can be modulated to produce a particular frequency of infrared light. The most commonly used modulation is OOK (ON – OFF – KEYING) modulation.

IR transmitters can be found in several applications. Some applications require infrared heat and the best infrared source is infrared transmitter. When infrared emitters are used with Quartz, solar cells can be made.

• **IR Receiver**

Infrared receivers are also called as infrared sensors as they detect the radiation from an IR transmitter. IR receivers come in the form of photodiodes and phototransistors. Infrared Photodiodes are different from normal photo diodes as they detect only infrared radiation. The picture of a typical IR receiver or a photodiode is shown below.

Different types of IR receivers exist based on the wavelength, voltage, package, etc. When used in an infrared transmitter – receiver combination, the wavelength of the receiver should match with that of the transmitter.

A typical infrared receiver circuit using a phototransistor is shown below.Different types of IR receivers exist based on the wavelength, voltage, package, etc. When used in an infrared transmitter – receiver combination, the wavelength of the receiver should match with that of the transmitter.

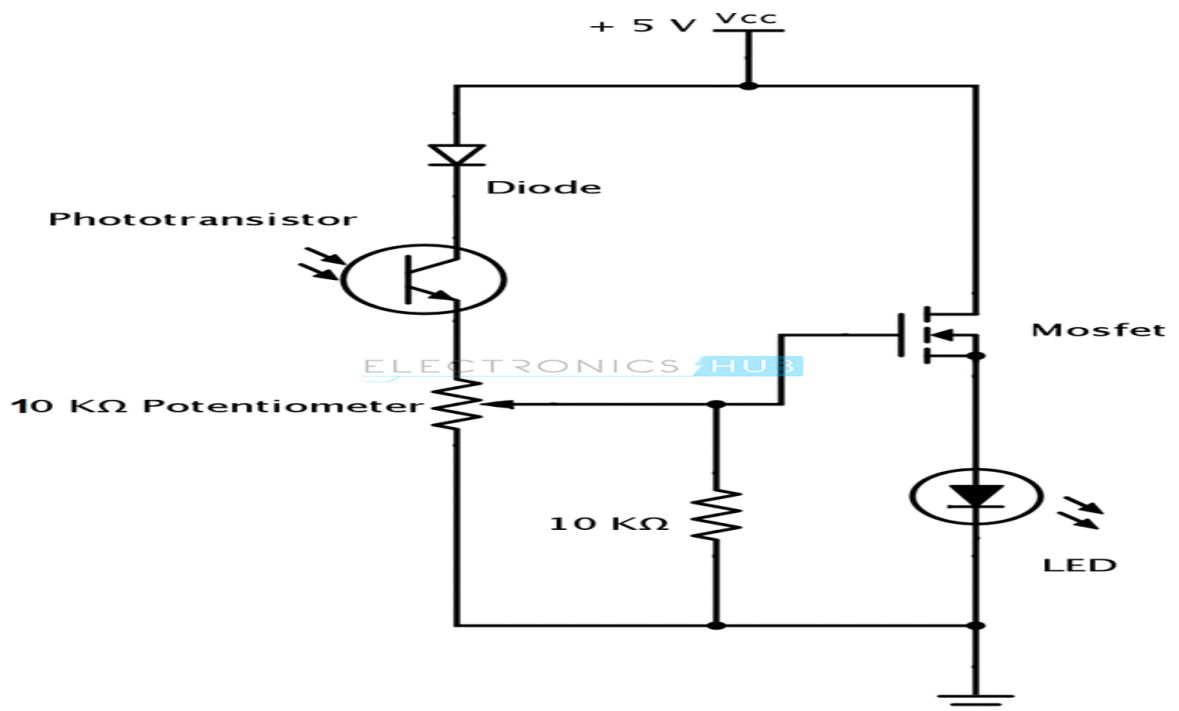A typical infrared receiver circuit using a phototransistor is shown below,figure (4.4)

Figure (4.6) : PHOTOTRANSISTOR

It consists of an IR phototransistor, a diode, a MOSFET, a potentiometer and an LED. When the phototransistor receives any infrared radiation, current

flows through it and MOSFET turns on. This in turn lights up the LED which acts as a load. The potentiometer is used to control the sensitivity of the phototransistor.

- **Principle of working**

The principle of an IR sensor working as an Object Detection Sensor can be explained using the following figure (4.5). An IR sensor consists of an IR LED and an IR Photodiode; together they are called as Photo – Coupler or Op
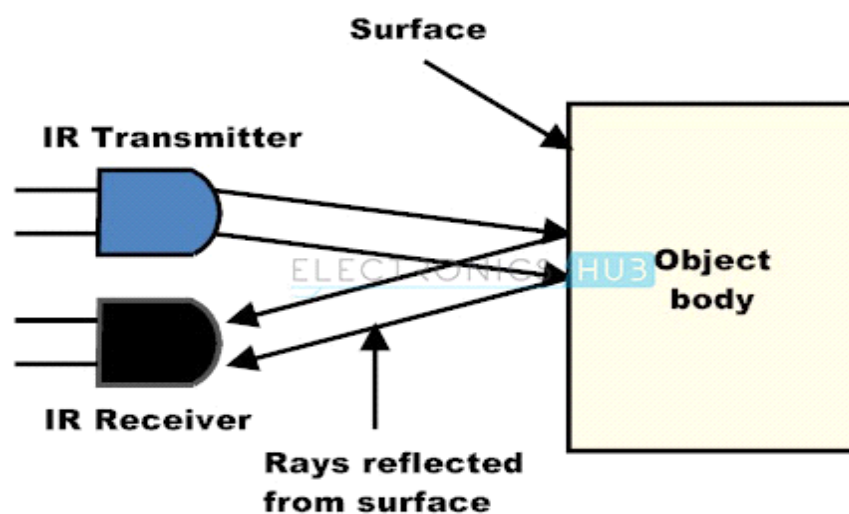
to – Coupler.

Figure (4.5): THE PRINCIPLE OF AN IR SENSOR

When the IR transmitter emits radiation, it reaches the object and some of the radiation reflects back to the IR receiver. Based on the intensity of the reception by the IR receiver, the output of the sensor is defined.

- **Obstacle Sensing Circuit or IR Sensor Circuit**

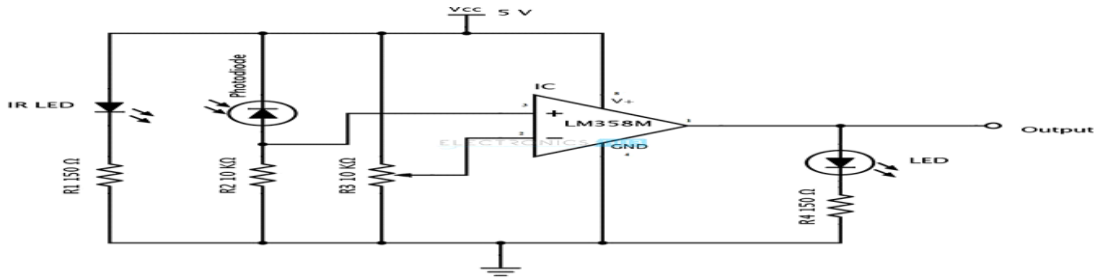A typical IR sensing circuit is shown below,figure(4.6)

Figure (4.6): A TYPICAL IR SENSING CIRCUIT

It consists of an IR LED, a photodiode, a potentiometer, an IC Operational amplifier and an LED.

IR LED emits infrared light. The Photodiode detects the infrared light. An IC Op − Amp is used as a voltage comparator. The potentiometer is used to calibrate the output of the sensor according to the requirement.

When the light emitted by the IR LED is incident on the photodiode after hitting an object, the resistance of the photodiode falls down from a huge value. One of the input of the op − amp is at threshold value set by the potentiometer. The other input to the op-amp is from the photodiode's series resistor. When the incident radiation is more on the photodiode, the voltage drop across the series resistor will be high. In the IC, both the threshold voltage and the voltage across the series resistor are compared. If the voltage across the resistor series to photodiode is greater than that of the threshold voltage, the output of the IC Op − Amp is high. As the output of the IC is connected to an LED, it lightens up. The threshold voltage can be adjusted by adjusting the potentiometer depending on the environmental conditions.

The positioning of the IR LED and the IR Receiver is an important factor. When the IR LED is held directly in front of the IR receiver, this setup is called Direct Incidence. In this case, almost the entire radiation from the IR

LED will fall on the IR receiver. Hence there is a line of sight communication between the infrared transmitter and the receiver. If an object falls in this line, it obstructs the radiation from reaching the receiver either by reflecting the radiation or absorbing the radiation.

- **Distinguishing Between Black and White Colors:**

It is universal that black color absorbs the entire radiation incident on it and white color reflects the entire radiation incident on it. Based on this principle, the second positioning of the sensor couple can be made. The IR LED and the photodiode are placed side by side. When the IR transmitter emits infrared radiation, since there is no direct line of contact between the transmitter and receiver, the emitted radiation must reflect back to the photodiode after hitting any object. The surface of the object can be divided into two types: reflective surface and non-reflective surface. If the surface of the object is reflective in nature i.e. it is white or other light color, most of the radiation incident on it will get reflected back and reaches the photodiode. Depending on the intensity of the radiation reflected back, current flows in the photodiode.

If the surface of the object is non-reflective in nature i.e. it is black or other dark color, it absorbs almost all the radiation incident on it. As there is no reflected radiation, there is no radiation incident on the photodiode and the resistance of the photodiode remains higher allowing no current to flow. This situation is similar to there being no object at all.

In order to avoid reflections from surrounding objects other than the object, both the IR transmitter and the IR receiver must be enclosed properly. Generally the enclosure is made of plastic and is painted with black color.

4.3 LED

A light-emitting diode (LED) is a two-lead semiconductor light source. It is a p–n junction diode, which emits light when activated When a suitable voltage is applied to the leads, 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 band gap of the semiconductor.

An LED is often small in area (less than 1 mm^2) and integrated optical components may be used to shape its radiation pattern.

Appearing as practical electronic components in 1962, The earliest LEDs emitted low-intensity infrared light. Infrared LEDs are still frequently used as transmitting elements in remote-control circuits, such as those in remote controls for a wide variety of consumer electronics. The first visible-light LEDs were also of low intensity, and limited to red. Modern LEDs are available across the visible ultraviolet, and infrared wavelengths, with very high brightness.

Early LEDs were often used as indicator lamps for electronic devices, replacing small incandescent bulbs. They were soon packaged into numeric readouts in the form of seven-segment displays, and were commonly seen in digital clocks.

Recent developments in LEDs permit them to be used in environmental and task lighting. LEDs have many advantages over incandescent light sources including lower energy consumption, longer lifetime, improved physical robustness, smaller size, and faster switching. Light-emitting diodes are now used in applications as diverse as aviation lighting, automotive headlamps, advertising, general lighting, traffic signals, camera flashes and lighted wallpaper. As of 2015, LEDs powerful enough for room lighting remain

somewhat more expensive, and require more precise current and heat management than compact fluorescent lamp sources of comparable output.

LEDs have allowed new text, video displays, and sensors to be developed, while their high switching rates are also used in advanced communications technology.
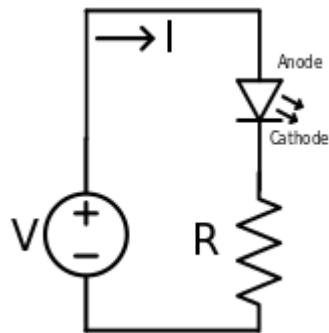
Figure(4.7):SIMPLE LED CIRCUIT WITH RESISTOR FOR CURRENT LIMITING

The current–voltage characteristic of an LED is similar to other diodes, in that the current is dependent exponentially on the voltage (see Shockley diode equation). This means that a small change in voltage can cause a large change in current. if the applied voltage exceeds the LED's forward voltage drop by a small amount, the current rating may be exceeded by a large amount, potentially damaging or destroying the LED. The typical solution is to use constant-current power supplies to keep the current below the LED's maximum current rating. Since most common power sources (batteries, mains) are constant-voltage sources, most LED fixtures must include a power converter, at least a current-limiting resistor. However, the high resistance of three-volt coin cells combined with the high differential resistance of nitride-based LEDs makes it possible to power such an LED from such a coin cell without an external resistor.

4.4 Battery (electricity):

An electric battery is a device consisting of one or more electrochemical cells with external connections provided to power electrical devices. When a battery is supplying power, its positive terminal is the cathode and its negative terminal is the anode. The terminal marked negative is the source of electrons that when connected to an external circuit will flow and deliver energy to an external device. When a battery is connected to an external circuit, electrolytes are able to move as ions within, allowing the chemical reactions to be completed at the separate terminals and so deliver energy to the external circuit. It is the movement of those ions within the battery which allows current to flow out of the battery to perform work. Historically the term "battery" specifically referred to a device composed of multiple cells, however the usage has evolved to additionally include devices composed of a single cell.

Primary (single-use or "disposable") batteries are used once and discarded; the electrode materials are irreversibly changed during discharge. Common examples are the alkaline battery used for flashlights and a multitude of portable devices. Secondary (rechargeable) batteries can be discharged and recharged multiple times; the original composition of the electrodes can be restored by reverse current. Examples include the lead-acid batteries used in vehicles and lithium-ion batteries used for portable electronics.

Batteries come in many shapes and sizes, from miniature cells used to power hearing aids and wristwatches to battery banks the size of rooms that provide standby power for telephone exchanges and computer data centers.

According to a 2005 estimate, the worldwide battery industry generates US$48 billion in sales each year, with 6% annual growth.

Batteries have much lower specific energy (energy per unit mass) than common fuels such as gasoline. This is somewhat offset by the higher

efficiency of electric motors in producing mechanical work, compared to combustion engines.

4.5 Radio Frequency

Radio frequency (**RF**) is any of the electromagnetic wave frequencies that lie in the range extending from around 3 kHz to 300 GHz, which include those frequencies used for communications or radar signals. RF usually refers to electrical rather than mechanical oscillations. However, mechanical RF systems do exist (see mechanical filter and RF MEMS).

Although radio frequency is a rate of oscillation, the term "radio frequency" or its abbreviation "RF" are used as a synonym for radio – i.e., to describe the use of wireless communication, as opposed to communication via electric wires[11]. Examples include:

- Radio-frequency identification
ISO/IEC 14443-2 Radio frequency power and signal interface

4.6 Electrical System Connections

When train arrived to station is cut one of two sensor and that sensor send signal to the arduino (connect two sensor at p8,p10,p5v,ground,(PGND)),after that the arduino work according to programmable ,sending signal to transmitter (connect at p13, pGND),which send that wireless signal to receiver device, which connect with relay (5v,source).out of receiver change position of relay all that lead to stop the train. After that the arduino send signal after certain time to change positive of relay to start the train. All pins shown in figure (3.5) .

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

Train control process became a reality would spread allover the world .

The control of the express train through the arduino ratio for easy programming and use, and the ability to add models to send and receive wireless signal, it is set parking country and his time reduce the consumer in a way traditional time. Designed controller to start and stop the train and use it to control several trains because its central control. The advantages of the use of IR sensor low coast. The advantage of wireless signal less expensive than wired and more flexible. Installation ware up to places that cannot get up to the cable signals.

5.2 Recommendations

• the system can be controlled by more advanced control techniques and the model can be developed for reality use.

• outomatic system for lock the doors of the train before specified time of the move and opened after specified time of access,using a sensors

• electronic relay proportion to the speed of their response.

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APPENDIX

```
int tx=13;

int sensor1=8;

int sensor2=10;

int s1;

int s2;

void setup()

{

pinMode(tx,OUTPUT);

pinMode(sensor1,INPUT);

pinMode(sensor2,INPUT);

Serial.begin(9600);

  // put your setup code here, to run once:


}


void loop()

{

s1=digitalRead(sensor1);

s2=digitalRead(sensor2);
```

```
if(s2==LOW)

{digitalWrite(tx,HIGH);

delay(5000);

digitalWrite(tx,LOW);

delay(3000);

Serial.println(s2);}

else if(s1==LOW)

{digitalWrite(tx,HIGH);

delay(5000);

digitalWrite(tx,LOW);

delay(3000);

Serial.println(s1);

}

else

{digitalWrite(tx,LOW);

Serial.println(s2);

}

  // put your main code here, to run repeatedly:


}
```