VIETNAM AVIATION ACADEMY

Department of Telecomunication - Electronics Engineering Technology

LOCATION IN HO CHI MINH CITY

PROJECT REPORT:

"Circuit Remote Controlled Using Infrared Light"

Written by

Nguyen Van Anh Tuan

Roll.No.1753020018

Under the guidance of

Master Cao Xuan Kim Anh

PREAMBLE

In this day of advancement, we are indispensable remote control to control the devices we use every day as televisions, machines air conditioners, fan, etc. So how do remote controls work? Can control other objects in the distance? Few know that the first remote control available during World War II. Initially, people use RF technology (Radio Frequency) and then catch to start applying IR (Infarred Remote) technology to the remote control. In today's life, we use both types, however control remote use infarred in more often used. Let's see the principle operation and construction of this remote control.

Auth. Nguyen Van Anh Tuan

Contents

1 Introduction **4**
1.1 Preliminary introduce: 4
1.2 Objectives of the study: 4
1.3 Research Methods: 4

2 Find out theoretical related to the research **5**
2.1 Application of remote controlled using infarred 5
2.2 Define of Infarred (IR LED) 5
2.3 Infarred receiver eye (TSOP-17xx) 7
2.4 IC 4017 8
2.5 Quickview about clock pulse 9
2.6 IC NE555 11
2.7 Principles of infrared transceiver 13
2.7.1 Principles of signal transmission 14
2.7.2 Principles of signal reception 16

Chapter 1

Introduction

1.1 Preliminary introduce:

With the current trend of modernization and industrialization, many modern technology devices appear to help save time. We can mention as public technology of things connected through the internet (Internet of Things) etc. But with expensive fees are not suitable for the average consumer. From there, i founded simple solutions with the same purpose and low cost.

In parallel, to supplement, to supplement the knowledge not studied in school. From there, i selected "Remote Controlled Using Infarred" for the topic.

1.2 Objectives of the study:

To help reduce costs and supplement knowledge not researched at school.

1.3 Research Methods:

Find information on internet.
Test on software.
Construction circuit.

Chapter 2

Find out theoretical related to the research

2.1 Application of remote controlled using infarred

Remote controlled now is using broadly, it use to controlled all wireless device. Remotes and televisions are the best example for application of this recieve and transmitter circuit. Or more application of this circuit. Beside that, we can see that remote controlled can use with air conditioners, fans, or even use to turn on the lights in house...etc.

2.2 Define of Infarred (IR LED)

Infarred light (infarred ray) is the light we can't see it by our eyes, they have wavelength from 700nm to 1mm. The infarred light have transmittion speed is equal to lightspeed.

The infarred can transmit many signal channels. It is widely applied in industry.

The amount of information that it can gain is 3 megabit/s. The amount of information transmit with infarred light is many times larger compared to the electromagnetic waves people still use.

Infarred rays are easily absorbed, poor penetration. In the word control far by infarred, the beam emits a narrow, directed direction, so when recieve must be in the right direction to use it.

Infarred wave have characteristics such as light (focusing through the lens, focal distance...). Normal light and infarred light differ very clearly in light through the material.

Other than emitting invisible infarred light, IR Led look like a normal led and also works like a normal Led, it means it will consume 20mA and 3 Volts.

Besides that infarred is divided by wavelength into three main regions. However, follow the US classification is divided into 5 areas as follow:

Name	Acronym	Wavelength	Frequency	Photon Energy	Featured
Near Infarred	NIR	750nm to 1.4μm	214-400THz	886-1653 meV	Determined by the absorption of water.Used in fiber optic telecomunications.
Short waves infarred	SWIR	1.4-3μm	100-214THz	413-886meV	Absorbed domestic increase significantly as of 1.45μm. Range 1.53-1.56μm is spectral region currently in use much in the far informed long road.
Medium waves infarred	MWIR	3-8μm	37-100THz	155-413meV	This band is called is thermal infarred, but it only detects slightly higher temperatures than body temperatures.
Long waves infarred	LWIR	8-15μm	20-37THz	83-155meV	This region is call "thermal infarred".
Far infarred	FIR	15-1000μm	0.3-20THz	1.2-83meV	See far infarred and far infarred laser.

Table 2.1: Classify Common of Infarred

2.3 Infarred receiver eye (TSOP-17xx)

It is an excellent line of infarred sensors for remote control applications. These infarred sensors are designed to improve shielding electric interface. These devices are designed to receive infarred rays from the infarred diode from a remote handset.

TSOP 17xx is a part of the Photomodules family of infarred sensors modules miniature with PIN photodiode and preamplification stage are placed in the shell epoxy. Its output is low and gives +5V when off. Its output is demodulation to be able to decoded directly by the microprocessor. Functions important modules include internal filter for PCM frequency capability. Compatible with TTL and CMOS, low power consumption (5V and 5mA), immune to ambient light, anti-jamming, etc....

Number	Name	Description
1	Ground	Grounding
2	Vcc	Usually connect to +5V, maybe 6V
3	Signal	Output Signal

Table 2.2: Configuration of TSOP

So, where do we use it?

- The TSOP sensors is capable of reading the output signal from the remote control like TV, home theater remotely etc... All the remote controls will work with a frequency of 38KHz and this IC can pick up any processor IR signal handle them and provide output on PIN 3 (signal).
- Also, keep in mind that this TSOP-1738 series will only receive 38KHz infarred signals. So almost all the remote control in our country will work in 38KHz.

Application of TSOP-1738:

- Receiving infarred signal.
- Decode the remote signal.
- Analyze, reproduce or copy signals remotely.
- Receiver circuit for remote control.
- Remote control test circuit.

2.4 IC 4017

Firstly, IC 4017 is the decimal counting IC, counting the clock. When we take IC clock count pulse and output 10 corresponding to 1 pulse.

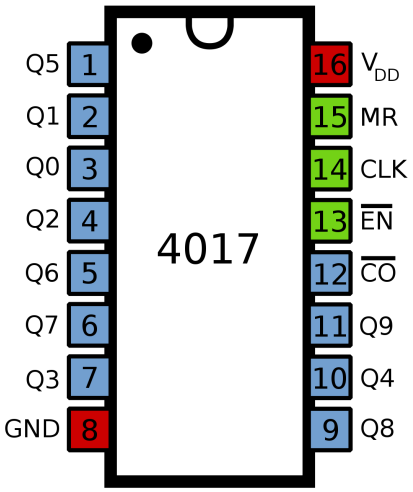

Figure 2.1: PIN chart of IC 4017

Number	Name	Description
1-7 and 9-11	Output PINS Q0 to Q9	10 output, they are not in order, so be careful when wiring
8	Vss or Ground	Grounding PIN
12	Carry out (CO)	The PIN to a high level after IC counting from 1-10. Often used to trigger another count IC.
13	Clock Enable (EN)	PIN allowed. This positive PIN is low. When EN=0, the circuit operates.
14	Clock	The counting circuit operates when there is a pulse from the Clock PIN, which is positively edge-up, usually connected to another IC555 or quartz set to generate a pulse
15	Reset	Set output status to high
16	Vcc/Vdd	Connect to the source

Table 2.3: Description of function of each IC 4017 PIN

In summary we have the characteristics of the IC 4017 as follow:

- 16-PIN CMOS decimal counter.
- Support 10 decoded outputs.
- Wide supply voltage range from 3V to 15V, usually +5V.
- Compatible with TTL (Transistor-transistor logic).
- Maximum frequency: 5,5MHz.

And what is application of IC 4017? That is:

- This IC usually use in the counter circuit, timer circuit, LED matrix, LED chaser, and almost the lost of other LED project.
- Use to make binary counter or binary decoder.
- Can be use to make splitters.
- Remote metering, cars, medical electronics.

2.5 Quickview about clock pulse

In logic techniques, people use pulse signals (high and low) to operate. This signal is called a pulse.

As you can see, the clock has an effect on the signal transmittion. Specifically, the higher frequency of the clock, the faster amount of signal transmitted.

For synchronous design systems, the clock is a global clock that allows all the components on it to communicate and control with each other.

As for the asynchronous setting system, the clock pulse is just a handshake pulse to communicate between 2 components (local clock) with each other, absolutely no clock pulse for the entire system.

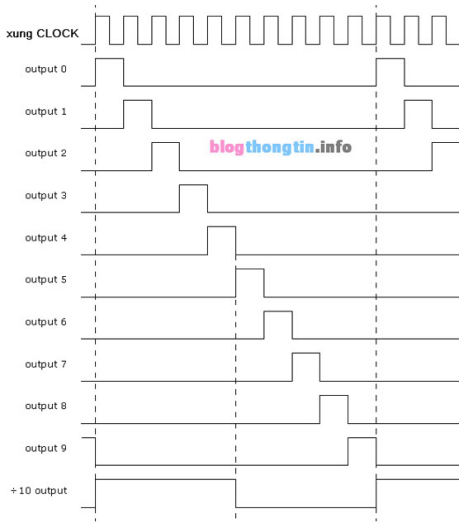

Figure 2.2: Output signal format according to pulse input signal of IC 4017

This is signal when IC is operated by an edge-up shock (the pulse from level 0 to level 1).

PIN 13 (pin E) is the PIN that allow the IC to work, to activate this pin we have to connect this pin to level 0 (also known as mass level).

MR pin or can be understood as Reset pin, when we give it a voltage of 1 (5V), the output Q will be reset, the output Q0 is default at 1, the remaining outputs are at 0 if we do not need to use the MR pin, we should connect this PIN to the mass. The diagram above we use MR pin to control the 4th counting so we connect MR to Q4 pin.

CO pin used to connect with other IC 4017 depending on the design needs of each person, for example when we need more counting of IC 4017 then we will use this pin (just connect the CO pin of this 4017 to the CLK pin of the next IC 4017).

As shown in the picture we see when the output pulse of the IC is simulated to a high level (level 1) so continuously until the output of the IC and will return to the beginning and so on, if it granted, it will be run continuously.

2.6 IC NE555

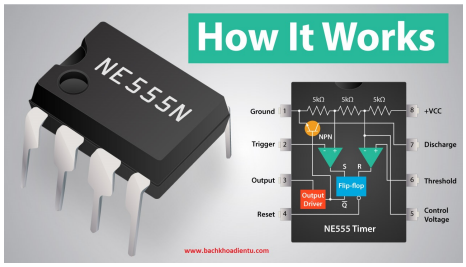

Figure 2.3: Image and structure of IC NE555

NE555 Timer IC is an intergrated circuit (chip) used in a variety of timer, pulse generation, and application oscillators. NE555 can be used to provide time lags, like an oscillators and as a flip-flop element.

IC NE555 has been in 1972 by Signetics Corporation with 2 product lines SE555/NE555 and is called time machine and is also the first available. It provides electronic circuit designers with relatively cheap, stable cost.

Its structure is composed of OP-AMP comparing voltage, flip circuit and transistor for discharging electricity like a image down here:

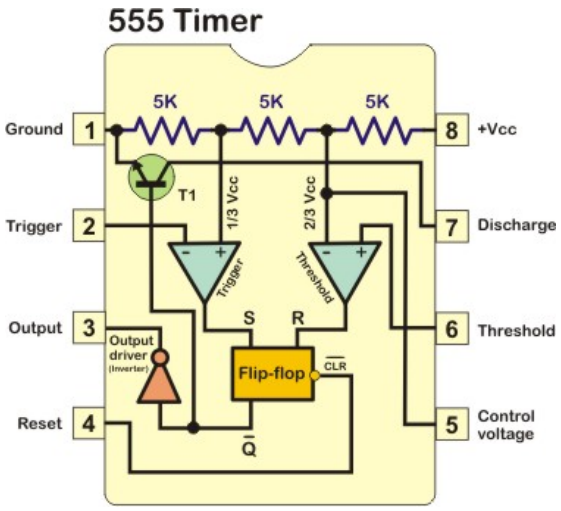

Figure 2.4: Structure inside of NE555

Depending on the manufacturer, NE555 has a different structure. Typically, the standard NE555 include 25 transistors, 2 diodes, and 15 resistors on silicon processors installed in the 8-pin dual package (DIP-8). Variations include 556 (one DIP-14 combining tow complete 555s on one chip), and 558/559 (both DIP-16 incorporating four reduced function timers on one chip).

NE555 parts are temperature range from 0°C to 70°C and NE555 parts are assigned the best temperature range from -55°C to 125°.

Low-power CMOS types of NE555 are also available, such as Intersil ICM7555 and Texas LM555, TLC555, TLC551. The CMOS timer uses less power than the bipolar timer. The CMOS timer also causes less noise than the dipole type when the output transitions.

PIN	PIN Name	PIN direction	PIN purpose
1	GND	Ground	Supply voltage: 0V
2	TRIG	Input	Activate: when the voltage at this PIN decrease 1/2 of battery voltage CONT (1/3 Vcc unless CONT have activate by outside signal).
3	OUT	Output	This is a push-pull output that is led to a low or high state (positive supply on the Vcc PIN minus about 1.7).
4	Reset	Reset	The time interval can be reset by bringing this PIN to GND, but the time does not start again until this PIN rises to about 0.7V. This PIN overrides TRIG and Threshold. This PIN is not used much, so it is often connected to Vcc to prevent electrical noise from causing repetition.
5	CTRL	Input	This PIN provides access to internal voltage (2/3 Vcc by default). Apply this voltage to CONT, we can change the time characteristics of the device.
6	THRES	Input	Threshold: when this voltage at PIN is greater than the voltage at the CONT PIN (2/3 Vcc), then the interval time ends.
7	DIS	Output	Discharge: this is the output of an open collector (OC), used to discharge capacitors between intervals, in phase with the output.
8	Vcc	Source	The guaranteed voltage range of bipolar timers is usually 4.5-1.5V (some timers are specified for up to 16V or 18V), although most will work as low as 3V.

Table 2.4: Describe the function of each IC NE555 pin

Properties	Value
Mounting type	Surface mount
Timer type	Standard
Package type	SOIC (Small Outline Intergrated Circuit)
Number of timer	1
Number of PIN	8
Minimum supply voltage	4.5V
Maximum operating voltage	16V
Minimum operating temperature	0°C
Maximum operating temperature	70°C
Maximum ouput current	200mA
Excited	4.9 x 3.91 x 1.58mm
Length	4.9mm
Height	1.58mm
Width	3.91mm

Table 2.5: Specification of NE555

The operating mode of IC:

- Astable mode: In this mode, 555 timer can work as an oscillator. Uses contain LED and lamp frashers, logic clocks, pulse generation, security alarms, tone generation and PPM and so on. The 555 timer IC can be used as a simple analog to digital converter.
- Monostable mode: In this mode, 555 timer IC works as a one shot pulse generator. Application mainly include bounce free switches, timers, touch switches, missing pulse detection, frequency divider, pulse-width modulation (PWM), capacitance measurement, and so on.
- Bistable mode: In this mode, 555 timer IC can work as a flip-flop, if the DIS pins is not connected no capacitor is used. It is used in bounce-free latched switches.

In this circuit that we use, NE555 is operated in Astable mode.

2.7 Principles of infrared transceiver

The IR transmitter consists of the LED that emits the IR (Infra Red) radiation. This is received by the photo diode, which acts as IR receiver at the receiving end. Since the IR radiation is invisible to human eye it is perfect for using in wireless coummunication.

A electronic remote device mainly consists of this IR transmitter and receiver. A remote control patterns a flash of invisible light which is turned into an instruction and is received by the receiver module.

So, how it works?

The IR signal is modulated during transmission. Modulation means assigning pattern to the data to be sent to the receiver. The most commonly used IR modulation is about 38KHz.

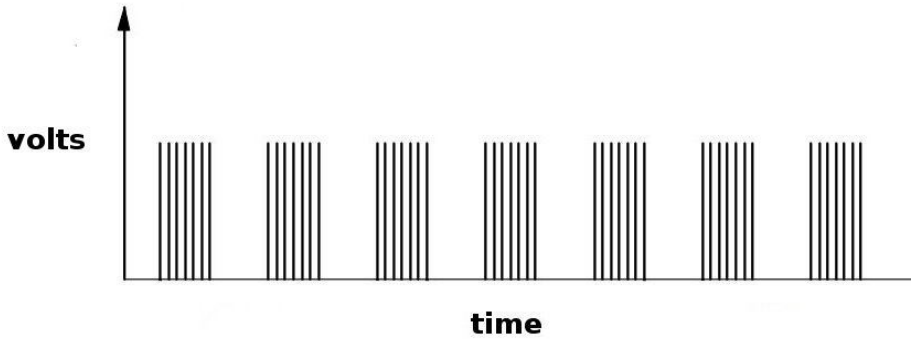

Figure 2.5: The IR signal

2.7.1 Principles of signal transmission

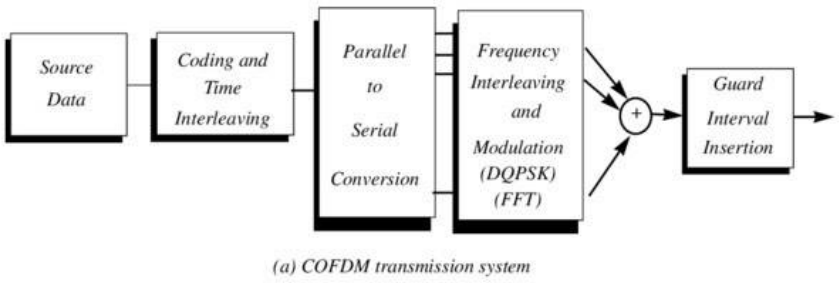

Figure 2.6: Principle of transmission

Explain the diagram:

At the transmitter, the message is encoded bit by bit. After the last bit of the message passes, two flushing bits 0 are interested to make sure the last transittion state is 00. Its aim is to facilitate the decoding process of receiver.

- Function selection and coding block: when the user presses the function keys to issue the request according to his request, each function key corresponds to the decimal number. The coding circuit will convert into corresponding binary code in the form of a digital signal code consisting of 0 and 1. The number of bits in a binary instruction code maybe 4 or 8 bits depending on the number of function keys more or less.
- Conditional oscillator block: when we press a function key, we simultaneously start the oscillator circuit to generate clock pulse, the clock frequency determines the standard time of each bit.
- Data latch block and parallel conversion unit to serial: the binary code at the coding circuit will be latched into the parallel data conversion circuit to serial. Serial to parallel data conversion circuits are controlled by clock pulses and timing circuits to ensure a timely completion of the conversion of a sufficient number of bits of code.
- Modulation and FM transmitter block: The code in the form of serial will be sent through the modulation circuit and FM transmitter to pair the code into the carrier with the frequency of about 38kHz to 100kHz, thanks to the higher frequency signal carrier, the longer the signal is transmitted, which means increasing its transmitting distance.
- Transmitter device block: it is simply an infarred LED. When the instruction code has a bit value of 1, LED imits infarred in the T interval of that bit. When the instruction code has a bit value of 0, LED will not light. Therefore, if the receiver does not receive the signal, it will be considered as having a bit value of 0.

2.7.2 Principles of signal reception

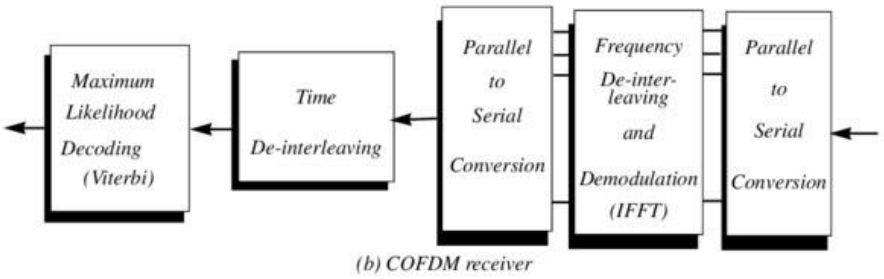

Figure 2.7: Principle of reception

Explain the diagram:

- Receive unit: infarred from the transmitter is directly received by the infarred receiver or other optical components.
- Application and decoupling unit: the signal amplification component will receive first and then pass through the detector circuit to eliminate the carrier and decouple the necessary data, which is the code.