DESIGN AND CONSTRUCTION OF A CLOSED CIRCUIT TELEVISION VIDEO SWITCHER

BY

HARRY LUEMO GWAR

2001/11989EE

PROJECT OPERATION MANUAL

Features:

(i) This video switcher is capable of switching a maximum of four cameras.

(ii) It offers only video signal switching with no sound (CCTVs don't make sound).

(iii) It offers two modes of operation: manual and automatic.

Operation of the CCTV video switcher:

(i) Connect Video cameras to video input jacks 1 to 4.

(ii) Connect monitor, video cassette recorder or digital video recorder to eith both of the video output jacks.

(iii) Connect the video switcher to external 220V A.C power outlet.

(iv) Multiplexer or switching action is observed on the monitor connected to t automatic mode video output jack. Switching action is indicated by the re LEDs.

(v) Switching action can be initiated in the manual mode by pressing the ma mode switch. Switching action is indicated by the green LEDs.

Specifications:

Input voltage (V)	180 – 240
Input voltage frequency (Hz):	50
Maximum current rating (A):	1.5
Maximum power rating (VA):	360

DECLARATION

I Harry Luemo Gwar declare that this work was done by me and has never been presented elsewhere for the award of a degree. I also hereby relinquish the copy right to the federal University of Technology, Minna.

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ACKNOWLEDGEMENT

To the almighty God, whom I leave for and owe everything to – I stoop in worship. To Major M. T. Gwar (Rtd.), my father, words cannot express my gratitude for your care and support; you couldn't have been better. To Mrs. Iveren Gwar, my mum, a million thanks will not suffice; I owe you a life time of gratitude. To my sibling, Ashi, Bem, Fashima and Fanan, the thought of you kept me going – many thanks. I also want to say special thanks to my supervisor, Mr. J. A. Ajiboye for the corrections and assistance offered me in the course of carrying out this project; it wouldn't have been this good without you. To my ever supportive uncle, Abaagu Terhemen and aunty, Brenda Faga I say a big thank you. To these special friends: Nicholas, Maiyaki, Moses, Henry and John, who always stood by me; I appreciate.

ABSTRACT

This project work aims at implementing a low cost approach to distributing video signals over a common transmission link or sending video images from numerous input sources unto a common output, say a video cassette recorder, monitor or television set. In other words, this project work seeks to provide visual monitoring using multiplexed transmission of video signals. This project work makes use of four video input channels and two output channels. One of the output channels is manually controlled while the other is automatically controlled. This project work also implements a wired scheme as against a wireless scheme.

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CHAPTER ONE:

INTRODUCTION

1.1 What is Closed Circuit Television (CCTV)?

CCTV is an acronym for Closed Circuit Television. "Closed circuit", refers to an installation of directly connected components creating a circuit which cannot be viewed by anybody outside of the circuit.

This is different from a terrestrial television broadcast system which can be viewed by anybody with an antenna or other reception equipment [1]. It is a visual surveillance technology designed for monitoring a variety of environments and activities. CCTV systems have been used for surveillance purposes for a long time, as a matter of fact they mean one and same thing to some people. It is also known as Image pick-up device. CCTV systems typically involve a fixed (or "dedicated") communications link between cameras and monitors. It transmits visual information over a closed circuit through electrically conducting cable or wireless transmitter and receiver. [2]

1.2 Why use CCTV

CCTV deters 'opportunistic' crime, where people take advantage of a situation on the spur of the moment. "Today's opportunist is tomorrow's professional criminal". If we decrease the number of opportunities for easy crime, we can reduce the number of people becoming professional criminals.

The limits of CCTV are constantly extended. Originally installed to deter burglary, assault and car theft, in practice most camera systems have been used to combat 'anti-social behavior', including many such minor offenses as littering, urinating in public, traffic violations, obstruction, drunkenness, and evading meters in town parking lots. They have also been widely used to intervene in other 'undesirable' behavior such as under-age smoking and a variety of public order transgressions. Other innovative uses are constantly being discovered. When combined with observation of body language, the cameras are particularly effective in detecting people using drugs and other substances. These systems are used increasingly to police public morals and public order. [6]

CCTV is very quickly becoming an integral part of crime control policy, social control theory and 'Community consciousness'. It is no exaggeration to conclude that the technology has had more of an impact on the evolution of law enforcement policy than just about any technology initiative in the past two decades [12]. It has become an icon for security, and for politicians, its promotion is guaranteed to create a feel-good response. When people are frightened of crime and criminals, critics of CCTV are often portrayed as enemies of the public interest. [13]

While Britain is clearly the lead nation in implementing CCTV, other countries are quickly following. North America, Australia and some European countries are installing the cameras in urban environments which a few years ago would most likely have rejected the technology [2]. Here in Nigeria, the banking industry has been in the lead of the use of this technology for surveillance purposes, it is also being used in high security areas such as the national assembly building and CBN head quarters. The CCTV fever is surely spreading.

1.3 The camera

The starting point for any CCTV system must be the camera. The camera creates the picture that is being transmitted to the control position. Apart from special designs, CCTV cameras are not fitted with a lens. The lens must be provided separately and screwed onto the front of the camera. There is a standard screw thread for CCTV cameras, although there are different types of lens mounts.

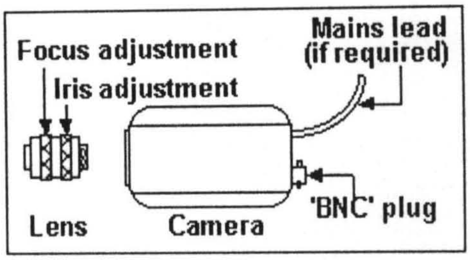


Fig. 1.0 Camera and Lens

Not all lenses have focus and iris adjustment, though most have iris adjustment. Some very wide angle lenses do not have a focus ring. The 'BNC' plug is for connecting the coaxial video cable. Line powered cameras do not have the mains cable. Power is provided via the coaxial cable.

1.4 The monitor

The picture created by the camera needs to be reproduced at the control position. A CCTV monitor is virtually the same as a television receiver except that it does not have the tuning circuits.

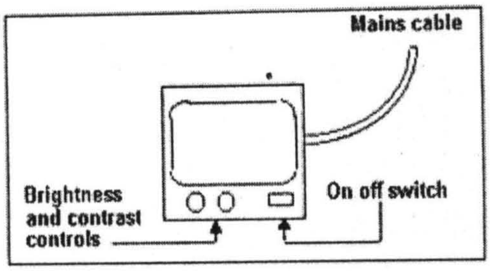


Fig. 1.1 CCTV Monitor

1.5 Simple CCTV systems

The simplest system is a camera connected directly to a monitor by a coaxial cable with the power for the camera being provided from the monitor. This is known as a line powered camera. Diagram 3 shows such a system. Probably the earliest well-known version of this was the Pye Observation System that popularized the concept of CCTV, mainly in retail establishments. It was an affordable, do-it-yourself, self-contained system. [6]

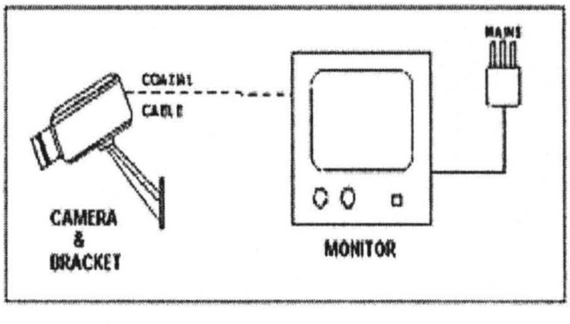


Fig. 1.3 simple CCTV system

1.5.1 PC based DVR (Digital Video recording) CCTV: In PC based DVR CCTV systems, cameras record the images on the computer hard drive instead of VHS tapes. It allows users to view the images from any other Internet connected computer. In this system a DVR card is placed on motherboard slot of a PC. A normal DVR card can be of 04 channels to 24 channels which mean it has a capacity to connect up to 24 cameras. Of course separate DVR devices can be placed as 'video switchers' in-between monitor and cameras for better performances.

1.6 Objective

The objective of this project work is to provide visual monitoring using multiplexed transmission of video signals. Via this project, I seek to provide a low cost approach to distributing video signals over a common transmission link.

This project work aims at actualizing two modes of operation, which are: manual and automatic. In other words, this project incorporates the use of two video outputs; one is manually controlled while the other is automatically controlled. The scan rate of the picture going into one of the output nodes is manually controlled while the scan rate of the video picture into the second node is determined automatically via a predetermined scan rate. However one can make use of a single output node to view pictures from several input sources.

1.7 Scope

The design and construction of this project work: Closed Circuit Television (CCTV) Video Switcher is limited to four (4) camera video input sources and two video output units. The scan rate of the video picture going to one of the output units is manually controlled while the scan rate of the video in to the second video output is automatically controlled. Summarily, video pictures from four camera input sources are time multiplexed unto one output unit.

However, this project work can be expanded to switch numerous camera video inputs as desired, unto one output unit. This project also seeks to make use of VCD video input sources instead of camera video sources for demonstration purposes. However, camera sources can be effectively used.

CHAPTER TWO:

LITERATURE REVIEW

2.1 Introduction to Multiplexers

The term Multiplexers was given to a device that time multiplexes video signals from numerous video cameras unto one VCR [5]. This means that one field or frame from one camera is switched to the VCR then immediately followed by another from another camera and so on from each camera, then it is started over again.

2.1.1 Multiplexer Math

One odd field and one even field (2 fields) make up one video frame. This is important to multiplexers since they are basically a time base multiplexing device.. In the CCTV world there really does not exist a standard to how many pictures per second are recorded in real time or time lapse mode. When setting the multiplexer there exists a menu or dip switches to tell the multiplexer this information. If this information is not set up correctly the mux will switch between its input cameras either too slowly or too fast resulting in lost video recorded on the VCR or at best reduces the efficiency of the multiplexer. When the VCR changes speed and the multiplexer does not know this fact the above problem exists. To eliminate this problem some multiplexer use a camera switcher pulse. This pulse tells the multiplexer electronically when it has recorded the last image on tape. The multiplexer can then switch to the next camera process it and have it ready for output to the VCR. The advantage of using the pulse is that the multiplexer is guaranteed to stay in sync with the VCR even if the VCR changes recording speed.

The most important thing that is normally forgotten about multiplexers is that they are still basically video switchers. When many cameras are connected and the time lapse recording is too slow, the time between recording a single image from a particular camera may be too long to catch any event. Basically, the number of camera inputs is taken and divided by the recording pictures per second.

No. of cameras/record pictures per second = update rate. This implies that if 16 camera system records at 168hr time lapse mode then there will be17.40 seconds from recording a new image from any one camera input. This of course will have little use in any application since some one could walk by and never be recorded. If we reduce the recording time to 24hr time lapse then we would have a new image after every 3.2 seconds. This would be more acceptable but not applicable in high traffic areas. If we went to 24hr virtual real time at 20 pictures per second then we would have a new image every 8 seconds. This is more like it and will be useful in most applications [3].

2.1.2 Multiplexer types

- Simplex

The simplex multiplexer is basically the lowest cost since it has the least amount of features. A simplex multiplexer has the ability to time multiplex to VCR and all the timing setups required. The main thing a simplex multiplexer does not have is the ability to record and show a multi screen display at the same time.weather it is 4, 8, 6 or 32 camera screen. Normally simplex multiplexers no have capability for multi-screen display at all. In this project, the use of a simplex multiplexer is employed.

- Duplex

A full duplex multiplexer has the ability to display multi-screen and record to the VCR the multiplexed data. Some duplex multiplexer can playback from one VCR while recording on another but you give up the multi-screen viewing at this time.

-Full duplex

A full duplex multiplexer has the ability to record the multiplexed output to the one VCR, playback from another, and view the multi-screen from at the same time.

-Triplex

A triplex multiplexer has all the features of the full duplex but the multi-screen output can be substituted for a third VCR if desired [5].

2.2 Previous Works

The only previous work done on this topic was done by Ifeanyichukwu Egeolu two years ago. A significant difference exists between his project and mine, the major difference being in the power supply. He made use of three different voltages in his work,+/-6V and 12V, while I made use of just +5V.having studied the data sheet of all the ICs used, I came to the conclusion that they could all work on only +5V. This led a great deal to the simplification of the circuit. Also in the decoder IC used to drive the indicator LEDs, while he used the decoder IC LM7445 as a LED driver, I used the decoder IC DM74LS445 which is also a LED driver with open collector outputs.

Also, in the titling of the projects, he titled his work “DESIGN AND CONSTRUCTION OF A FOUR CAMERA SURVEILLANCE SYSTEM WITH MULTIPLEXED SWITCHING” while I titled mine “DESIGN AND CONSTRUCTION OF A CLOSED CIRCUIT TELEVISION (CCTV) VIDEO SWITCHER”.

CHAPTER THREE:

Design and implementation.

3.0 Overview

In the design of this project, the following were the major components used:

1. The 74HC4052 Dual 4-channel multiplexer.
2. CD4518 Dual binary up counter.
3. DM74LS445 BCD-To Decimal decoder.
4. NE555 Timer
5. LM337 and LM317 adjustable positive and negative voltage regulators.

3.1 The multiplexer

The 74HC4052 is a dual 4-channel analogue multiplexer with common select logic. It is a high speed si-gate CMOS device and it is pin compatible with the HE4052B. Each mux has four independent inputs/outputs (pins nX to nY) and a common input/output (pin nZ). The common channel select logics include two digital select inputs (pins S0 and S1) and an active low enable (pin E). When pin E= low, one of the four switches is selected (low impedance ON-state) with pins A and B. When pin E=HIGH, all switches are in the high impedance OFF- state, independent of pins A and B.

Table 1.0 function table

CD4052B			
INHIBIT	B	A	
0	0	0	0x, 0y
0	0	1	1x, 1y
0	1	0	2x, 2y
0	1	1	3x, 3y
1	X	X	None

Table 1.1 Pinning

PIN	SYMBOL	DESCRIPTION
1	0Y	independent input or output
2	2Y	independent input or output
3	2Z	common input or output
4	3Y	independent input or output
5	1Y	independent input or output
6	E	enable input (active low)
7	V_{EE}	negative supply voltage
8	GND	ground (0V)
9	B	select logic input
10	A	select logic input
11	3X	independent input or output
12	0X	independent input or output
13	1Z	common input or output
14	1X	independent input or output

15 2X independent input or output

16 V_{CC} positive supply voltage [3]

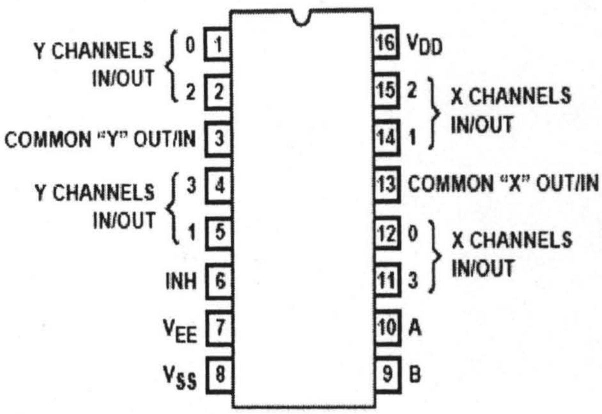


Fig. 3.1.0 pin configuration DIP16

3.1.1 Implementation

Four video inputs from four surveillance cameras are connected to each of the four inputs of the half section of the two multiplexers. (Only half the circuit in each chip is used.) The video inputs are terminated into standard 16V100µF input capacitances as required for a video signal. Independent input or output pins 11,12,14,15 (Not needed) and enable pin 6 (low) are all grounded. The two multiplexers are run off +5V. Outputs from the multiplexers are terminated into 50Ω impedances as also required for video application. One multiplexer is driven by a CD4518 binary up-counter clocked by the scan rate generator and the other mux is driven by the second pair of the CD4518 clocked manually.

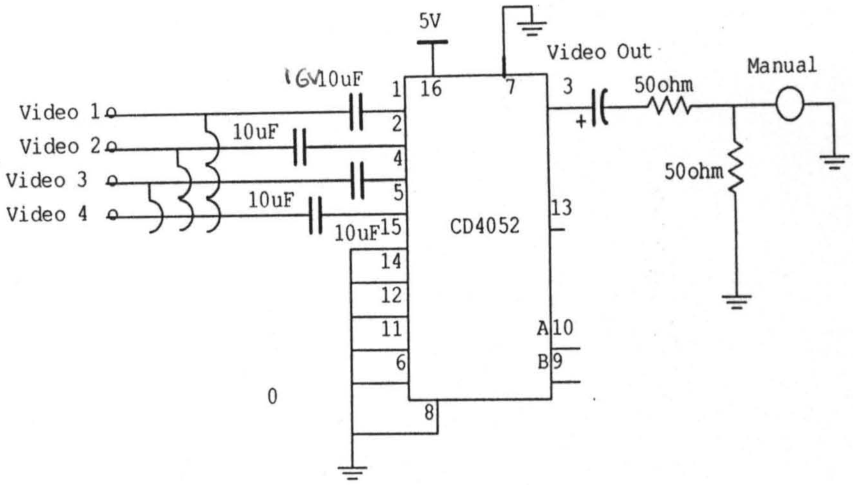


Fig.3.1.1 implementation of the CD4052 [4]

3.2 The counter

A counter is a device that counts events or periods of time or puts events into sequence. Other functions of counters include dividing frequency, addressing and serving as memory units. [7]

3.2.1 Binary address generator

The binary address generator is built around a CD4518 dual 4-bit synchronous up-counter. One half of the counter has its clocking circuitry driven by the output of the NE555 scan rate clock while the other half is clocked manually. The outputs of the counters are 4-bit (0000-1111), though only the first four bit combination are used: (0000-0011)

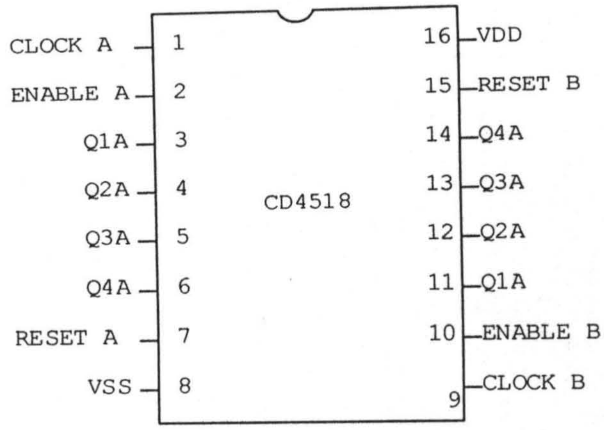


Fig.3.1.2 CD4518 pin-out

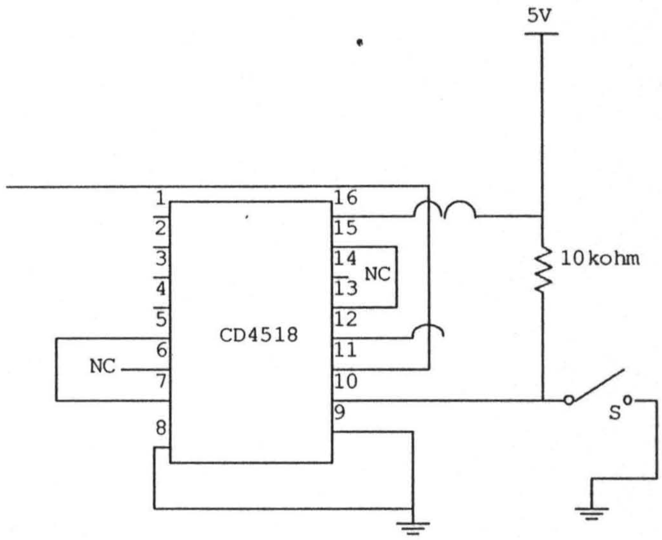


Fig. 3.1.3 implementation of the CD4518 [4]

One multiplexer is addressed by the scan rate generator while the other multiplexer is addressed by the manually clocked counter. Both counters are reset on the 4th count to repeat the loop. The counting sequence is given in table 3.0 below. The 10KΩ resistor is added in the circuit as a pull-up resistor for current limiting for the switch S.

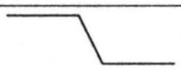
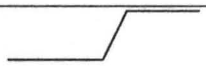
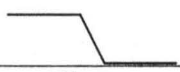
Table 3.0 counting sequence [3]

CLOCK PULSES	D	C	B	A	DECIMAL COUNT
0	0	0	0	0	0
1	0	0	0	1	1
2	0	0	1	0	2
3	0	0	1	1	3
4	0	1	0	0	4
5	0	1	0	1	5
6	0	1	1	0	6
7	0	1	1	1	7
8	1	0	0	0	8
9	1	0	0	1	9
10	1	0	1	0	10
11	1	0	1	1	12
12	1	1	0	0	13
13	1	1	0	1	14
14	1	1	1	0	15
15	1	1	1	1	16

Table 3.1Video select truth table

Address Lines		Selected Video Output
A1	A2	
0	0	Video 1
0	1	Video 2
1	0	Video 3
1	1	Video 4

Table 3.2 truth table of the CD4518 [3]

CLOCK	ENABLE	RESET	ACTION
	1	0	Increment counter
		0	Increment counter
	X	0	No change
X		0	No change
	0	0	No change
1		0	No change
X	X	1	Q1 thru Q4 = 0

3.3 Decoder

A decoder is a device that detects the presence of a specified combination of bits (code) on its input and indicates the presence of that code by a specified output level. In its general form a decoder has n inputs lines to handle n bits and from one to 2n output lines to indicate the presence of one or more n-bit combination [8].

3.3.1 SN7445 BCD-to-Decimal Decoder/Driver

This BCD-to-decimal decoder/driver consists of eight inverters and ten four-input NAND gates. Full decoding of valid BCD input logics ensure that all outputs remain off for all invalid binary input conditions.

3.3.2 Features of the SN7445 BCD-to Decimal Decoder

1. Full decoding of input logic.
2. 80mA sink current capability.
3. All outputs are OFF for invalid BCD input conditions.
4. Operates on a HIGH LEVEL (OFF) /LOW LEVEL (ON)

Table 3.3 functional table

S/NO	INPUTS				OUTPUTS									
	D	C	B	A	0	1	2	3	4	5	6	7	8	9
0	L	L	L	L	L	H	H	H	H	H	H	H	H	H
1	L	L	L	H	H	L	H	H	H	H	H	H	H	H
2	L	L	H	L	H	H	L	H	H	H	H	H	H	H
3	L	L	H	H	H	H	H	L	H	H	H	H	H	H
4	L	H	L	L	H	H	H	H	L	H	H	H	H	H
5	L	H	L	H	H	H	H	H	H	L	H	H	H	H
6	L	H	H	L	H	H	H	H	H	H	L	H	H	H
7	L	H	H	H	H	H	H	H	H	H	H	L	H	H
8	H	L	L	L	H	H	H	H	H	H	H	H	L	H
9	H	L	L	H	H	H	H	H	H	H	H	H	H	L
	H	L	H	L	H	H	H	H	H	H	H	H	H	H
	H	L	H	H	H	H	H	H	H	H	H	H	H	H
	H	H	L	L	H	H	H	H	H	H	H	H	H	H
	H	H	L	H	H	H	H	H	H	H	H	H	H	H
	H	H	H	H	H	H	H	H	H	H	H	H	H	H

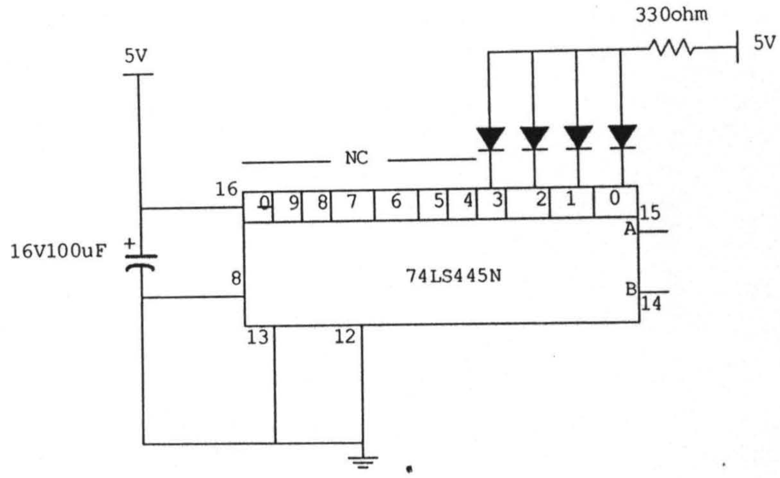


Fig.3.1.4 implementation of the decoder/LED driver

Inputs C and D (pins 12 and 13) on the decoders are tied to logic 0 (Ground), so that the binary combination presented to the decoder ranges from 0000 to 0011, before rolling back to 0000 to repeat the sequence.

The 330Ω resistor is used to provide 3.8mA anode current for the four LEDs.

From diagram, 4I =V/R =5/330

I =3.8mA (max nominal current for LEDs=10mA).

3.4 The Oscillator

An oscillator is a circuit that creates an AC signal, that is, it converts AC to DC. The only input to the oscillator is the DC power supply and the output is an AC signal. Oscillator can be designed to produce many kinds of wave forms such as sine, rectangular, triangular or saw tooth. The range of frequency that the oscillator can generate is from less than 1Hz to well over 10GHz. Oscillators are designed in different ways depending on the wave form and frequency requirements. Most oscillators are amplifiers with feedback, if the feedback is positive, the amplifier may oscillate (produce AC) [9]. With respect to this project, the oscillator of interest is the free running or astable mode 555 timer oscillator.

3.4.1 The scan rate generator

This is a pulse generator, the frequency of which determines the rate at which the BCD up-counter will increment thereby determining the rate at which the multiplexer switches between the cameras. In this project work, the NE555 timer IC was used to accomplish this task.

The NEE555 IC timer has become very popular with designers because of its low cost and versatility. It is available in the 14-pin dual in-line package and the 8-pin DIP. The 555 provides stable time delays or free running oscillation. The time delay mode is RC-controlled by two external components, depending on the desired output waveform. Frequencies from less than 1Hz to 500 kHz with duty cycles from 1 to 99% can be attained [9].

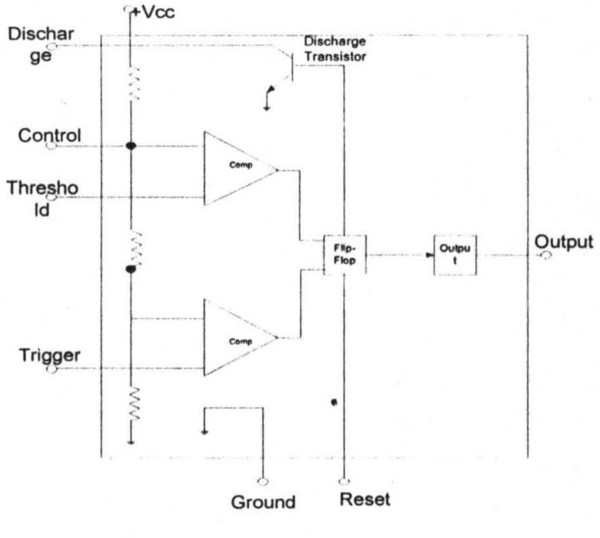


Fig 3.1.5 Functional block diagram of the NE555

Fig 3.1.6 shows the major sections of the 555 timer IC. It contains two comparators, a bistable flip-flop, a discharge transistor, a resistor divider network and an output amplifier with up to 200mA current capability. There are three divider resistors, and each is 5KΩ. This divider network sets the *threshold* comparator trip point at 2/3 of V_{CC} and the *trigger* comparator at 1/3 of V_{CC}. V_{CC} may range from 4.5 to 16V [9]. The circuit implementation of the 555 timer is as shown below.

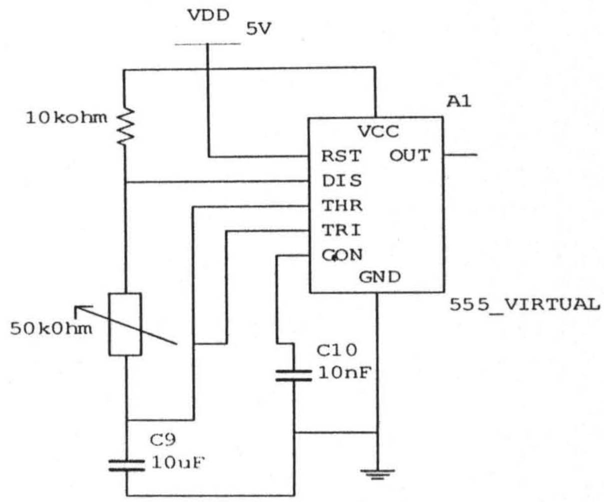


Fig. 3.1.6 implementation of the 555

The frequency of the pulse generated is given by the formula:

$$F = \frac{1}{0.693\,(RA + 2RB)\,xC1}$$

With RA = 10K, RB = 2.2K and C1=100uF, frequency F= 1Hz

3.5 The power Supply

The supply unit consists of the following:

- The transformer
- The full wave Bridge rectifier unit
- The capacitive filters
- The voltage regulation unit

3.5.1 The transformer unit

A transformer is a static (or stationary) piece of apparatus by means of which electric power in one circuit is transform into electric power of same frequency in another circuit. It can raise or lower the voltage in a circuit but with a corresponding decrease or increase in current. The physical basis of a transformer is mutual inductance between the two circuits linked by a common magnetic flux. In its simplest form, it consists of two inductive coils which are electrically separated but magnetically linked through a path of low reluctance as shown in Fig. 3.1.7.

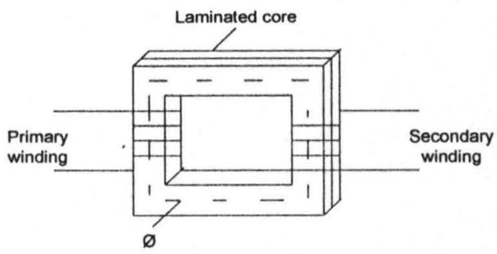


Fig. 3.1.7: Primary and Secondary Winding of a Transformer Linked by Magnetic Flux Ø

The two coil is connected to a source of alternating voltage, an alternating flux is set up in the laminated core most of which is linked with the other coil in which it produces mutual induced e.m.f (according to Faradays law of electromagnetic induction e = Mdl/dt). If the second coil circuit is closed, a current flows in it and so electric energy is transferred (entirely magnetically) from the first coil to the second coil. The first coil in which electric energy is fed from the A.C mains is called the **primary winding** and the other from which energy is drawn out, is called the **secondary winding.** Summarily, a transformer is a device that;

1. Transfer electric power from circuit to another
2. It does so without change in frequency

3. It accomplishes this by electromagnetic induction, and

4. Where the two electric circuits are mutual induction influence of each other [10].

3.5.2 Full wave Bridge rectifier unit

The DC level obtained form a sinusoidal input can be improved 100% using a process called full wave rectification. A packaged full-wave bridge rectifier (D3SBA20) was used for this project but its internal structure which is the most familiar network for performing such a function appears in Fig. 3.1.8 with its four diodes in bridge configuration.

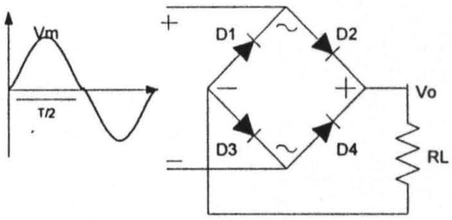


Fig. 3.1.8: Full-Wave Bridge Rectifier.

During the period T= 0 to T/2 the polarity of the input is shown in Fig. 3.1.9. The resulting polarities across the ideal diodes also showed in Fig. 3.1.9 to reveal that D2 and D3 are conducting while D1 and D4 in "off" state.

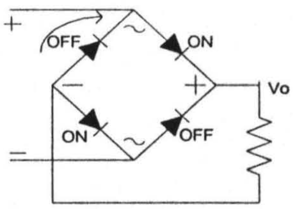


Fig. 3.1.9: Networks of Fig. 3.2.0 for the Period 0 to T/2 of the Input Voltage.

The net result is the configuration of Fig. 3.2.0, with its indicated current and polarity across R. Since the diodes are ideal the load voltage is Vo = Vi, as shown below.

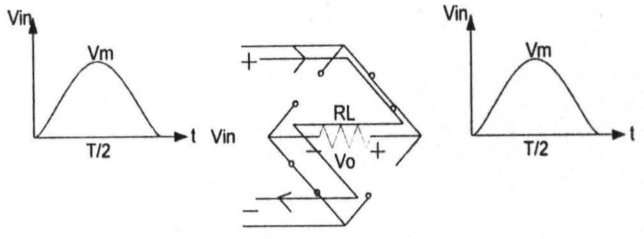


Fig. 3.2.0: Conduction Path for the Positive Region of Vi.

The input and output waveform is shown in Fig. 3.2.1 below:

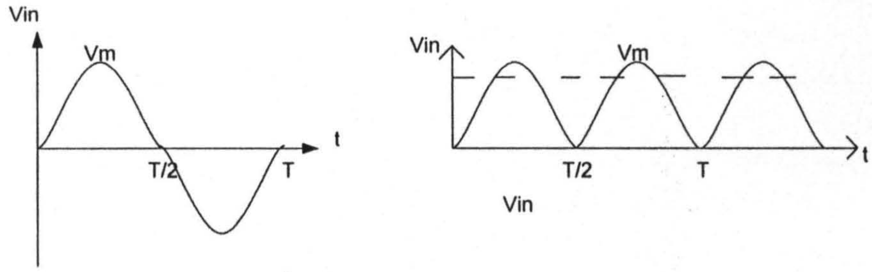


Fig. 3.2.1: Input and Output Waveforms for a Full Wave Rectifier.

Since the area above the axis for one full cycle is now twice that obtained for a half wave system, the d.c level has also doubled and,

$V_{d.c} = 2(0.318V_m) = 0.636V_m$ for a full wave.................. (3.1)

If silicon rather than ideal diodes are employed, an application of Kirchoff's voltage law around the conduction path would result in $V_{in} - V_t - V_o - V_t = 0$, and $V_o = V_{in} - 2V_t$.

The peak value of the output voltage V_o is therefore $V_{omax} = V_{in} - 2V_t$.

For situations where $V_{in} >> 2V_t$, equation 3.2 can be applied for the average value with a relatively high level of accuracy. [7]

$V_{dc} = 0.636(V_{in} - 2V_t)$.......................... (3.2).

Then again, if V_m is sufficiently greater than $2V_t$, the equation (3.1) is often applied as a first approximation for V_{dc}.

3.5.3 PIV (Peak Inverse Voltage)

The required PIV of each diode (Ideal) can be determined by four equation obtained at the peak of the positive region of the input signal. For the indicated loop the main voltage across R is V_m and the PIV rating is defined by

$PIV \geq V_m$ ……………………full wave bridge rectifier.

3.5.4 The Capacitive Filter

A very popular filer is the capacitor filter circuit. A capacitor is connected at the output, and a dc voltage is obtained across the capacitor.

Fig. 3.2.2 shows the block diagram of the circuit.

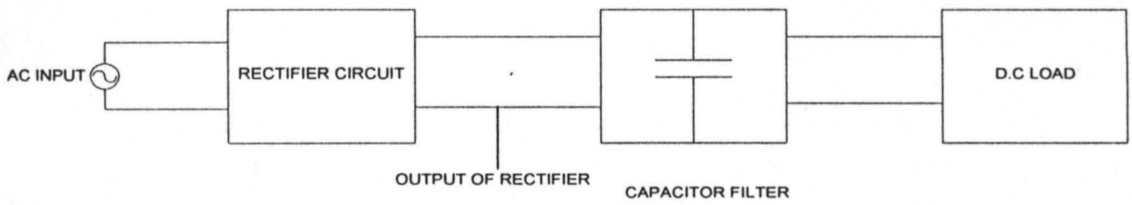


Fig. 3.2.2: Simple Capacitor Filters.

Fig. 3.2.3 shows the resulting wave form after the filter capacitor is connected at the rectifier output.

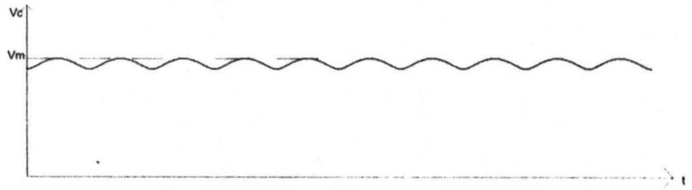


Fig. 3.2.3: The Output Wave Form after Connecting the Capacitor.

Calculation for C1

The choice of a filter capacitor can be based on the following equation:

$$C = \frac{I \times T}{V_{p\text{-}p}}$$

Where C = the capacitance in farads (F)

I = the load current in amperes (A)

$V_{p\text{-}p}$ = allowable peak -to- peak ripple voltage in Volts (V)

T = the period in seconds (s) [9]

With $I = 0.2$A $V_{p\text{-}p} = 1$V f = 50Hz, $T = 1/(2 \times 50) = 0.01$s (ripple frequency = 2x input frequency for full wave rectifiers.)

$C1 = (0.2/1) \times 0.01 = 0.002\mu F = 2000\mu F = 2200\mu F$ (standard value).

Capacitor C2 is optional but is included to improve the way the regulator responds to changing load currents.

3.5.6 The voltage Regulation Unit

Voltage regulators comprise a class of widely used ICs. Regulator IC units contains the circuitry for reference source, comparators, control devices and overload protection all in a single IC. Although the internal construction of the IC is somewhat different from that of the discrete components circuits, the external operation is much the same.

In this project, the LM78XX (Series Voltage Regulators) was used.

General Description of the 78XX series

The LM78XX series of three terminal regulators is available with several fixed output voltages making them useful in a wide range of applications. The voltages available allow these regulators to be used in logic systems, instrumentation, HiFi, and other solid state electronic equipment [13].

Features include:

- ▪Output Current up to 1A
- ▪Output Voltages of 5, 6, 8, 9, 10, 12, 15, 18, 24
- ▪Thermal Overload Protection
- ▪Short Circuit Protection
- ▪Output Transistor Safe Operating Area Protection

General Description

The LM78XX series of three terminal positive regulators are available in the TO-220 package and with several fixed output voltages, making them useful in a wide range of applications. Each type employs internal current limiting, thermal shut down and safe operating area protection, making it essentially indestructible. If adequate heat sinking is provided, they can deliver over 1A output current. Although designed primarily as fixed voltage regulators, these devices can be used with external components to obtain adjustable voltages and currents. [11]

Fig. 3.2.4(a) and Fig. 3.2.5(b) show the schematic representation and the physical appearance of the 78xx positive regulator series.

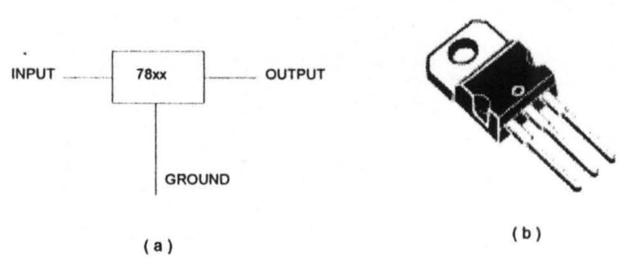


Fig. 3.2.4(a) and Fig. 3.2.5(b): Schematic Drawing and Package of the 78xx Positive Voltage Regulator Series.

THE POWER SUPPLY

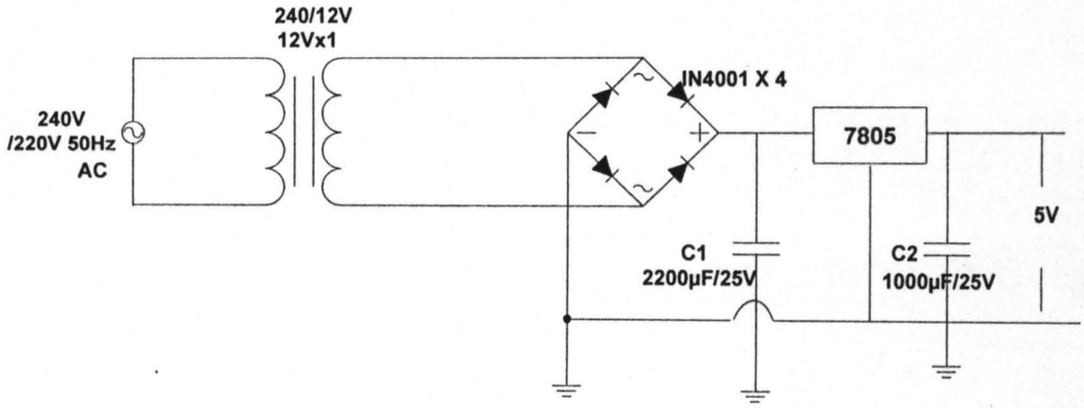


Fig. 3.2.6 The power supply circuit [12]

CHAPTER FOUR

Tests, Results and Discussion

This project work though meant to multiplex video signals from four CCTV cameras was tested using two VCDs and a television. The output jacks of the two VCDs were inserted into two of the video input jacks or the video switcher and the televisions input jack was connected to the automatic scan video output jack of the video switcher. Multiplexer or switching action was observed as the video switcher switched between the pictures outputted by the two VCDs.

For auto scan, the time taken for a new image to be displayed or the duration of display of image from any one camera is set by the value of the potentiometer R_B and given the formula for the period of pulse generated by the scan rate generator i.e.

$$T = 0.693(R_A+2R_B) \times C1 \ [9]$$

$$T=0.693(10E3+2R_B)\ 100\mu F$$

For potentiometer R_B set at 45.5K, it was observed that a new image was displayed every 7seconds between switching from the image from video input1 to the image from video input2 or from image from video input3 to image from video input4. The maximum switching time for this circuit is 7.6seconds and this is obtained when R_B is set at its maximum value of 50KΩ. Next, the television's input jack was inserted into the manual scan video output jack and switching\multiplexer action was tested by closing switch S1. For each closing of the switch, a new image was displayed. This is because the CD4518 BCD up-counter was configured to be triggered on a falling pulse edge by grounding its enable pin. Thus my work was successfully tested.

CHAPTER FIVE:

5.1 Conclusions

This project, CCTV VIDEO SWITCHER, has been successfully designed and constructed. It has also been tested and confirmed to work according to its stated objective. This project makes use of four input channel and two output channels, an automatic and a manual. The application of a multiplexer has been fully explored in this project; its workability and functionality have also been fully demonstrated. This project is divided into five subsections, these are:

1. Video switching / multiplexer section
2. Two bit binary address generator
3. A 0.5Hz adjustable scan rate generator
4. Dual 1-of-4 LED driver/decoder
5. The power supply

5.1.1 Limitations

Though a feasible design, this project work has some inherent limitations, these are:

1. Two televisions are needed for the actualization of the two modes operation: Manual and Automatic.
2. The switching system is connected to four camera sources by wires.
3. There is no log of previous scans, which is to say that no history can be referred to.

5.1.2 Recommendations

To overcome the first limitation, a scheme that displays the four video frames at the same time on the same screen should be implemented. This can be achieved by the use of a Duplex or Triplex multiplexer. The second limitation can be overcome by employing a wireless scheme whereby each video source is sent to the switch as a modulated RF signal. This permits the remote monitoring of events without the encumbrance of wiring. The third limitation can be eliminated by storing previously scanned frames on a non-volatile memory i.e. a video tape or a digital recorder such as a computer hard disk.

VIDEO SWITCHER CIRCUIT DIAGRAM

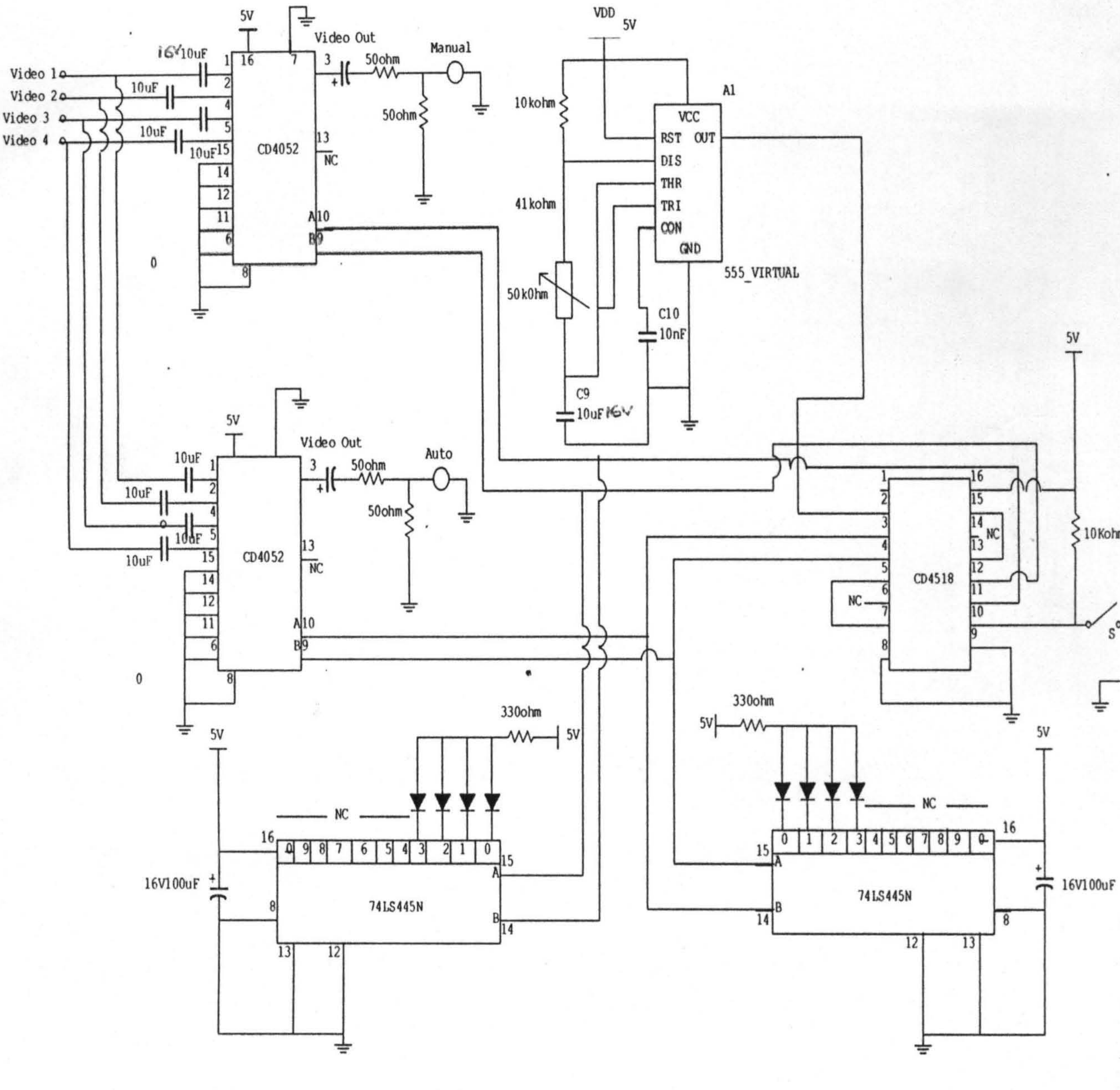


Fig.3.2.7. video switcher circuit diagram [4]

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DESIGN AND CONSTRUCTION OF A CLOSED CIRCUIT TELEVISION VIDEO SWITCH

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