



Sudan University of Science and Technology



College of Engineering

*School of Electrical & Nuclear
Engineering*

Implementation of GSM camera

تنفيذ أنظمة التجوال العالمي على الكاميرا

**A project Submitted In Partial Fulfillment for the Requirement of the
Degree of B.Sc. (Honor) in Electrical Engineering**

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الآية

قال تعالى :

﴿ يَرْفَعِ اللَّهُ الَّذِينَ آمَنُوا مِنْكُمْ وَالَّذِينَ أُوتُوا الْعِلْمَ دَرَجَاتٍ ﴾

صدق الله العظيم

سورة المجادلة الآية (11)

إهداء

الى امي وابي أقرب الناس الى قلبي..

من وسعتني رحمتها صغيرا، وأسعدتني صحبتها كبيرا ..

الى اخوتي ..

الى رفقاء الحلم و الدرب اصدقائي ..

الى كل من علمني حرفا اضاء به طريقي

الشكر و العرفان

الشكر أولا و أخيرا لله تعالى الذى وفقنا لإنهاء هذا العمل المتواضع

وننتقدم بالشكر الى الذين مهدوا لنا طريق العلم والمعرفة

الى جميع اساتذتنا الافاضل

ونخص بالشكر والتقدير:

الأستاذ/ جلال عبدالرحمن محمد

لما منحه لنا من وقت وجهد وتوجيه وارشاد

كما نشكر كل من ساعدنا وقدم لنا العون ولو بكلمة

Abstract

Telecommunication is now a growing field in our lives, also a lot of people are depending on modern technologies on every day tasks.

This project is done to aid people in monitoring their homes, facilities, ...etc. and not affecting the way of living their modern lives by designing a security camera controlled by the cellular phone(Gsm) and also receiving the live video stream on the cellphone.

It provides an easy access to the user, also there will be no need to other devices besides the cell phone(which is already an essential part of everybody's way of living).

المستخلص

الاتصالات أصبحت من الحقول المتطورة حيث يوجد العديد من الناس المعتمدين على التقنيات الحديثة لانجاز المهام اليومية.

هذا المشروع يؤدي أغراض أمنية عن طريق تصميم كاميرا مراقبة يتم التحكم فيها عن طريق الهاتف الخليوي(شبكة الهاتف الخليوي) واستقبال بث الفيديو المباشر على الهاتف الخليوي. توفر هذه الطريقة الوصول السهل للكاميرا وايضا تغني عن اي اجهزة اضافية عدا الهاتف الخليوي(الذي يعد جزءا مهم من طريقة حياة كل فرد) .

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LIST OF ABBREVIATIONS

CEPT	European conference of postal and telecommunications
GSM	Global system for mobile
EU	Europe
MOU	Memorandum of understanding
LCD	Liquid crystal display
RF	Radio frequency
DVR	Digital video recorder
GHZ	Giga hertz
MHZ	Mega hertz
IP	Internet protocol
WIFI	Wireless fidelity
PC	Personal computer
LOS	Line of sight
MS	Mobile station
BSS	Base station subsystem
NSS	Network switching subsystem
OSS	Operation support subsystem
HLR	Home location register
VLR	Visitor location register
EIR	Equipment identity
AuC	Authentication center
SMS SC	SMS serving center
GMSC	Gateway MSC

TRAU	Tran coder and adaptation
CGI	Cell global identity
LA	Location area
LAI	Location area identity
PLMN	Public land mobile network
GMSK	Gaussian minimum shift keying
DC	Direct current
AC	Alternating current
SIM	Subscriber Identity Module

CHAPTER ONE

INTRODUCTION

1.1 Background

In 1982, work began to develop a European standard for digital cellular voice telecommunications when the European Conference of Postal and Telecommunications Administrations (CEPT) created the Group Special Mobile committee and later provided a permanent technical support group based in Paris. Five years later, in 1987, fifteen representatives from thirteen European countries signed a memorandum of understanding in Copenhagen to develop and deploy a common cellular telephone system across Europe, and EU rules were passed to make GSM a mandatory standard. The decision to develop a continental standard eventually resulted in a unified, open, standard-based network which was larger than that in the United States.

In 1987 Europe produced the very first agreed GSM Technical Specification in February. Ministers from the four big EU countries cemented their political support for GSM with the Bonn Declaration on Global Information Networks in May and the GSM MOU was tabled for signature in September. The MOU drew-in mobile operators from across Europe to pledge to invest in new GSM networks to an ambitious common date. It got GSM up and running fast.

Nowadays there is an enormous breakthrough in the telecommunications world, and different data types could be sent, which allow different uses for the GSM network as in the GSM camera system.

1.2 Problem Statement

Transmission of video image captured by a camera and receiving it on a cell phone through a GSM network. Also implementing this technique in various types of functions such as security, Spying, monitoring and others.

1.3 Objectives

The aims of the project are:

- Receiving video image instantly anywhere anytime.
- Lowering the interference and noise.
- Receiving a live video stream with the minimum clock delay through GSM camera.
- Ease of access
- Quick response.

1.4 Methodology

Firstly the necessary information regarding the project will be gathered, then design the technical block diagram and schematic diagram of the project to make the model. Then programme the Arduino Uno based on the objectives of the project and simulate the circuit.

1.5 Layout

The project is composed of an abstract & five chapters.

Chapter one represents an introduction that include background, project problems, project objectives, project methodology and the project outlines.

Chapter two represents general overview of GSM, Arduino, Camera, Relay and ULN.

Chapter three represents system components including introduction and explanation of how its work and system block diagram.

Chapter four represents application including introduction, system simulation and system operation.

Chapter five represents conclusion and recommendations.

CHAPTER TWO

GENERAL OVERVIEW

2.1 Introduction

GSM was intended to be a secure wireless system .it has considered the user's authentication using a pre-shared key and challenge-response, and over-the-air encryption. However, GSM is not vulnerable to different types of attack, each of them aimed at a different part of network. GSM camera refers to the use of GSM technique where the system takes the advantage of the communications network in the control of the camera.

2.2. Camera

A camera is an optical instrument for recording or capturing images, which may be stored locally, transmitted to another location, or both. The images may individual or sequences of images constituting videos or movies. The camera is a remote sensing device as it senses subjects without physical contact. The word camera comes from camera obscura, which means “dark chamber” and is the Latin name of the original device for projecting an image of external reality onto a flat surface. The functioning of the camera is very similar to the functioning of the human eye.[12]

2.2.1 Functional description

A camera may work with the light of the visible spectrum or with other portions of the electromagnetic spectrum. A still camera is an optical device which creates a single image of an object or scene, and records it on an electronic sensor or photographic film. All cameras use the same basic design:

-Light enters an enclosed box through a converging lens/convex lens and an image is recorded on a light-sensitive medium(mainly a transition metal-hallide). A shutter mechanism controls the length of time that light can enter the camera. Most photographic cameras have functions that allow a person to view the scene to be recorded, allow for desired part of the scene to be in focus, and to control the exposure so that it is not too bright or too dim. A display, often a liquid crystal display(LCD), permits the user to view scene to be recorded and settings such as ISO speed, exposure, and shutter speed.

A movie camera or a video camera operates similarly to a still camera, except records a series of static images in rapid succession, commonly at a rate of 24 frames per second, when the images are combined and display in order, the illusion of motion is achieved. [12]

2.2.2 Types of camera:

There are many types of camera such as:

- Action camera
- Animation camera
- Autofocus camera
- Backup camera
- Banquet camera
- Box camera
- Bridge camera
- Camcorder
- Camera phone
- Closed-circuit television camera

- Compact camera
- Dash came
- Digital camera
- Disposable camera
- Document camera
- Field camera
- FireWire camera
- Folding camera [12]

2.2.3 Types of Security Cameras

Security cameras are either wired or wireless, and which setup you'll need depends on where you'll want to put the cameras and how visible you want them to be. Wired cameras might be trickier to install, and stray wires can hamper your attempts to be discreet. They do, however, have a typically higher-quality picture than wireless cameras, since their signals aren't travelling through the air.

Wireless cameras have more flexibility, but broadcasts from other devices such as wireless Internet, cordless phones and baby monitors can interrupt a wireless camera's signal. Also, keep in mind that if you decide on a wireless system, there's a possibility your video feeds could be intercepted by others. Having someone else monitor your activity around the house or finding out whether or not you're at home defeats the purpose of having security cameras. If you're worried about your personal security, you can check with the manufacturer to see whether or not they encrypt their wireless system. [12]

Larger cameras will be visible, and people typically install them outside or in an area where people know they're under video surveillance. You can also find smaller, hidden cameras online in many different forms a tiny camera

hidden inside of an alarm clock, for instance, or a small pinhole camera that fits inside of an intercom system.

But before you install any type of security system into your home especially the small, "hidden" type you should note the legal restrictions on video surveillance. In most states, anyone recording either audio or video in a specified area needs to alert anyone in range of the surveillance device that he or she is being recorded. For instance, if you record someone does telephone conversation without them know it, that's illegal? It's also true that if you install a tiny camera into a room in your house without letting anyone know it's there, you're technically breaking the law. If anyone found the camera and wasn't previously aware of its existence, you could potentially face charges.

➤ **Wireless Camera:** Wireless technology is being applied to just about everything these days, and video surveillance takes good advantage of it. A wireless camera includes a built-in transmitter to send video over the air to a receiver instead of through a wire. Many people aren't aware that there are multiple types of wireless technology in use, each with unique advantages and disadvantages. Most wireless cameras are technically cordless devices, meaning that though they transmit a radio signal, they still need to be plugged into a power source. Still, "wireless" is the commonly used industry term. Some cameras do have batteries, of course, making them truly wireless. But battery life is still an issue for professional or even semi-professional applications.

These devices work on a simple principle. The camera contains a wireless radio (RF) transmitter. This transmitter broadcasts the camera's video, which can be picked up by a receiver, which will be connected to a monitor or recording device. Some receivers have built-in storage, while others must be connected to a DVR. [12]

There are two basic types of RF transmissions, analog and digital. Analog devices send out a constant string of data when they transmit. The data can be picked up by any receiver that picks up signal in its frequency range. This means that anyone with a properly tuned receiver can pick up a transmitter. It also makes interference more likely. If there are multiple transmitters in the same area, the most powerful signal will knock out any others in range.

Digital wireless cameras work a little bit differently. They modulate their signal slightly, constantly cycling through frequencies in order to avoid interference. This also makes transmissions more secure. In order to pick up this video feed, a receiver needs to be paired with the camera. This means the camera and receiver are programmed to cycle through frequencies at the same rate.

❖ **Types of Wireless**

Whether analog or digital, most commercially available electronic devices that broadcast do so in either the 2.4 GHz or 5.8 GHz ranges. 900 MHz and 1.2 GHz were common at one time, but have both been nearly completely phased out of use.

2.4 GHz and 5.8 GHz cameras are similar in function. Both contain a transmitter that sends a signal to a receiver, which can be connected to a monitor to view or a DVR to record. [12]

➤ **2.4 GHz**

Available in digital and analog

Has a maximum practical range of about 700 feet

A single receiver can carry a maximum of 4 transmissions

The frequency most cordless/wireless devices transmit on, so analog devices are very prone to interference

➤ **5.8 GHz**

Available in digital and analog

Maximum range of about 2000 feet

A single receiver can carry a maximum of 8 transmissions

Used by fewer household devices, less prone to interference

Analog signals can still be picked up by outside receivers

❖ **Increasing the range of wireless cameras**

There are devices called repeaters that can be used to increase wireless range. They work on a simple premise, receiving a camera's signal and retransmitting it. This can effectively double the range of a wireless camera, but using multiple repeaters is not advised, as each one will degrade video quality exponentially.

Maximum camera ranges are always calculated based on line of sight (LOS). This means the transmitter and receiver have no obstructions between them. Though a transmitter can send data through walls, windows, and even thin metal, those obstacles will weaken the signal and shorten the device's transmission range. [12]

➤ **Wi-Fi**

Wi-Fi cameras are wireless IP cameras. They allow multiple devices to be networked together and access a local area network through a wireless router. Each device talks to the router, which can send information back and forth to other networked devices as well as to and from the internet. A typical Wi-Fi

router has a range of about 150-300 feet and can (for practical purposes) connect as many devices as they have bandwidth to support. Typically, routers are not included with these cameras and must be purchased separately.

Wi-Fi cameras are so popular because they allow remote access to a video feed from outside the network. Set up can be more complicated than traditional wireless cameras and usually requires the user to have a PC available to set up the camera.

❖ **Transferring wired cameras to wireless cameras**

There are simple kits available consisting of a transmitter to connect to an existing camera and a receiver that can be connected to any analog camera.

➤ **Cellular:**

Cellular cameras contain a cellular transmitter and connect to a cellular network to send video. In function, they can be very similar to Wi-Fi cameras. This is the newest of the wireless technologies, and reliability can vary widely, largely based on network conditions.

These also tend to be very costly. Not only is equipment expensive, but it also requires a cellular data plan in order to transmit video. These costs can vary by cellular carrier, and a lack of cellular coverage can render the devices inoperable. As costs drop, expect to see this type of camera become more and more popular. [12]

2.3 GSM

GSM stands for Global System for Mobile Communication. It is a digital cellular technology used for transmitting mobile voice and data services. It is used by over three billion people across more than two hundred and twenty-one countries and territories.

2.3.1 GSM features

The features of GSM are:

- Improved spectrum efficiency.
- International roaming.
- Low-cost mobile sets and base stations.
- High-quality speech.
- Compatibility with Integrated Services Digital Network (ISDN) and other telephone company services. [2]

2.3.2 GSM network

The GSM network can be broadly divided into:

- The Mobile Station (MS).
- The Base Station Subsystem (BSS).
- The Network Switching Subsystem (NSS).
- The Operation Support Subsystem (OSS). [9]

The additional components of the GSM architecture comprise of databases and messaging systems functions:

- Home Location Register (HLR).
- Visitor Location Register (VLR).
- Equipment Identity Register (EIR).
- Authentication Center (AuC).

- SMS Serving Center (SMS SC).
- Gateway MSC (GMSC).
- Transcoder and Adaptation Unit (TRAU). [9]

2.3.3 GSM network areas

In a GSM network, the following areas are defined:

- ❖ **Cell:** Cell is the basic service area; one BTS covers one cell. Each cell is given a Cell Global Identity (CGI), a number that uniquely identifies the cell.
- ❖ **Location Area:** A group of cells form a Location Area (LA). This is the area that is paged when a subscriber gets an incoming call. Each LA is assigned a Location Area Identity (LAI). Each LA is served by one or more BSCs.
- ❖ **MSC/VLR Service Area:** The area covered by one MSC is called the MSC/VLR service area.
- ❖ **PLMN:** The area covered by one network operator is called the Public Land Mobile Network (PLMN). A PLMN can contain one or more MSCs.

2.3.4 Modulation

Modulation is the process of transforming the input data into a suitable format for the transmission medium. The transmitted data is demodulated back to its original form at the receiving end. The GSM uses Gaussian Minimum Shift Keying (GMSK) modulation method. [2]

2.3.5 Access Methods

Radio spectrum being a limited resource that is consumed and divided among all the users, GSM devised a combination of TDMA/FDMA as the method to divide the bandwidth among the users. In this process, the FDMA part divides the frequency of the total 25 MHz bandwidth into 124 carrier frequencies

of 200 kHz bandwidth.

Each BS is assigned with one or multiple frequencies, and each of this frequency is divided into eight timeslots using a TDMA scheme. Each of these slots is used for both transmission as well as reception of data. These slots are separated by time so that a mobile unit doesn't transmit and receive data at the same time. [2]

2.3.6 Channel Spacing

Channel spacing indicates the spacing between adjacent carrier frequencies. For GSM, it is 200 kHz.

2.3.7 Operation

When a mobile subscriber makes a call the MSC/VLR receives the message of a call request. The MSC/VLR checks if the mobile station is authorized to access the network. If so, the mobile station is activated. If the mobile station is not authorized, then the service will be denied. MSC/VLR analyzes the number and initiates a call setup with the PSTN. MSC/VLR asks the corresponding BSC to allocate a traffic channel (a radio channel and a time slot). The BSC allocates the traffic channel and passes the information to the mobile station. The called party answers the call and the conversation takes place.

The mobile station keeps on taking measurements of the radio channels in the present cell and the neighboring cells and passes the information to the BSC. The BSC decides if a handover is required. If so, a new traffic channel is allocated to the mobile station and the handover takes place. If handover is not required, the mobile station continues to transmit in the same frequency. [2]

2.3.8 GSM - User Services

GSM offers three basic types of services:

- Telephony services or teleservices.

The abilities of a Bearer Service are used by a Teleservice to transport data. These services are further transited in the following ways Voice Calls, Videotext and Facsimile, Short Text Messages.

- Data services or bearer services.
- Supplementary services.

2.4 Arduino

Arduino is a tool for making computers that can sense and control more of the physical world than your desktop computer. It's an open-source physical computing platform based on a simple microcontroller board, and a development environment for writing software for the board. This microcontroller comes from a company called Atmel and the chip is known as an AVR. It is slow in modern terms, running at only 16MHz with an 8-bit core, and has a very limited amount of available memory, with 32 kilobytes of storage and 2 kilobytes of random access memory.

Arduino can be used to develop interactive objects, taking inputs from a variety of switches or sensors, and controlling a variety of light alone, or they can be communicating with software running on your computer.

There are many other microcontrollers available for physical computing. All of these tools take the messy details of microcontroller programming and wrap it up in an easy to use package. Arduino also simplifies the process of working with microcontrollers. [4]

2.4.1 Types

- The first popular manufactured Arduino was called the NG:

The NG (new generation) used the ATMEGA8 chip running at 16 MHZ and an FT232 chip for the USB interface. The bootloader takes up 2KB of space and runs at 19200 baud.

- The next version was the Diecimila:

The Diecimila updated the chip from the ATMEGA8 to the ATMEGA168. The great thing here is double the space and memory (16K instead of 8K). It still runs at 16MHZ. The Diecimila also added two extra header pins for 3.3V (from the FTDI chip) and the reset pin which can be handy when a shield is covering up the reset button. The bootloader takes up 2KB of space and runs at 19200 baud.

- Duemilanove:

In 2009, the Duemilanove was released. This one also upgraded the chip again to the ATMEGA328. Yet another doubling of space and memory, another upgrade is now the power is automatically switched between USB and DC-jack which removed the previous jumper. This makes it easier and faster to move from programming to standalone and got rid of some confusion. The bootloader takes up 2KB of space and runs at 57600 baud.

- UNO:

The UNO still uses the 328p chip and the power switcher. It has a smaller bootloader called option (more space for user's projects) that runs at 115K. [4]

All of the old Arduinos (NG, Diecimila and Duemilanove) have used an FTDI chip (the FT232RL) to convert the TTL serial from the Arduino chip (Atmel ATmega). This allows printable debugging, connecting to software like Pure Data/Max, processing, and python. It also allows updating the firmware via the serial bootloader.

The FT232RL has royalty-free drivers and pretty much just works. It can only act as USB/Serial port. It can't act like a keyboard, mouse, disk drive, MIDI device.

2.4.2 Advantages

The advantages of the Arduino are:

- Inexpensive: Arduino boards are relatively inexpensive compared to other microcontroller platforms.
- Cross- platform: the Arduino software runs on windows, Macintosh OSX, and Linux operating system. Most microcontroller systems are limited to windows.
- Open source and extensible software: the Arduino and is published as open source tools, available for extension by experienced programmers.
- Open sours and extensible hardware: the Arduino is based on Atmel's ATMEGA8 and ATMEGA168 microcontrollers. [4]

2.5 Relay

A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must

be controlled by one signal. The first relays were used in long distance telegraph circuits as amplifiers: they repeated the signal coming in from one circuit and re-transmitted it on another circuit. Relays were used extensively in telephone exchanges and early computers to perform logical operations.

A type of relay that can handle the high power required to directly control an electric motor or other loads is called a contactor. Solid-state relays control power circuits with nonmoving parts, instead using a semiconductor device to perform switching. Relays with calibrated operating characteristics and sometimes multiple operating coils are used to protect electrical circuits from overload or faults; in modern electric power systems these functions are performed by digital instruments still called "protective relays".

Magnetic latching relays require one pulse of coil power to move their contacts in one direction, and another, redirected pulse to move them back. Repeated pulses from the same input have no effect. Magnetic latching relays are useful in applications where interrupted power should not be able to transition the contacts.

Magnetic latching relays can have either single or dual coils. On a single coil device, the relay will operate in one direction when power is applied with one polarity, and will reset when the polarity is reversed. On a dual coil device, when polarized voltage is applied to the reset coil the contacts will transition. AC controlled magnetic latch relays have single coils that employ steering diodes to differentiate between operate and reset commands. [5]

Small "cradle" Relay often used in electronics. The "cradle" term refers to the shape of the relay's armature. A simple electromagnetic relay consists of a coil of wire wrapped around a soft iron core, an iron yoke which provides a low reluctance path for magnetic flux, a movable iron armature, and one or more sets of contacts (there are two contacts in the relay pictured). The armature is hinged to the yoke and mechanically linked to one or more sets of moving

contacts. It is held in place by a spring so that when the relay is de-energized there is an air gap in the magnetic circuit. In this condition, one of the two sets of contacts in the relay pictured is closed, and the other set is open. Other relays may have more or fewer sets of contacts depending on their function. The relay in the picture also has a wire connecting the armature to the yoke. This ensures continuity of the circuit between the moving contacts on the armature, and the circuit track on the printed circuit board (PCB) via the yoke, which is soldered to the PCB.

When an electric current is passed through the coil it generates a magnetic field that activates the armature and the consequent movement of the movable contact either makes or breaks (depending upon construction) a connection with a fixed contact. If the set of contacts was closed when the relay was de-energized, then the movement opens the contacts and breaks the connection, and vice versa if the contacts were open. When the current to the coil is switched off, the armature is returned by a force, approximately half as strong as the magnetic force, to its relaxed position. Usually this force is provided by a spring, but gravity is also used commonly in industrial motor starters. Most relays are manufactured to operate quickly. In a low-voltage application this reduces noise; in a high voltage or current application it reduces arcing.

When the coil is energized with direct current, a diode is often placed across the coil to dissipate the energy from the collapsing magnetic field at deactivation, which would otherwise generate a voltage spike dangerous to semiconductor circuit components. Such diodes were not widely used before the application of transistors as relay drivers, but soon became ubiquitous as early germanium transistors were easily destroyed by this surge. Some automotive relays include a diode inside the relay case.

If the relay is driving a large, or especially an active load, there may be a similar problem of surge currents around the relay output contacts. In this case

a snobbier circuit (a capacitor and resistor in series) across the contacts may absorb the surge. Suitably rated capacitors and the associated resistor are sold as a single packaged component for this commonplace use.

If the coil is designed to be energized with alternating current (AC), some method is used to split the flux into two out-of-phase components which add together, increasing the minimum pull on the armature during the AC cycle. Typically this is done with a small copper "shading ring" crimped around a portion of the core that creates the delayed, out-of-phase component, which holds the contacts during the zero crossings of the control voltage. [5]

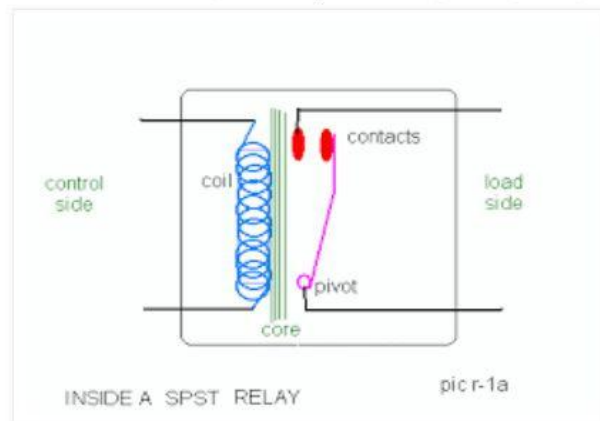


Figure 2.1: RELAY description

2.6 ULN

The ULN 2003A is an array of seven NPN Darlington transistors capable of 500mA, 50 V output. The **Darlington** Transistor named after its inventor, Sidney Darlington is a special arrangement of two standard NPN or PNP bipolar junction transistors (BJT) connected together. The Emitter of one transistor is connected to the Base of the other to produce a more sensitive transistor with a much larger current gain being useful in applications where current amplification or switching is required. [5]

In most electronics applications it is sufficient for the controlling circuit to switch a DC output voltage or current "ON" or "OFF" directly as some output

devices such as LED's or displays only require a few milliamps to operate at low DC voltages and can therefore be driven directly by the output of a standard logic gate.

However as we have seen above, sometimes more power is required to operate the output device such as a DC motor than can be supplied by an ordinary logic gate or micro-controller. If the digital logic device cannot supply sufficient current then additional circuitry will be required to drive the device.

One such commonly used Darlington transistor chip is the **ULN2003** array. The family of Darlington arrays consists of the ULN2002A, ULN2003A and the ULN2004A which are all high voltage; high current Darlington arrays each containing seven open collector Darlington pairs within a single IC package.

Each channel of the array is rated at 500mA and can withstand peak currents of up to 600mA making it ideal for controlling small motors or lamps or the gates and bases of high power semiconductors. Additional suppression diodes are included for inductive load driving and the inputs are pinned opposite the outputs to simplify the connections and board layout. [5]

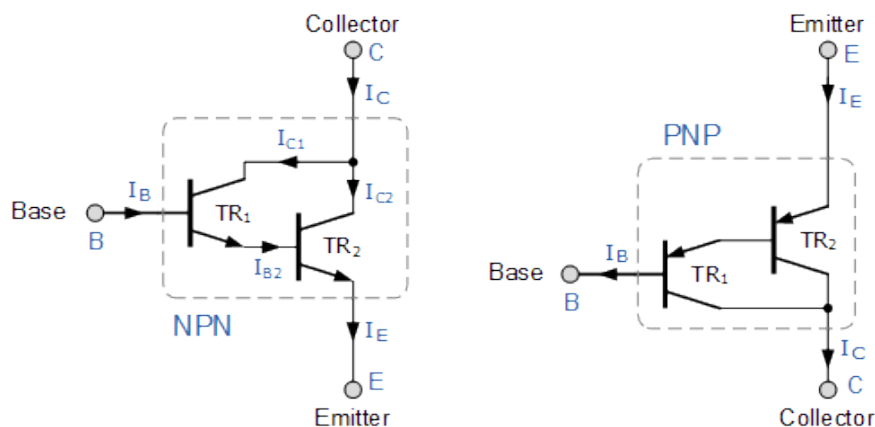


Figure 2.2 ULN

CHAPTER THREE

SYSTEM COMPONENTS

3.1 Introduction

A complete security camera system should provide all the basics of a video security network with an easy and secure access. The GSM camera system is designed to suit the various needs of users.

3.2 System Components

The system connects with multi components which are:

- Arduino Uno
- GSM shield
- SIM card
- IP camera
- ULN 2003
- Relay
- LEDs

3.2.1 Arduino Uno

The Arduino Uno is a microcontroller board based on the ATmega 328. The ATmega328 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega16 achieves throughputs approaching 1 MIPS per MHz allowing the system designer to optimize power consumption versus processing speed. [3]

The AVR core combines a rich instruction set with 32 general purpose working registers. All the 32 registers are directly connected to the Arithmetic Logic Unit

(ALU) .The ATmega32 provides 32 Kbytes of In-System Programmable Flash Program memory with Read-While-Write capabilities, 1024 bytes EEPROM, 2K byte SRAM, and 32 general purpose I/O lines.

The UNO has 14 digital input/output pins , 6 analog inputs ,a 16 MHz ceramic resonator , a USB connection, a power jack ,a ICSP header ,and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. [8]

The Uno differs from all preceding boards in that it does not use the FIDI USB-to-serial converter. [3]

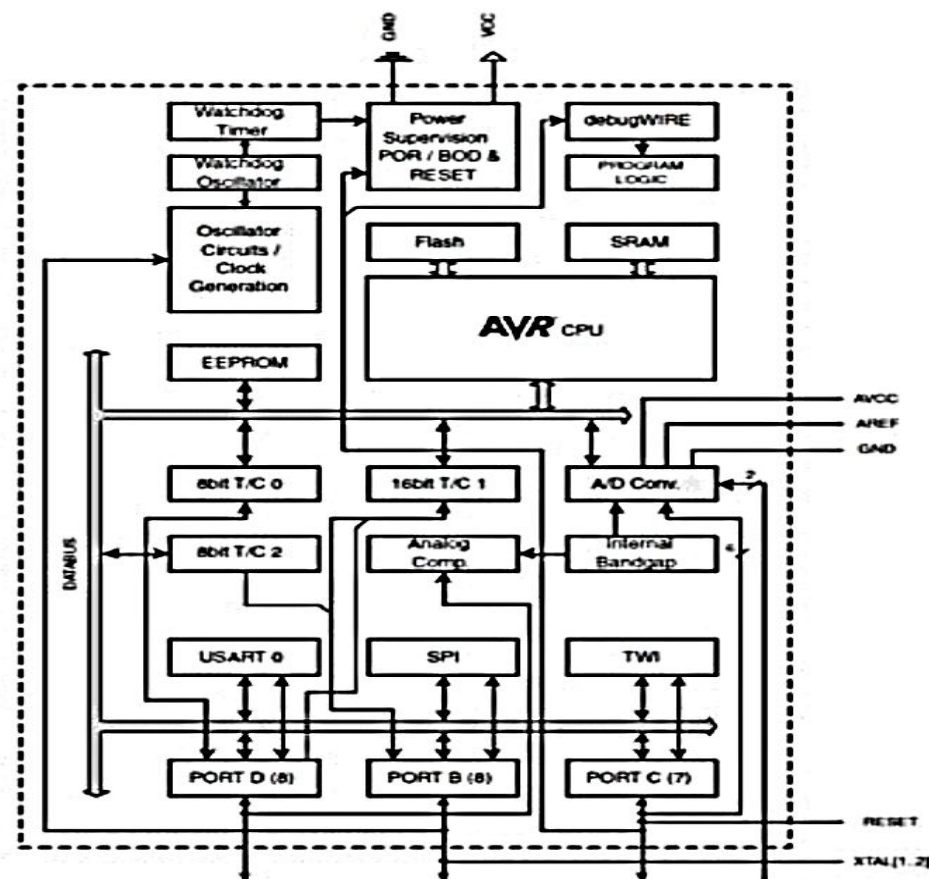


Figure 3.1: block diagram of Arduino

❖ Pin Descriptions

Each of the fourteen digital pins on the Arduino Uno can be used as an input or output all the fourteen pins are shown in the figure below: [3]

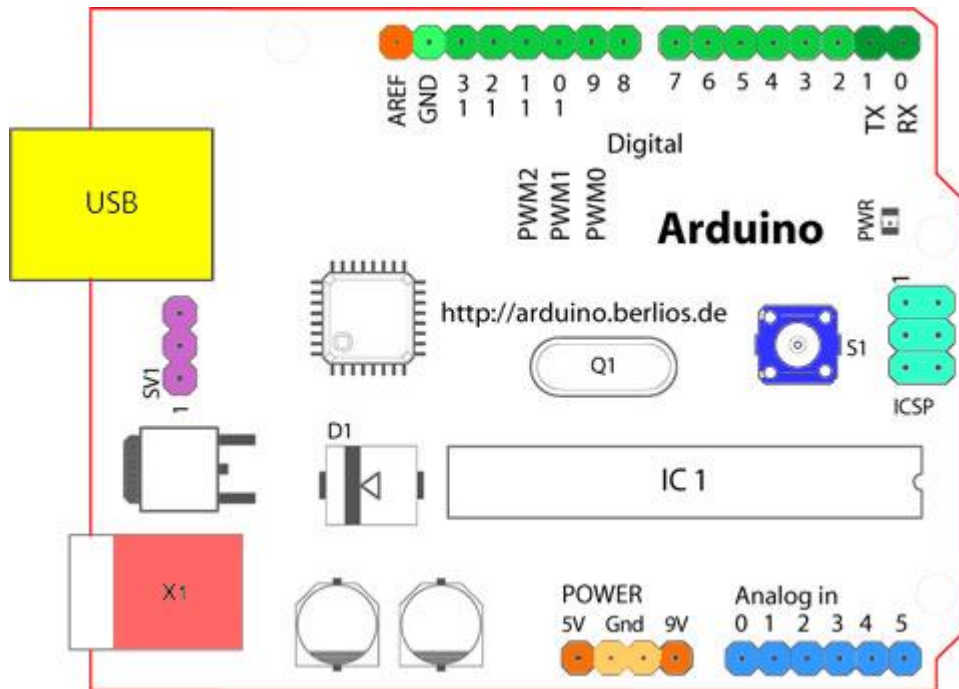


Figure 3.2: Arduino description

Analog Reference pin (orange)

Digital Ground (light green)

Digital Pins 2-13 (green)

Digital Pins 0-1 Serial In/Out - TX/RX (dark green)

Reset Button - S1 (dark blue)

In-circuit Serial Programmer (blue-green)

Analog in Pins 0-5 (light blue)

Power and Ground Pins (power: orange, grounds: light orange)

External Power Supply In (9-12VDC) - X1 (pink)

Toggles External Power and USB Power (place jumper on two pins closest to desired supply)- SV1 (purple)

USB (used for uploading sketches to the board and for serial communication between the board and the computer; can be used to power the board) (yellow)

The digital pins on an Arduino board can be used for general purpose input and output via the pin Mode (), digitalRead (), and digitalWrite () commands. Each pin has an internal pull-up resistor which can be turned on and off using digitalWrite () (w/ a value of HIGH or LOW, respectively) when the pin is configured as an input. The maximum current per pin is 40 mA. The digital pins are: [3]

- **Serial:** 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. On the Arduino Diecimila, these pins are connected to the corresponding pins of the FTDI USB-to-TTL Serial chip. On the Arduino BT, they are connected to the corresponding pins of the WT11 Bluetooth module. On the Arduino Mini and Lily Pad Arduino, they are intended for use with an external TTL serial module
- 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 analogWrite function. On boards with an ATmega8, PWM output is available only on pins 9, 10, and 11.
- **BT Reset:** 7. (Arduino BT-only) Connected to the reset line of the Bluetooth module.
- **SPI:** 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication, which, although provided by the underlying hardware, is not currently included in the Arduino language.
- **LED:** 13. On the Diecimila and Lily Pad, there is a built-in LED

connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.

The analog input pins support 10-bit analog-to-digital conversion (ADC) using the analog Read function. Most of the analog inputs can also be used as digital pins: analog input 0 as digital pin 14 through analog input 5 as digital pin 19. Analog inputs 6 and 7 (present on the Mini and BT) cannot be used as digital pins. The analog pins are:

- **I2C:** 4 (SDA) and 5 (SCL). Support I2C (TWI) communication using the Wire library.

In addition there are power pins:

- **5V.** the regulated power supply used to power the microcontroller and other components on the board. This can come either from VIN via an on-board regulator, or be supplied by USB or another regulated 5V supply.
- 3V3.(Diecimila-only) A 3.3 volt supply generated by the on-board FTDI chip.

- **GND.** Ground pins.

Other Arduino pins:

- **AREF.** Reference voltage for the analog inputs. Used with analog Reference.
- **Reset.** (Diecimila-only) Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board.

3.2.2 GSM shield

This is an ultra-compact and reliable wireless module. The SIM900A is a complete Dual-band GSM/GPRS solution in a SMT module which can be embedded in the applications. Featuring an industry-standard interface, the SIM900A delivers GSM/GPRS 900/1800MHz performance for voice, SMS, Data, and Fax in a small form factor and with low power consumption. With a

tiny configuration of 24mmx24mmx3mm, SIM900A can fit in almost all the space requirements in user applications, especially for slim and compact demand of design. We use the module [SIMCom SIM900](#). It's the cheaper module now available in the market. The module is not simple to mount by an hobbyist, so we use the Breakboard TDGGSM_900. [1]



Figure 3.3: GSM shield

3.2.3 SIM card:

A Subscriber Identity Module (SIM) card is a portable memory chip used mostly in cell phones that operate on the Global System for Mobile Communications ([GSM](#)) network. These cards hold the personal information of the account holder, including his or her phone number, address book, text messages, and other data. When a user wants to change phones, he or she can usually easily remove the card from one handset and insert it into another. SIM cards are convenient and popular with many users, and are a key part of developing cell phone technology. [1]

❖ SIM Cards Sizes:

SIM cards are made in three different sizes to accommodate different devices. Most phones use mini-SIM or micro-SIM cards, which are quite small — the mini is 25 mm by 15 mm (0.98 in by 0.59), and the micro is 15 mm by 12

mm (0.59 in by 0.47 in). Full-sized cards are much larger, 85.6 mm by 53.98 mm (3.37 in by 2.13 in), and are too big for most phones. All cards are only 0.76 mm (0.03 in) thick, however, and the microchip contacts are in the same arrangement. This means that, with the proper adapter, the smaller cards can be used in devices designed for larger ones.

❖ **Security:** A SIM card offers security for both the user's data and his or her calls. The cards can be locked, meaning that only someone who has the correct personal identification number (PIN) can use the card. If the phone is stolen, the thief cannot use a locked SIM or get any information off of it without the PIN.

In addition, the card has a secret authentication code and an encryption key that protect the phone's transmissions. Although it is possible to "clone" a cell phone on the [GSM network](#) and thus steal service, it's much more difficult than it is to clone a phone on the competing Code Division Multiple Access (CDMA) network. Because of the way the encryption information is transmitted to the carrier, it's usually necessary to have physical access to the SIM card in order to copy it. [12]

3.2.4 Internet protocol (IP) Camera

An Internet protocol camera, or IP camera, is a type of digital video camera commonly employed for surveillance, and which unlike analog closed circuit television (CCTV) cameras can send and receive data via a computer network and the Internet.

IP camera is composed of lenses, optical filter, CCD sensor, ARTPEC chip performing controlling function and compression chip. CCD sensor (Charge Coupled Device) is a basic element of almost all contemporary cameras. These are photosensitive elements composing of fine network of individual pixels. The

monitored picture is focused at through an objective on the surface of an element and an electric signal is generated on it, which is proportional to light intensity falling upon it. Typical number of pixels for CCD elements range between 250,000 and 500,000 pixels. The greater number of pixels means higher quality of camera. [12]

3.2.5 ULN 2003 A

The uln2003 IC is a high voltage and current Darlington array IC, it comprises of 7-open collector Darlington pairs with common emitters. A pair of Darlington is an arrangement of two bipolar transistors. This IC belongs to the family of ULN200x ICs and various types of this family interface to various logic families. This ULN2003 IC is for 5V TTL and CMOS logic devices. These ICs are used as relay drivers as well as to drive a wide range of loads, line drivers, display drivers etc. This IC is also normally used while driving Stepper Motors. The pairs of Darlington in ULN2003 esteemed at 500mA and can withstand peak current of 600mA. In the pin layout I/PS & O/PS are provided reverse to each other. Each driver also has a suppression diode to dissipate voltage spikes while driving inductive loads. In some applications the amount of input current available to switch on a transistor is very low. This may mean that a single transistor may not be able to pass sufficient current required by the load. As stated earlier this equals the input current x the gain of the transistor (HFE). If it is not possible to increase the input current then the gain of the transistor will need to be increased. This can be achieved by using a Darlington Pair. [5]

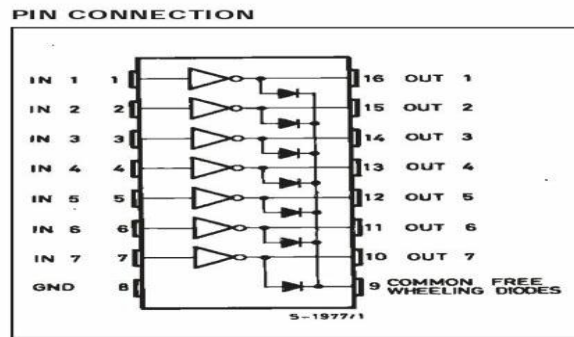


Figure 3.4: ULN inside description

3.2.6 Relay

The OUAZ-SS-112L, 900 is a communications and signal PC board relay that is characterized by its class protection level of RTIII. This relay operates in a maximum working temperature of 70°C and is equipped with a coil that possesses a direct current rating voltage of 12 Volts. The coil can withstand a maximum load current of 700 Ohms

Ouaz series miniature, sealed pc board relay features are:

- Gold overlay silver palladium alloy contact suitable for low loads.
- High density available on PC board due to small size.
- 2.54mm terminal pitch same as I.C. socket terminal pitch.
- Sensitive and standard coils available.
- Immersion cleanable, sealed version available.[5]

Table 3.1: Ouaz Relay data sheet

Initial Insulation Resistance Between Mutually Insulated Elements	1,000M ohms min. at 500VDCM
Mechanical Data	
Termination	Printed circuit terminals
OUAZ-SS	Vented (Flux-tight), plastic cover.
OUAZ-SH	Sealed, plastic case

Weight	0.12 oz. (3.5g) approximately
Operate Voltage	70% of nominal voltage or less.
OUAZ-L	75% of nominal voltage or less.
Release Time	7 ms max.
Vibration, Mechanical	10 to 55 Hz., 1.5mm double amplitude
Operational	10 to 55 Hz. 1.5mm double amplitude.
Shock, Mechanical	500m/s ² (50G approximately).
Operational	100m/s ² (10G approximately).
Between Open Contacts	500VAC 50/60 Hz. (1 minute).
Between Coil and Contacts	1,000VAC 50/60 Hz. (1 minute).
Surge Voltage Between Coil and Contacts	1,500V FCC Part 68 (10/160 μ s).
Max. Switching Rate	300 ops./min. (no load). 30 ops./min. (rated load).
Expected Mechanical Life	10 million operations (no load).
Expected Electrical Life	100,000 operations (rated load).
Minimum Load	1mA at 1VDC
Initial Contact Resistance	50 milliohms at 100mA, 6VDC

3.3.7 LEDs

A diode is a component that only allows electricity to flow one way. It can be thought as a sort of one way street for electrons. Because of this characteristic, diode is used to transform or rectify AC voltage into a DC voltage. Diodes have two connections, an anode and a cathode. The cathode is the end on the schematic with the point of the triangle pointing towards a line. Current

flows from the anode to the cathode. Light emitting diodes, or LEDs, differ from regular diodes in that when a voltage is applied, they emit light. This light can be red (most common), green, yellow and orange. [5]

3.4 block diagram

The system's block diagram is shown as figure below:

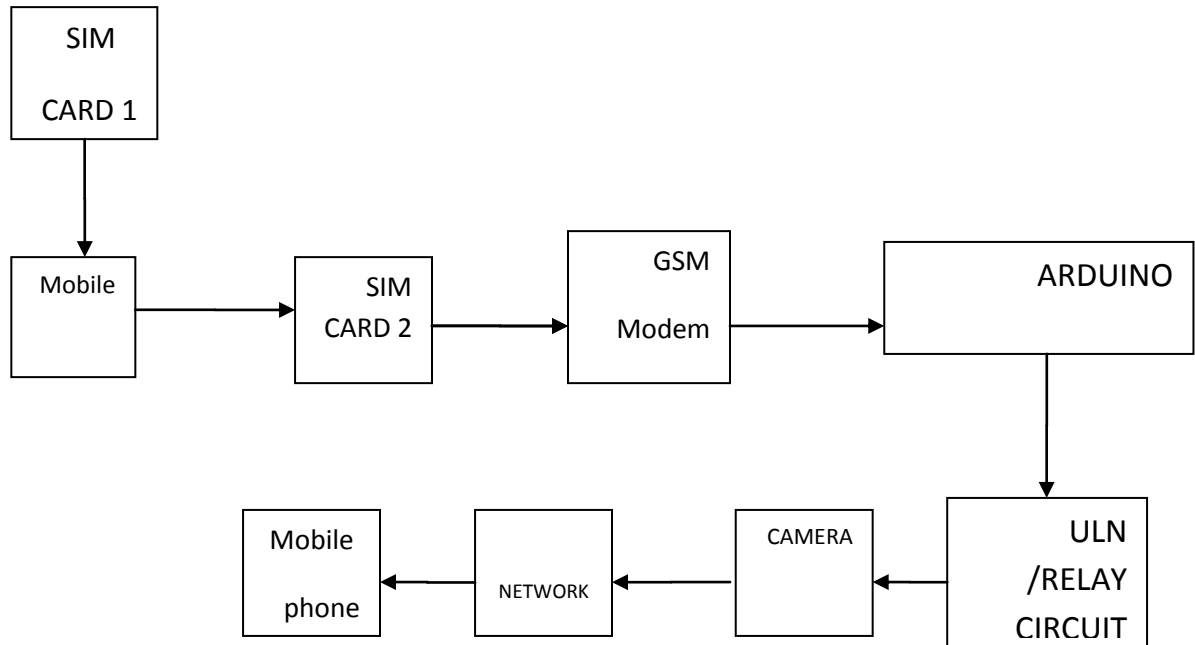


Figure 3.5: System block diagram

CHAPTER FOUR

Simulation and Practical

4.1 Introduction:

Simulation is the imitation of the operation of a real-world process or system over time. The act of simulating something first requires that a model be developed; this model represents the key characteristics or behaviors/functions of the selected physical or abstract system or process. The model represents the system itself, whereas the simulation represents the operation of the system over time.

Simulation is used in many contexts, such as simulation of technology for performance optimization, safety engineering, testing, training, education, and video games. Often, computer experiments are used to study simulation models. Simulation is also used with scientific modeling of natural systems or human systems to gain insights into their functioning. Simulation can be used to show the eventual real effects of alternative conditions and courses of action. Simulation is also used when the real system cannot be engaged, because it may not be accessible, or it may be dangerous or unacceptable to engage, or it is being designed but not yet built, or it may simply not exist.

The Components in the previous chapter are used to implement GSM camera ,Proteus simulation illustrates how the system works , installation is as shown in figure 4.1

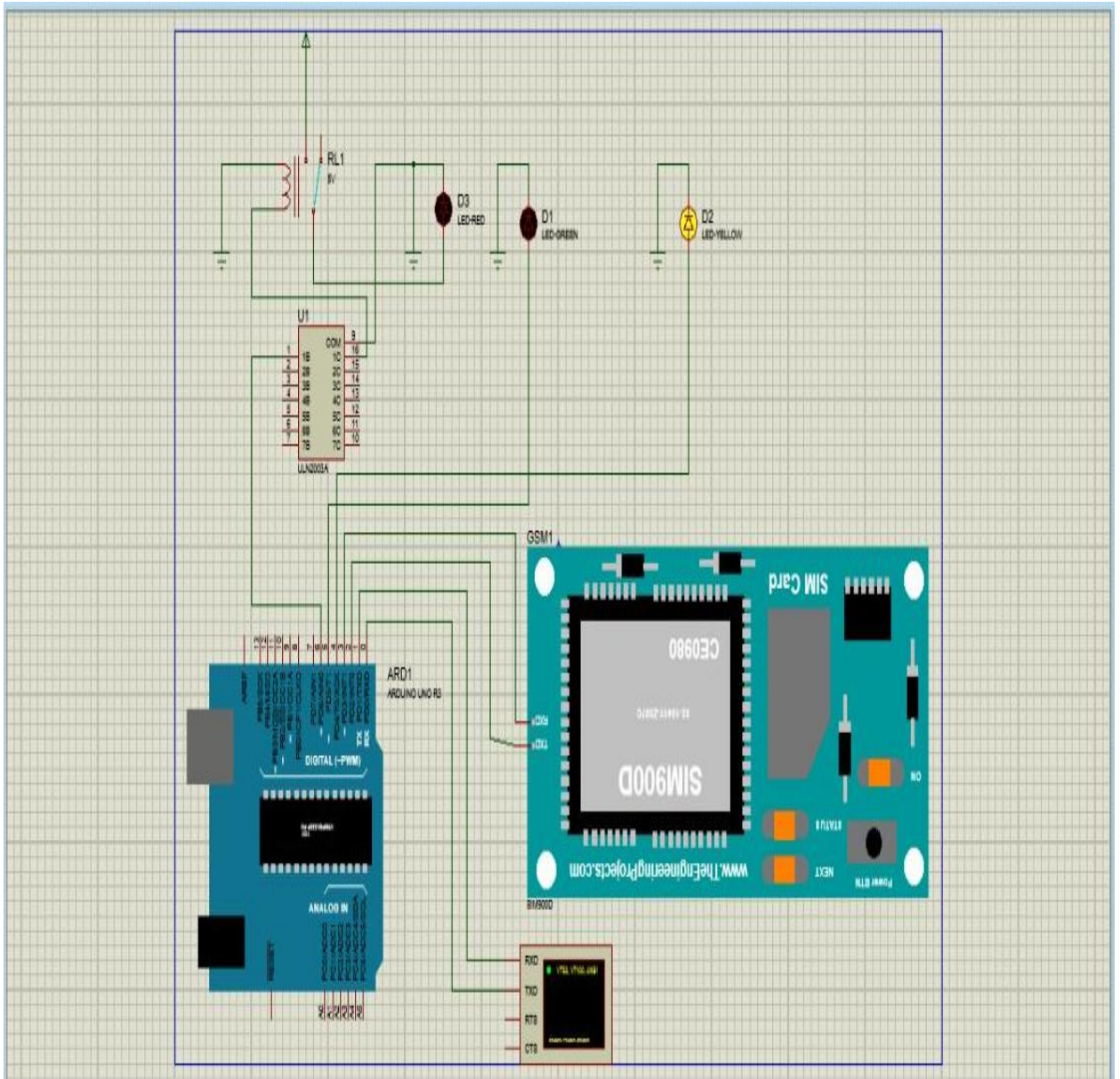


Figure 4.1: installation of circuit in simulation

Step by step connect all the components continued to simulate all the system. A camera is added inside a property to give the possibility of monitoring from distance.

After sending a message from the user's cellphone(SIM1) to the GSM module ,it contact's with the Arduino then the Arduino sends a high signal(1) to the ULN to amplified it and send it to the relay to complete the circuit and

activates the camera.

4.2 Practical Operation:

The GSM-shield receives a specific SMS message from the users cellphone number, if the number matches the number saved at the program code, pin2(RX) and pin3(TX) will be high ,when the Arduino receives the high signal it sends it to the ULN through pin6,the amplified signal is sent through pin16 from the ULN to the relay to enable the camera, while the camera is being enabled a confirmation message is sent .if the message text or the phone number does not match the saved one at the program it ignores the command.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1 Conclusion:

After the necessary information was gathered the circuit was executed then the model was made after programming the Arduino and GSM-Shield, then the camera was successfully activated.

The video call technology is not supported by the cellular phone companies and the type of the compatible camera (TTL serial JPEG Camera) was not available.

5.2 Recommendation:

To improve and progress the project we recommended:

- Using the GSM to transfer the video instead of using internet.
- Using TTL serial JPEG Camera instead of using IP Camera.

REFERENCES

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[10] Anton A.Hurdeman,"The worldwide History of telecommunications", John wiley & sons, 2003, page529

[11] Michel Mouly-Marie Bernadette Pautet,"The GSM System for Mobile Communications", Germany, 1992.

[12] www.wikibidia.net/camera.

APPENDIX A:

CODE

```
#include <SoftwareSerial.h>
SoftwareSerial gsm(0, 1); // RX, TX
char incomingByte;
void setup() {
  pinMode(4, OUTPUT);
  pinMode(5, OUTPUT);
  pinMode(6, OUTPUT);
  pinMode(7, OUTPUT);
  digitalWrite(4,HIGH);
  delay(100);
  Serial.begin(9600);
  delay(1000);
  gsm.begin(9600);
  delay(2000);
  Serial.println("sms receiver");
  delay(1000);
  gsm.println("ATE0\r");
  delay(1000);
  gsm.print("\r");
  delay(1000);
  gsm.print("AT+CMGF=1\r");
  delay(1000);
```

```

gsm.write("AT+CMGD=1,4\r");
delay(1000);
gsm.write("AT+CPMS=\"SM\"\r");
delay(1000);
gsm.write("AT+CNMI=2,2,0,0,0\r");
delay(1000);
if (gsm.available()>0)
  while (gsm.available())
  {
    incomingByte = gsm.read();
    if (incomingByte=='O'){
      incomingByte = gsm.read();
      if (incomingByte=='K'){
        digitalWrite(4,LOW);
        digitalWrite(5,HIGH);
        Serial.print("Gsm start ok");
      }
    }
  }
}
void loop() {
  if (gsm.available()>0)
  {
    while (gsm.available())
    {
      incomingByte = gsm.read();

```

```

if (incomingByte=='c'){
    incomingByte = gsm.read();
    if (incomingByte=='a'){
        incomingByte = gsm.read();
        if (incomingByte=='m'){
            incomingByte = gsm.read();
            if (incomingByte=='o'){
                incomingByte = gsm.read();
                if (incomingByte=='n'){
                    incomingByte = gsm.read();
                    if (incomingByte=='1'){
                        incomingByte = gsm.read();
                        if (incomingByte=='2'){
                            incomingByte = gsm.read();
                            if (incomingByte=='3'){
                                incomingByte = gsm.read();
                                Serial.print("Camira enable");
                                digitalWrite(6,HIGH);
                                delay(100);
                                gsm.print("AT+CMGS=\"0907266574\"\r");    // Number to which you
                                want to send the sms
                                delay(1000);
                                gsm.print("Camira enable"); //The text of the message to be sent
                                delay(1000);
                                gsm.write(0x1A);
                                digitalWrite(4,HIGH);

```



```

incomingByte = gsm.read();
if (incomingByte=='2'){
incomingByte = gsm.read();
if (incomingByte=='3'){
incomingByte = gsm.read();
Serial.print("Camira disable");
digitalWrite(6,LOW);
digitalWrite(7,LOW);
delay(100);

gsm.print("AT+CMGS=\"0907266574\"\\r"); // Number to which you
want to send the sms
delay(1000);
gsm.print("Camira disable"); //The text of the message to be sent
delay(1000);
gsm.write(0x1A);
digitalWrite(4,HIGH);
delay (1000);
digitalWrite(4,LOW);
delay (1000);
digitalWrite(4,HIGH);
delay (1000);
digitalWrite(4,LOW);
delay (1000);
}
}
}

```

```
    }  
    }  
    }  
    }  
}  
Serial.print(incomingByte);  
}  
}  
}
```