(PFKE106) UNIVERSAL REMOTE CONTROL

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Date : 23rd NOVEMBER 2007

DEDICATION

Specially dedicated to

My beloved parents, brother and sister.

ACKNOWLEDGMENT

Alhamdulillah, the highest thanks to God because with His Willingness I can complete the final year project in time.

I would like to express my gratitude to my dedicated supervisor, Mr Raja Mohd Taufika bin Raja Ismail for guiding this project with clarity and that priceless gift of getting things done by sharing his valuable ideas as well as his knowledge.

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ABSTRACT

With most pieces of consumer electronics, from camcorders to stereo equipment, an infrared remote control is usually always included. Video and audio apparatus, computers and also lighting installations nowadays often operate on infrared remote control. There are many different coding systems in use, and generally different manufacturers use different codes and different data rates for transmission. A universal remote control was developed by using C language via serial communication data transfer port. Basically, the Graphical User Interface (GUI) for the Universal Remote Control program was developed by using Microsoft Visual C++, the Microsoft application that enables the programmer to create conventional console and Windows applications. The hardware was interfaced to PC via the serial communication port. The remote can be operated on any standard TV, DVD player, satellite receiver and air-conditioner, operate over range of 15 ft, easy to use, and also reliable.

ABSTRAK

Hampir kebanyakan peralatan elektrik dan elektronik hari ini, dari perakam video kepada kelengkapan audio, unit kawalan jauh inframerah turut disertakan. Peralatan video dan audio, sistem komputer dan pencahayaan rumah pada hari ini beroperasi berasaskan unit kawalan jauh. Terdapat banyak system kod yang berbeza, dan pada kebiasaannya pengeluar berlainan menggunakan kod dan kadar data tranmisi yang berbeza. Sebuah alat kawalan jauh universal telah dibina dengan menggunakan bahasa program C menerusi terminal data komunikasi serial.Pada asasnya, antaramuka grafik pengguna untuk program kawalan universal telah dibangunkan dengan menggunakan perisisan Microrosft Visual C++, sebuah perisian Microsoft di mana ia membolehkan pemprogram untuk mencipta peraturan konsol dan aplikasi Windows. Unit perkakasan (penghantar/penerima) dihubungkan ke komputer melalui terminal komunikasi serial. Unit kawalan ini mampu beroperasi ke atas pelbagai jenama televisyen, pemain DVD, set penerima satelit, dan penghawa dingin, boleh beroperasi sehingga jarak 15 kaki, dan mudah dikendalikan.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter explains about the characteristic of infrared remote control and how they function. This chapter also explains about the problem statement, objectives of the project, project scopes and thesis outline.

1.2 Infrared Remote Control

With most pieces of consumer electronics, from camcorders to stereo equipment, an infrared remote control is usually always included. Video and audio apparatus, computers and also lighting installations nowadays often operate on infrared remote control. The carrier frequency of such infrared signals is typically in the order of around 36 kHz. The control codes are sent in serial format modulated to that 36 kHz carrier frequency (usually by turning the carrier on and off). There are many different coding systems in use, and generally different manufacturers use different codes and different data rates for transmission.

"IR" stands for infrared. Infrared light is invisible since its frequency is below that of visible red. Otherwise, it is like any other light source, operating under the same laws of physics. In most cases, the IR signals are produced by an LED source.

TV remotes send commands only one way, in a low-speed burst for distances of up to 30 feet. They use directed IR with LEDs that have a moderate cone angle to improve ease-of-use characteristics. The IR signal sent out by those devices is generally modulated to around 38 kHz carrier using amplitude shift keying (carrier on or off). The data rate send is generally in range of 100-2000 bps. There are some IR systems which use other frequencies and other modulation systems.

IR transmit and receive systems are inexpensive and are generally reliable. However, interference from other IR sources can be a minor issue. Interference can come from IR remote controls, IR audio systems (these broadcast an IR signal continuously) or other IR sources. Interference can also be caused by other light sources such as fluorescent lights (the ballast can cause IR interference). Sometimes some electronic ballasts powered light can cause interference problems. In order to avoid any interference with this kind of equipment, the operating frequency of all electronic ballasts has to be chosen so that problems in the 36 kHz frequency area are out of the question.

Many existing IR systems modulate the IR light at around 36-40 kHz (this is the frequency of the IR carrier and should not to be confused with the actual frequency of the IR light itself). The possibility of interference is more likely around the 40 kHz frequencies. One way to limit interference is to use higher IR carrier frequencies. Some IR systems now use carrier frequencies into the megahertz region.

Generally infrared remote controls are a 32-40 kHz modulated square wave for communication. This square wave is then send to IR transmitter (IR LED). The carried frequency is amplitude modulated by the data, usually full on/off type modulation. The data rate is typically in 50-1000 bit/s range depending on the system used. Usually the transmitter part is constructed so that the transmitter oscillator, which is driving the infrared transmitter LED, can be turned on/off by applying a TTL voltage on the modulation control input (the signal that goes here is usually serial data from remote control keyboard decoding IC). On the receiver side a photodiode takes up the signal. The integrated circuit inside a typical receiving chip is sensitive only around a specific frequency in the 32-40 kHz range. The output is the demodulated digital input, just what was used to drive the transmitter. The output is the demodulated digital input, just what was used to drive the transmitter. Usually this kind of receivers work so that when IR the carrier is present, this output is high. When no carrier is detected, the output is low. This type of circuits can usually transmit a 1-3 kHz digital signal through infra light. When trying to receive IR signals, leave demodulation to one of the special IC's/modules meant for this and deal with the data only.

The free air IR data transmission, IR remote control as well as the most optoelectronic sensors and light barrier systems work with a wavelength between 870nm and 950nm.

The system described above is not the only one IR remote system in use, it is just the most commonly used one. Asystem that use unmodalated signals of a one kHz or 100 kHz (and several other frequencies) exist as well.

1.3 Problem Statement

There is no doubt that remote controls are extremely popular and it has become very hard to imagine a world without them. Nowadays it is not surprise to see 4 or 5 different remote control units in an average living room. TV, Stereo set, DVD player, Air-conditioner and a Satellite receiver are among the most popular devices and each and every one of them has a unique remote control unit. No wonder that people want to control all these devices with one single universal remote control unit. Problems also occur when some of the remote unit stops functioning, broke or lost.

1.3.1 Problem Solution

A universal remote control is going to be develops by using C language via serial communication data transfer port. Basically, the Graphical User Interface

(GUI) for the Universal Remote Control program is going to be develop by using Microsoft Visual C++, the Microsoft application that enables the programmer to create conventional console and Windows applications. The circuits were constructed from two modules, one to capture the signal and provide timing functions, and the second as transmitter placed somewhere near the target equipment. The hardware was interfaced to PC on the communication port, using the Data lines 1 and Data lines 5 as input, and Data lines 3 and 5 as output. The remote can be operated on any standard TV, DVD player, satellite receiver and air-conditioner, operate over range of 15 ft, easy to use, and also reliable.

1.4 Project Objectives

The objective of this project is to develop a functional universal serial remote control software or program that will make it possible for all people to control any brand of their TV, DVD player, Satellite receiver and other remote control based electrical appliances from their personal computer or notebook.

1.5 Project Scopes

This project was developed by using C language and Microsoft Visual C++ for the Graphical User Interface (GUI). The prototypes can receive and store the data in the computer memory for every function button that it learn from a remote control unit, and transmit it back after that.

The program or software for the serial universal remote designed to be run in Windows.

For this project, the scope of electrical appliances expected to be test and analysed with standard brand of Television, DVD player, ASTRO satellite receiver and HP notebook.

The hardware was constructed from two modules:

(i) Receiver to capture the signal, stores the data, and provides timing functions.
(ii) Transmitter to resend the data stream under computer control placed somewhere near the target equipment.

1.6 Thesis Outline

Chapter 1 explains about the characteristic of Robot and its implementation to the industry and interfacing with the computer. It also explains about project objectives, problem statement and project scopes.

Chapter 2 explains about the literature review including the applications in daily life and feedback from users. It also includes review articles of the past project from other party.

Chapter 3 discuss about the methodology that have been taken to develop this project. This methodology is important to make sure the project is finish on time.

Chapter 4 focuses on hardware specifications and describe about serial port, input port in the receiver circuit and output port for transmitter circuit.

Chapter 5 describe about software specifications including Visual C++, source code (.c) and header files (.h).

Chapter 6 is for result of this project and the discussions. This also including problem faced while finishing this project.

Chapter 7 concludes this project and the future enhancement that can be done on this project.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter review about the remote control, how it works, the protocol, the universal remote control, types and the software used to program the graphical user interface (GUI) for Serial Universal Remote Control (SURC).

2.2 IR Remote Control Theory

The cheapest way to remotely control a device within a visible range is via Infrared light. Almost all-audio and video equipment can be controlled this way nowadays. Due to this wide spread use the required components are quite cheap, thus making it ideal for us hobbyists to use IR control for our own projects.

This part of my knowledge base will explain the theory of operation of IR remote control, and some of the protocols that are in use in consumer electronics.

2.3 Infra-Red Light

Infrared actually is normal light with a particular colors. Humans can't see this colors because its wavelength of 950nm is below the visible spectrum. That's one of the reasons why IR is chosen for remote control purposes, we want to use it but we're not interested in seeing it. Another reason is because IR LEDs are quite easy to make, and therefore can be very cheap.

Although humans can't see the Infrared light emitted from a remote control doesn't mean it can't make it visible. A video camera or digital photo camera can "see" the Infrared light as shown see in Figure 2.1. By using web cam, point a remote to it, press any button and see the LED flicker.

Unfortunately for us there are many more sources of infrared light. The sun is the brightest source of all, but there are many others, like: light bulbs, candles, central heating system, and even our body radiates infrared light. In fact everything that radiates heat, also radiates infrared light.

Therefore we have to take some precautions to guarantee that our IR message gets across to the receiver without errors. [8]

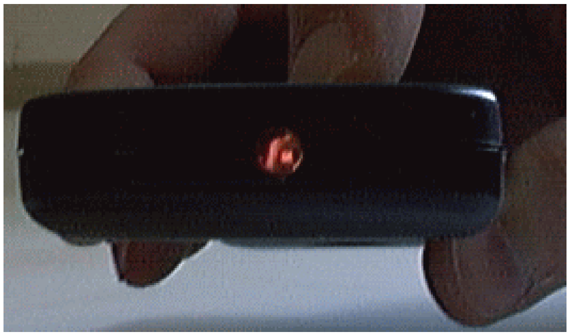

Figure 2.1 IR light emitted from a RC

2.4 Modulation

Modulation is the answer to make our signal stand out above the noise. With modulation we make the IR light source blink in a particular frequency. The IR receiver will be tuned to that frequency, so it can ignore everything else.

You can think of this blinking as attracting the receiver's attention. We humans also notice the blinking of yellow lights at construction sites instantly, even in bright daylight.

In Figure 2.2, a modulated signal driving the IR LED of the transmitter on the left side. The detected signal is coming out of the receiver at the other side.

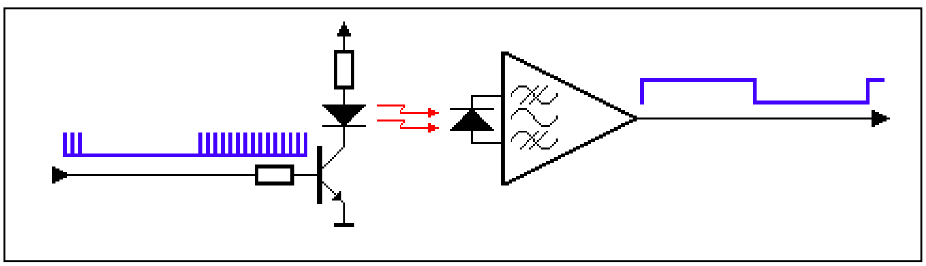

Figure 2.2 Signal modulation

In serial communication we usually speak of 'marks' and 'spaces'. The 'space' is the default signal, which is the off state in the transmitter case. No light is emitted during the 'space' state. During the 'mark' state of the signal the IR light is pulsed on and off at a particular frequency. Frequencies between 30kHz and 60kHz are commonly used in consumer electronics.

At the receiver side a 'space' is represented by a high level of the receiver's output. A 'mark' is then automatically represented by a low level. Note that the 'marks' and 'spaces' are not the 1-s and 0-s we want to transmit. The real relationship between the 'marks' and 'spaces' and the 1-s and 0-s depends on the protocol that's being used. More information about that can be found on the pages that describe the protocols.

2.5 The Transmitter

The transmitter usually is a battery-powered handset. It should consume as little power as possible, and the IR signal should also be as strong as possible to achieve an acceptable control distance. Preferably it should be shock proof as well.

Many chips are designed to be used as IR transmitters. The older chips were dedicated to only one of the many protocols that were invented. Nowadays very low power microcontrollers are used in IR transmitters for the simple reason that they are more flexible in their use. When no button is pressed they are in a very low power sleep mode, in which hardly any current is consumed. The processor wakes up to transmit the appropriate IR command only when a key is pressed.

Quartz crystals are seldom used in such handsets. They are very fragile and tend to break easily when the handset is dropped. Ceramic resonators are much more suitable here, because they can withstand larger physical shocks. The fact that they are a little less accurate is not important.

The current through the LED (or LEDs) can vary from 100mA to well over 1A! In order to get an acceptable control distance the LED currents have to be as high as possible. A trade-off should be made between LED parameters, battery lifetime and maximum control distance. LED currents can be that high because the pulses driving the LEDs are very short. Average power dissipation of the LED should not exceed the maximum value though. You should also see to it that the maximum peek current for the LED is not exceeded. All these parameters can be found in the LED's data sheet.

A simple transistor circuit, as shown in Figure 2.3, can be used to drive the LED. A transistor with a suitable HFE and switching speed should be selected for this purpose.

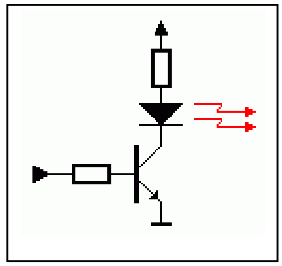

Figure 2.3 IR LED transistor circuit

The resistor values can simply be calculated using Ohm's law. Remember that the nominal voltage drop over an IR LED is approximately 1.1V.

The normal driver, described above, has one disadvantage. As the battery voltage drops, the current through the LED will decrease as well. This will result in a shorter control distance that can be covered. An emitter follower circuit can avoid this. The 2 diodes in series, as shown in Figure 2.4 will limit the pulses on the base of the transistor to 1.2V. The base-emitter voltage of the transistor subtracts 0.6V from that, resulting in a constant amplitude of 0.6V at the emitter. This constant amplitude across a constant resistor results in current pulses of a constant magnitude. Calculating the current through the LED is simply applying Ohm's law again.

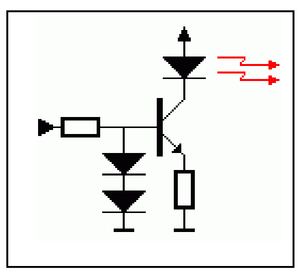

Figure 2.4 IR LED transistor circuit with two diodes in series

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