DESIGN AND CONSTRUCTION OF AN AUTOMATIC LOCAL AREA NETWORK (LAN) CABLE TESTER

BY

ADENIRAN ONIKEPO DAMILOLA

2004/20879EE

ELECTRICAL AND COMPUTER ENGINEERING DEPARTMENT

NOVEMBER, 2008

DESIGN AND CONSTRUCTION OF AN AUTOMATIC LOCAL AREA NETWORK (LAN) CABLE TESTER

ADENIRAN ONIKEPO DAMILOLA

2004/20879EE

A THESIS SUBMITTED TO THE DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING, FEDERAL UNIVERSITY OF TECHNOLOGY MINNA, NIGER STATE.

NOVEMBER 2008

DEDICATION

I dedicate this report to **Almighty God**, who in his infinity mercy gives me strength, wisdom and knowledge and have been my source of inspiration, sustenance and success. The only sufficient God, to him alone be all the glory, honor and adoration; and **my parents Mr and Mrs G.O Adeniran** for their parental care and support of my academic pursuit.To my siblings, **Jesugbemi,Seye and Ife** for their love and support, May **God** continue to bless and strengthen you abundantly.

DECLARATION

I, Adeniran Onikepo Damilola, 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 Federal University of Technology, Minna.

ADENIRAN ONIKEPO DAMILOLA

(Name of Student)

11/11/08

(Signature and date)

MR. BALA A. SALIHU

(Name of Supervisor)

11/11/2008

(Signature and date)

PROFESSOR Y. A. ADEDIRAN

(Name of H.O.D)

.....

(Name of External Examiner)

_____

(Signature and date)

_____

(Signature and date)

ACKNOWLEDGEMENT

Thanks be to Almighty God who made it possible for me to carry out this Project work successfully.

My profound gratitude goes to my parents Mr and Mrs G.O Adeniran for their dedicated effort to see me through my academic pursuit till date.

My thank also goes to my supervisor Mr. Bala A. Salihu for his assistance, Recommendation, suggestion and time given to me during my project work. I Also say thanks to the Head of Department and all the lecturers of Electrical /Computer Engineering Department for knowledge they impacted on me.

My special gratitude goes to Memunat,Jibola,Kenny.Hauwa,Shittu,Daniel,Rita and to all my other friends who are not mentioned here but nevertheless not less important,Thank you so much for your support and encouragement.

To my siblings Jesugbemi,Seye,Ife,Adeyemi,Toyosi,Yanmife,You make my world go round.

ABSTRACT

This project report deals with the testing of computer networking cable for correctness and continuity .the networking cable aids the sharing and transfer of data between different computer systems. This project is designed with the use of the microcontroller as the main processing unit of the device ,it processes the input signal and gives an output based on the Processed signal .The output is displayed on a four digit seven segment display, the aid of resistor ,transistors ,RJ45 connectors ,capacitors ,crystal oscillator, normally open switch button, IC socket, voltage regulator and battery are used to achieve the project goal.

TABLE OF CONTENTS

Page

Dedication ii

Declaration iii

Acknowledgement iv

Abstract..... vi

Table of Content vii

List of Figures..... x

List of Tables xi

Chapter 1: Introduction

1.1 Local Area Network..... 1

1.2 Network Cables 2

1.3 Motivation 4

1.4 Aims and Objectives 4

1.5 Methodology 5

Chapter 2: Literature Review/ Theoretical Background

2.1 Historical Background 6

2.1.1 Computers 7

2.1.2 Networks.....7

2.2 Local Area Network (LAN)..... 8

2.3 Previose work 10

2.4 Theoretical Background 11

2.3.1 Ethernet 11

2.4.2 Physical Ethernet Network Types..... 12

2.4.3 Base Band and Broadband 13

2.4.4 Pin Assignment Used In Twisted Pair Ethernet Cabling..... 13

2.4.5 Rj45 Plugs and Jacks 14

2.4.6 Twisted-Pair Cable 15

2.4.7 Unshielded Twisted Pair (Utp) Cable 15

Chapter 3: Design and Implementation

3.1 Design 19

3.2 Power Supply 20

3.3 Eight (8) bit embeded microcontroller 21

3.4 Interface socket 22

3.5 Cable autodetection 23

3.6 Visual display unit 25

3.7 Reset circuit 26

3.8 Crystal clock circuit 27

3.7 Reset circuit 26

3.8 Crystal clock circuit 27

3.9 Design calculation 28

Chapter 4: Tests, Results and Discussion

4.1 Layout of component 31

4.2 Arrangement and soldering of components on vero board 31

4.3 Tools used in design and construction 32

4.4 Making a network cable ready for testing 32

4.5 Testing of the cable 32

4.6 Result 33

4.7 Discusion of result 34

4.8 limitation 34

Chapter 5: Conclusion and Recomendation

5.1 Conclusion 34

5.2 Recommendations 34

References 37

Appendix 38

LIST OF FIGURES

Fig 2.1 RJ45 connector plug 14

Fig 2.2 Unshielded twisted pair cable 15

Fig. 3.1: Block diagram of the sub units of the LAN cable tester 20

Fig. 3.2: Power supply circuit 21

Fig. 3.3: AT89C51 microcontroller 22

Fig. 3.4: connection between RJ45 socket and 8951 microcontroller. 24

Fig. 3.5: connection between transistor and four digit seven segment display 27

Fig. 3.6: Reset circuit 28

Fig. 3.7: Crystal clock circuit 29

Fig. 3.8 Seven segment display unit 30

Fig. 3.9 Circuit diagram of the LAN cable tester 31

LIST OF TABLES

Table 2.1:	Internal cable structure and color coding for utp cables	30
Table 2.2:	color coding for utp cables	18
Table 4.1	Test and Results	34

CHAPTER ONE

1.0 INTRODUCTION

Computers have become an important fixture in the day to day activities of an average person or organization, computers perform tasks like calculation or electronic communication etc depending on the of the individual or organization using it. Computers perform a variety of activities reliably, accurately and quickly.

In organizations it's necessary for two or more computers to communicate, which gives rise to networking. Networking is a group of computers linked or connected together so that information can be mutually accessed or exchanged. It could also be said to be a system of two or more computers, terminals and communication devices linked by wires, cables or telecommunication system in order to exchange data. The network may be limited to a group of users in LAN or be global in scope as the internet.

1.1 LOCAL AREA NETWORK (LAN)

A local area network is a collection of interconnected computers that can share data, applications and resources printers, scanners etc. computers in LAN can be separated by distances up to a few km, and they are used in offices and even university campus. A LAN enables the fast and effective transfer of information within a group of users reduces operational cost.

Computer network may be classified according to the functional relationships which exist between elements of the network for example; client-server or peer-peer method of

networking is where every client is connected to the server and to each other. A peer -to-peer method of networking is where each client shares their resources with other workstation in a network.

Computer network may also be classified according to the hardware technology that is used to connect the individual devices such as optical fibre; wireless LAN, Ethernet etc, the scope of this project is limited to the "Ethernet cable technology"

Ethernet is increasingly the standard interface for networks. Computers linked by or via Ethernet cable can be joined directly (from one computer to another) using cross over cables or joined indirectly via a network hub that allows multiple connections. (Straight through cables are usually used here).

The network administrator may have to tune the network to correct delay issues and achieve the desired performance levels

1.2 NETWORK CABLES

Cables are the medium through which information usually move from one network to another. There are several types of cables commonly used in a LAN. Examples of this type of cabling include; twisted pair cables, coaxial cables, fibre optics cable etc. the scope of this project deals extensively with the twisted pair which is the most popular method of cabling because of its flexibility and low cost.

Twisted pair cables can be classified into two e.g unshielded twisted pair (UTP), simply twisted pair cables that are unshielded and shielded twisted pair which is the same as

UTP except that it has a braided foil shield around the twisted wires (to decrease electrical interferences).

UTP comes in six grades to offer different levels of protection electrical interference and even different speeds of transmission and are named from category one to category six the level of protection increasing with the number of the category, for example category3(cat 3) cables are able to transmit data at speed up to 10MBPS, while category 5(cat5) cables are able to transmit data at speed of up to 100MBPS. They are also referred to as 10base-T cables.

These cables are similar to telephone cables found in most homes today, except that is heavier and has four pairs of wires as opposed to two pairs contained in the phone cables which use modular plug known as RJ11 as a result of the additional wires i.e four, the modular lugs used with the UTP cables is an eight conductor device known as an RJ45. In some cases a network will use a variety of cable types, which some other utilizes, a variety of cable types. The type of cable chosen for a network is related to the network topology, protocols and size. Understanding the characteristics of different types of cabling and how to relate to other aspects of the network.

The LAN cable tester that will be described in this project is a basic continuity tester, it handles RJ11/R45 straight and cross cables, with a visual display or indication of the cable type on a four digit seven segment display. It is intended for use as a troubleshooting tool for connectivity or continuity in a cable within a LAN.

It will work as a continuity tester for any standard RJ11/RJ45, cross and straight cables, as used within a network.

1.3 MOTIVATION

The design and construction of this type of project is very essential to any local area network, newly constructed or previously existing. A network administrator will find it easy to implement when as to connect and troubleshoot a network.

1.4 AIMS AND OBJECTVES

This project is designed to enable the confirmation of continuity in cables on a network and correct wiring of computer networks or more appropriately when setting up a local area network.

- The tester is cheaper and easier to use than the more sophisticated alternatives.
- It is designed to save a lot of time when connecting computer switches etc or more appropriately when setting up a LAN.
- Checking for the correctness and continuity of the cable will reduce the stress of the connection and disconnection when the cable configuration is being wired; this helps to reduce the wastage of the plug.
- It is also designed to work in a user friendly mode which makes it easier to use and work with.

1.5 METHODOLOGY

The LAN cable tester will be designed and constructed using a microcontroller. The system will be divided into three main units ,the input,the control unit and the output unit.the input unit will consist of a DC power supply section and an RJ45 connection section. The controller unit will consist of an 8951 microcontroller and a clock pulse circuit. The 8951 microcontroller will be programmed using the instruction set provided by the manufacturer.

The output unit will consist of a four digit seven segment display. This component will be configured to display the information or worthiness of the cable being tested.

CHAPTER TWO

LITERATURE REVIEW

2.1 HISTORICAL BACKGROUND

Ethernet increasingly is the standard interface for networks, these distinctions are more important to the network administrator than the user. Network administrators may have to tune the network, to correct delay issues and achieve the desired performance level.

Ethernets use physical wiring to connect devices. Often they employ hubs, switches, bridges, and/or routers.

Computer networks can also be classified according to the hardware technology that is used to connect the individual devices in the network such as Optical fibre, Ethernet, Wireless LAN, HomePNA, or Power line communication.

Computer networks , and the technologies needed to connect and communicate through and between them, continue to drive computer hardware, software, and peripherals industries. This expansion is mirrored by growth in the numbers and types of users of networks from the researcher to the home user. Today, computer networks are the core of modern communication.

The scope of communication has increased significantly in the past decade and this boom in communications would not have been possible without the progressively advancing computer network.[8]

The history of computers and networks are disscussed below.

2.1.1 COMPUTERS

The first devices that resemble modern computers date back to the mid 20th century around 1940-1945,although the computer concept and various machines similar to computer existed earlier early electronic computers where the size of a large room and consumed as much power as several hundred modern personal computers, vacuum tube based computers were in use throughout the 1950s and were largely replaced in the 1960s by transistor based computers, when compared with tubes, transistors are smaller, faster, cheaper and use less power and were more reliable in the 1970's integrated circuits technology and the subsequent creation of microprocessors such as the intel 4004, caused another generation of increased speed and reliability, and as continued to evolve.

2.1.2 NETWORKS

With the advent of computer s came the need for communication and networking. Before the advent of computer networks that were based upon some type of telecom system, communication between calculation machines and early computers were performed by human users by carrying instructions between them. Many of the social behavior seen in today's internet was demonstrately present in 19th century telegraph networks and arguably in even earlier networks using visual signals.

Networking is a complex part of computing that makes up most of the IT industry. Without networks almost all communication in the world would cease to happen. It is because of networking that telephones, televisions and the internet etc work.

2.2 LOCAL AREA NETWORK (LAN)

A local area network can be as basic as two computers each having a network interface card (NIC) or network adapter and running network software connected together with a cross over cable and tne next step up would be a network of three or more computers and hubs, each of the computer is plugged into the hub with straight through cable (the cross over function is performed by the hub).

Over the years, the need to test LAN cable easily, efficiently and most importantly troubleshooting its functionality has been on the increase .This is achieved by break through made by electrical and electronics engineers

2.3 PREVIOUS WORK

LAN cable identifiers for testing and identifying conductor LAN cables in conjunction with a LAN cable test instrument was made and improved over the years. Series combination of resistors and diodes allow for both resistance measurements and polarity determination for selected pairs of conductors of the LAN cable resistance wiring errors and to identify the particular LAN cable identifier. In addition, capacitance measurements are accommodated with minima contribution to measurement error by careful orientation of the resistors and diodes so that the diodes may be reverse biased by a DC bias voltage provided by the LAN cable test instrument, the reverse bias diode conjunctions contributed *only* a

small amount of shunt capacitance to the measurement in recent times. A simple continuity tester is employed to solve the problem of testing cables. The tester is paralleled eight times to check each of the wire in the Ethernet cable, its just a battery, a bulb (LED) that shows you have a good connection on your connector. Calculation of the SIL resistor in OHM is the only technical part of this device.

$$\frac{battery\ voltage - LED\ forward\ voltage}{LED\ forward\ current} \text{ X } 100$$

The other issue with LEDs is that they can only be used one way round. The wire connected to the battery positive and anode is usually the longest leg on a new LED, the wire connected to the battery negative, the cathode is usually marked by a small flat area on the small flange that runs around the base of LED body.

Another modern day improvement is the UTP cable tester which can be used for many purposes, although mainly used to test UTP network cables; it can also be used to find the light cable in a large bundle of identical looking cables. The UTP cable tester consists of two tiny boxes that have to be connected to each end of the cable under test. One of the boxes contains a signal generator, powered by a standard 9V battery. The other bulb contains eight LEDs that indicates the cable condition, and IC 4060is used for frequency assignment and 4017 is used as counter.

The principle of operation is very simple, a good cable will show a single working light but when the light are out of order it indicate that some of the wires have been switched in one or both of the connectors. If One or more lights aren't light, it shows that one or more wires are cut whereas is 2 or more lights light up simultaneously it indicates that two or more

wires are shorted together. This is only a simpler tester and hence doesn't detect separated pairs, and even if all pins are connected, showing the expected working light pattern does not mean the pins are still pairs in the cable separating or mixing pairs will cause network problems on higher speeds and longer cables . The UTP tester will not indicate such faults conditions.

The above device has two many circuit components which tend to make the work complex and bulky.

In an attempt to improve on the faults or inconsistencies noticed in the above, the following factors were taken into considerations.

- Simplicity of the circuit
- Ease of maintenance
- Ease of assembly of circuit
- Packaging and time saving property of the project

Hence a programmable microcontroller 89C51 will be used and programmed to simplify the control unit of the device in this project, also instead of LEDS, an Alpha numeric BCD to seven segment display the output. This will not only reduce complexity but will also save time, all this put together will achieve simpler usage of the device and better performance. This project is basically an improvement on previous works.

2.4 THEORETICAL BACKGROUND

2.4.1 ETHERNET

Ethernet is a local area network developed by Xerox in 1976, originally for linking minicomputers, it's a widely implemented network from which IEEE802.3 standard for contention network was developed. Ethernet uses a bus topology configuration and relies on the form of access known as CSMA\CD to regulate traffic on the main communication line. This access method carrier sense multiple access with collision detection is the basis for Ethernet system which range from speeds of 1Mb\s through 1000Mbs.

The design goals for Ethernet was to create a simply defined topology that made efficient use of shared resources, was easy to reconfigure and maintain, provided there is compatibility across many manufacturers and system while keeping the cost low.

The Ethernet has since evolved after being developed Xerox, it has been improved on by intel, digital equipment corporation and Xerox.

In 1980 Ethernet version 2 in 1982, by 1985, the IEEE 802.3 specification was completed and provided a specification for Ethernet connectivity over thick coax and thin coax. In 1990, The specification was adopted to include the Ethernet over twisted pair copper wiring with a 10 base-T, the current IEEE 802.3 specification include thick coax, thin coax twisted pair cabling and fibre, with speed of 10Mbs, 100Mbs and 1000Mbs.

In 1991 the electronics industry association (EIA) together with the telecommunication cabling standard called EIA\TIA 568, the structured cabling system was burn, it was based on category 3 unshielded twisted pair UTP cable category 4 and 5.cat 4 specified data rates

of up to 20MHz and cat 5 up to 100MHz which at the time must have seemed like ample bandwidth for future development, but now less than ten years , even cat 5is being pushed to its limit by new networking technologies. recent developments being cat 5, cat 6 and cat 7 standards.

2.4.2 PHYSICAL ETHERNET NETWORK TYPES

Some of the Ethernet physical types as defined in the 802.3 specification are: 10BASE5-10BASE5 is the originally design of the traditional Ethernet backbone design to be left in place permanently or for extended periods. 10BASE2-10BASE2 is the original design for a departmental or workgroup sized Ethernet environment. It is designed to be simple, inexpensive and flexible as people and stations move.

10BROAD36-10BROAD36: Is a seldom used Ethernet specification which uses a physical medium similar to cable television with CATV-type cables, tap connectors and amplifiers.

1BASE5-BASE5: Is a specification of Ethernet that runs at 1Mbs over twisted pair wiring. This physical topology uses centralized hubs to connect the network devices.

10BASE-T-10BASE-T: Provides Ethernet services over twisted pair copper wire.

FOIRL – fibre optic inter-repeater link: this specification of the 802.3 standard defines a standard means of connecting Ethernet repeaters via optical fibre.

10BASE-F-10BASE-F: Is a set of optical fibre medium specification which defines connectivity between devices.

10BASE-T-0 BASE-T:Is a series of specification that rode 100megabit speeds over copper or fibre. These topologies are often referred to as fast Ethernet.

Gigabit Ethernet –gigabit Ethernet provides speeds of 1000Mbs/s over copper and fibre.

2.4.3 BASE BAND AND BROADBAND

A base band network has a single channel that is used for communication between stations.Ethernet services specifications which use BASE in the name refer to baseband networks. A broadband network is much like cable television where different services communicate across different frequencies on the same cable as voice or video. 10BROADBAnd36 is an example of broadband networking.

2.4.4 Pin Assignment used in Twisted pair Ethernet Cabling

Twisted pin Ethernet (10BASE-T, 100BASE-T, OR 1000BASE-T) uses an RJ-45 connector, which is an eight-pin modular connector.

Contact 1 Transmit

Contact 2 Transmit

Contact 3 Receive

Contact 4 Not Used

Contact 5 Not Used

Contact 6 Receive

Contact 7 Not Used

Contact 8 Not Used

When looking at an RJ-45 wall jack (female) contact 1 is on the left and contact 8 is to the right. When looking at the RJ-45 connector on the end of the cable (male) with the tab on the button and the contacts on the top contact 8 is on the left and contact 1 is to the right.

2.4.5 RJ45 Plugs and Jacks

The standard connector for unshielded twisted pair cabling is an RJ-45 connector. This is a plastic connector that looks like a large telephone-style connector The EIA/TIA specifies an RJ-45 (ISO 8877) connector for unshielded twisted pair (UTP) cable. The plug is the male component crimped on the end of the cable while the jack is the female component in a wall plate or patch panel

RJ stands for Registered Jack, implying that the connector follows a standard borrowed from the telephone industry. This standard designates which wire goes with each pin inside the connector.

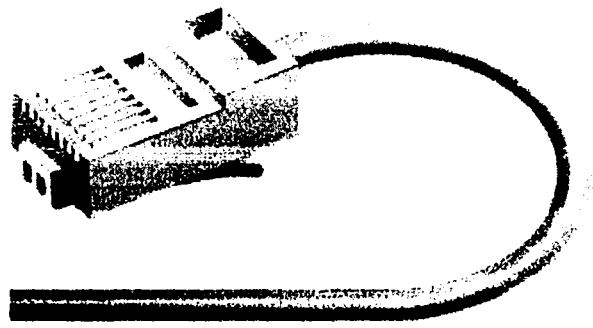


Fig:2.1

2.4.6 TWISTED-PAIR CABLE

The two types of twisted-pair cable are :

1 UTP – Unshielded twisted pair

2 STP – shielded twisted pair

The unshielded twisted pair are commonly used in Ethernet networks today.

2.4.7 UNSHIELDED TWISTED PAIR (UTP) CABLE

Twisted pair cabling comes in two varieties: shielded and unshielded. Unshielded twisted pair (UTP) is the most popular and is generally the best option for school networks (See fig. 1.1).

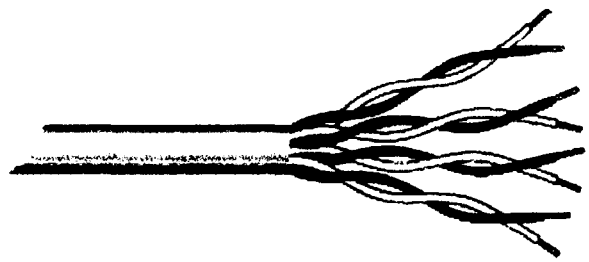


Fig.2.2 Unshielded twisted pair

The quality of UTP may vary from telephone-grade wire to extremely high-speed cable. The cable has four pairs of wires inside the jacket. Each pair is twisted with a different number of twists per inch to help eliminate interference from adjacent pairs and other electrical devices. The tighter the twisting, the higher the supported transmission rate and the

greater the cost per foot. The EIA/TIA (Electronic Industry Association/Telecommunication Industry Association) has established standards of UTP and rated several categories of wire.

There are terms commonly used when using UTP cables. These include:

UTP cable stripping: UTP cable's jacket is not exactly round in shape. Since it is impossible to strip the jacket completely without nicking the inner conductors, adjust the jacket cutting blades so its only partially scores the jacket. Bending and twisting the jacket at the score will complete the strip

UTP cable pulling: Avoid stretching UTP cable. Pulling tension should not exceed 110N (25ibf) for pair cable, also the bend radius of 4-pair UTP cable should not exceed 4 times the cable diameter. When cable ties are used, install them loosely.

UTP cable termination: UTP cable pair twists must be maintained and untwisting must not exceed 0.5 inches when installing category 5 plugs and jacks when punching down into a 110 block. The cable jacket should only be striped back 0.5 inches for the plug and held by the plug's primary latching strain relief when crimped. The table below shows UTP configuration

UTP Category	Mbps	Type	
Category1		Voice	Telephone Cable
Category2		Data	4 twisted-pairs

Category3		Data	4 twisted-pairs – 3 twisted per foot
Category4		Data	4 twisted- pairs
Category5		Data	4 twisted- pairs of copper wire

Table2.1 Internal cable structure and color coding for utp cables

Inside the cable, there are 8 color coded wires. These wires are twisted into 4 pairs of wires; each pair has a common color theme. One wire in the pair being a solid or primarily solid colored wire and the other being a primary white wire with a colored stripe (sometimes cable doesn't have any color on the striped cable, the only way to tell is to check which other wire it is twisted around). Examples of the naming schemes used are Orange (alternative Orange/White) for solid colored wire and white/Orange for the striped cable. The twists are extremely important. They are there to counteract noise and interference.

It is important to wire according to a standard to get proper performance from the cable. There are two wiring standard for twisted-pair cables, called "T-568A" and "T-568B". They differ only in connection sequence, not in use of the various colors.

Because only two pairs of wires in the eight-pin RJ-45 connector are used to carry Ethernet signals both 10BASE-T and 100BASE-TX use the same pins a crossover cable made for one will also work with the other.

	Ethernet 10BASE-T 100BASE-TX	EIA/TIA 568A	EIA/TIA 568B
1	Transmit +	White with green strip	White with orange stripe
2	Transmit -	Green with white stripe or solid green	Orange with white stripe or solid orange
3	Receive +	White with orange stripe	White with green stripe
4	N/A	Blue with stripe or solid blue	Blue with white stripe or solid blue
5	N/A	White with blue stripe	White with blue stripe
6	Receive -	Orange with white stripe or solid orange	Green with white stripe or solid green
7	N/A	White brown strip or solid brown	White with brown stripe
8	N/A	Brown with white stripe or solid brown	Brown with white stripe or solid brown

Table 2.2 colour coding for UTP cables

CHAPTER THREE

DESIGN AND IMPLEMENTATION

3.1 DESIGN

This chapter throughly discusses the design and construction of the project, ie the Auto LAN cable tester; the auto LAN cable tester unit comprises the following subunits

1. Power supply
2. 8-bit system controller
3. 4-digit visual display unit
4. Interface socket

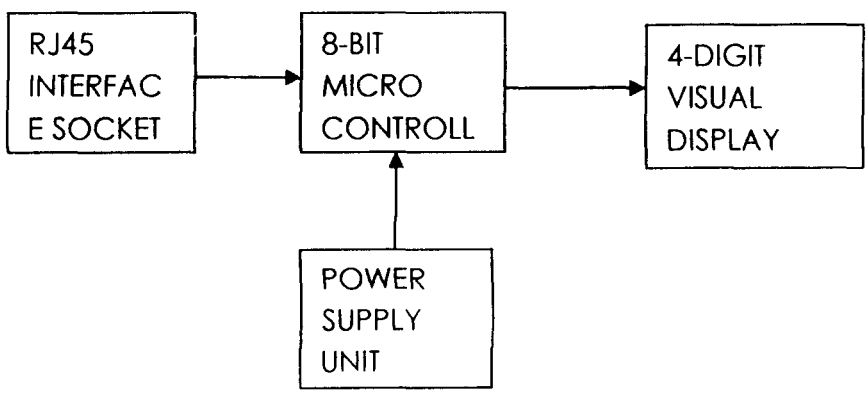


Fig 3.1 block diagram of the subunits of a LAN cable tester

3.2 POWER SUPPLY

The power supply unit supplies the whole system with appropraite and regulated voltage; this is necessary becauser electronic because electronic components are sensitive to flunctuations,

The power supply was derived from a nine (9) DC battrey source,since the device is meant to be portable and hand held,the supply circuit is diagramed below

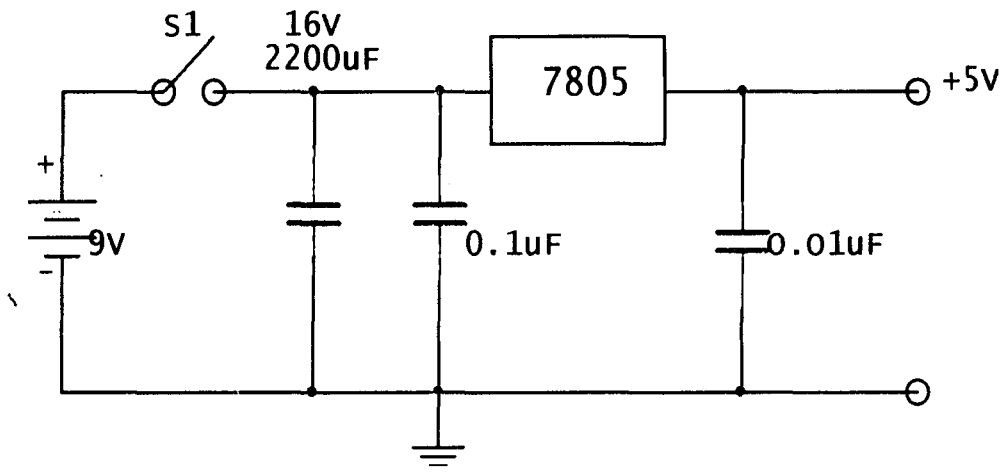


Fig 3.2 power supply circuit

The system requires a five (5) volt regulated supply which was provided by a 7805 1A regulator interposed between the nine (9) volt DC battery and the circuit .

The nine (9) volt supply was buffered by a 16V2200uf capacitance .the five (5) volt regulated DC was stabilized by a second 16V2200uf capacitance

3.3 EIGHT (8)-BIT EMBEDDED MICROCONTROLLER

An 89C51 microcontroller was selected as the system controll unit, where all logical operations and control take place, this component is analogues to the central processing unit(cpu) of the project.this component as various features which was influencial in its being chosen some of these features are:

- It has 40 pins
- 32 pins programmable input/ output pins
- Its compartable with MCS-51 products ie 8051 compartable
- 256 by 8 bits internal RAM
- Full static operation 0 hz to 24M hz .

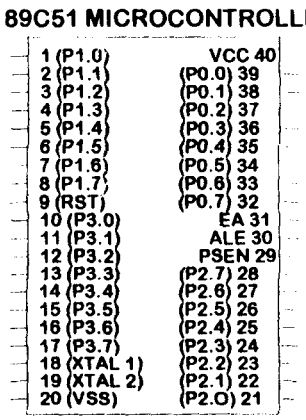


Fig 3.3 AT89C51 microcontroller

The controller performs a variety of functions such as:

1. Refreshes the visual display unit
2. Automatically detects the connected cable

The controller was chosen for its numerous input/output pins(32 in all).the system requires 16 pins for interfacing with the cable under test,8 pins for interfacing with segments a,b,c.....g,dp of the display unit,and 4 pins for controlling the digit drivers .

The 89C51 was programed in assembly language for highest processing speed,the system software was writen to effect :

1. Automatic detection of the cable under test
2. Automatic scroll display of the project name and student Identitity

Bit-level hardware interfacing was employed since the cable under test had to be checked for continuity between designated ends of the cable. the figure bellow shows the interface between the RJ45 sockets and the 4 digit 7 segment and the transistors.

3.4 INTERFACE SOCKET UNIT

The interface socket unit consists of two female RJ45 connectors.with the connector interfaced with port P3 being the master port, and will be used to output data, while port P1 being the slave port will be used to input data,The RJ45 connector with pin numbering is shown in the fig below

The diagram shows the interface between the RJ45 jacks and the microcontroller

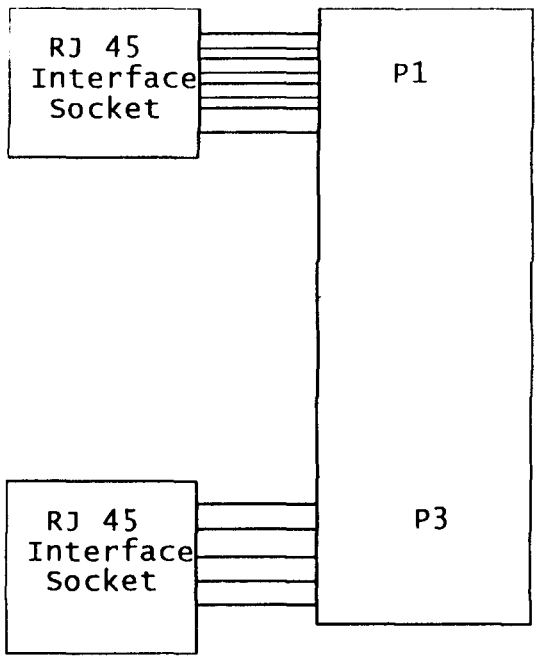


Fig 3.4 connection between RJ45 socket and 89C51 microcontroller

3.5 CABLE AUTODETECTION

Autodetection was realised using the following algorithm:

- Test cable for 10baseT RJ45 straight connection
- Test cable for 10baseT RJ45 cross connection
- Test cable for 100base T RJ45 straight connection
- Test cable for 100baseT RJ45 cross connection

If the cable under test fails the four steps above,the system does not post a "cable found" message,other wise "Cable found" is scrolled across the display ,and the cable types alongside the wiring type is displayed.

10baseT Detection (straight/ cross connection): 10baseT cables primarily use four(4) wires (tx +,tx -,Rx +,Rx-) [2] for connection, the four wires are checked end to end for continuity for a straight cable or swapped for cross.

100baseT Detection (straight/ cross connection): Eight (8) wires are used for this connection type.[2] The wires are also checked end to end for continuity in both the straight wire cabling type and the cross as well.

End-to-end was effected by:

- Making port1(P1) input ports (0ffh is written to both ports)
- Clearing a pin on the master port(P1)
- Checking for a zero (0) on the slave Port. If a zero(0) is detected on the slave port (P3),the routine moves on to check the next pin interfaced to the cable under test .

Four routines were used, the routines were accessed Top-down as shown below.

- 100baseT straight routine
- 100baseT cross routine
- 10baseT staight routine
- 10baseT cross routine

Each routine exits with a result if the cable under test satisfies the condition therein. Control is then transferred to a different portion of the code that affects a display of the result

3.6 VISUAL DISPLAY UNIT

A four (4) digit 7-segment display unit was utilised for user interactivity ,the display was multiplexed to save on the required number of wires needed to interface the segments to the controller.

Multiplexing was done on a time slice allocation of the common data port i.e the data to be displayed is placed on the common transmission path (P0) for a period of time, the associated digit bit driver turned on briefly and then off.

Software control was used for this basically, display multiplexing involves :

1. Switching off all digit drivers
2. Placing the data to display on (P0)
3. Turning on the digit driver associated with display position
4. Delaying for persistance of vision
5. Turning off the digit driver that was on in step (3)

If the above block of code is executed at a frequency greater than 50 times per second, there is the illusion of vision in which the 4-digits appear as if continously on ,but in reality ,only a single digit is on at any one time .

The display was interfaced with the controller via P0 (segment a to dp), and the digit drivers over P2, the display unit is diagramed below

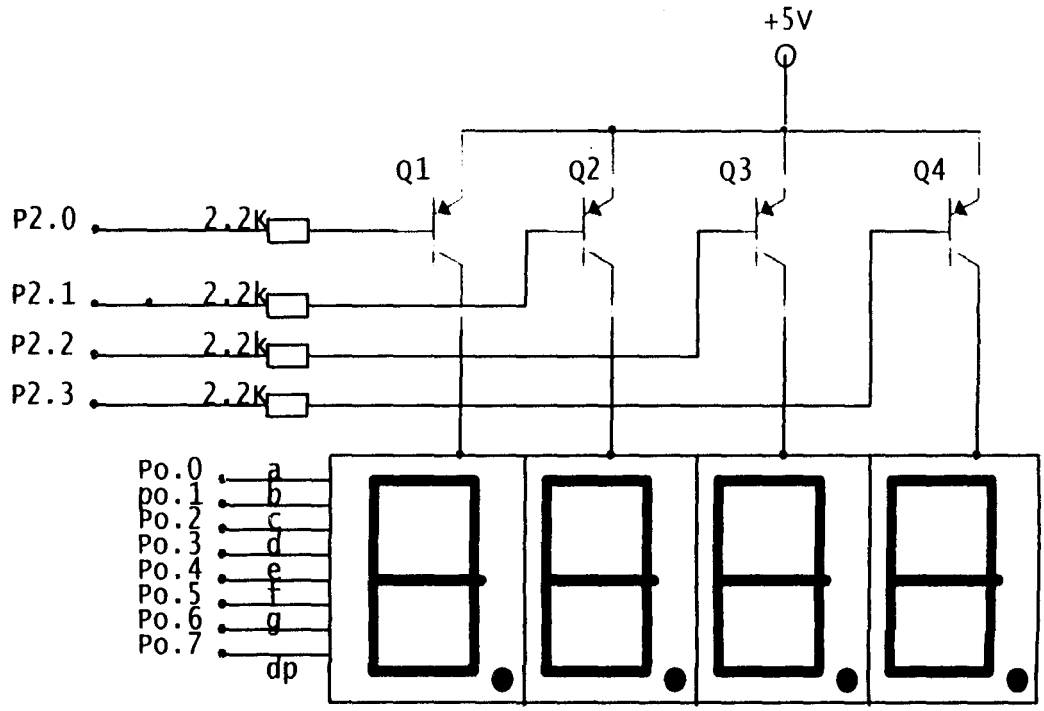


Fig 3.5 Connection between transistor and four digit seven segment display (4-digit-7 segment display)

Transistor 1-4 control the digit display positions .clearing the port pin associated with a digit driver forward biases the PNP transistor, sourcing current into the segments, a current return path is provided over port zero (P0) of the controller

3.7 Reset Circuitry

The reset circuitry is used to reset the microcontroller after every display session. A 2.2KΩ resistor and a 2.2uf capacitor is connected across the reset pin and the V_{CC} as shown below

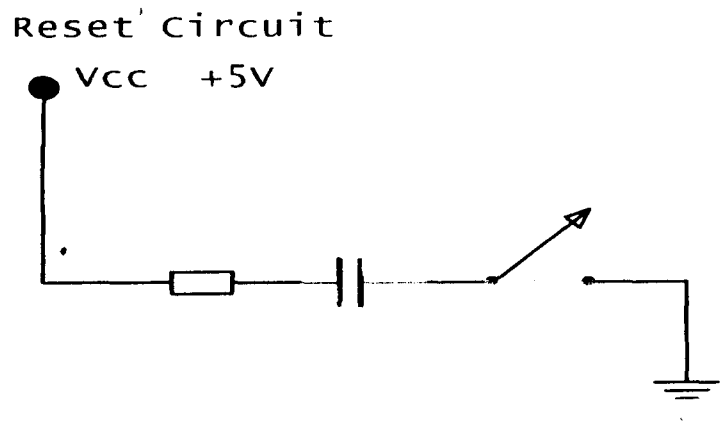


Fig 3.6 reset circuit

3.8 Crystal Clock Circuit

The crystal clock circuit generates the clock pulse for the microcontroller to execute its instruction.the interface between the clock source unit and the microcontroller is shown in the fig below.

The crystal which is 12MHz crystal will generate 12,000,000 pulses in one second. Usually an 8051 compartable microcontroller executes one instruction in every 12 clock pulses, therefore the microcontroller will perform 12,000,000 divided by 12 in one second.

$$\frac{12,000,000}{12} = 1,000,000 = 1\text{Mps}$$

Hence one million instructions will be executed in one second.

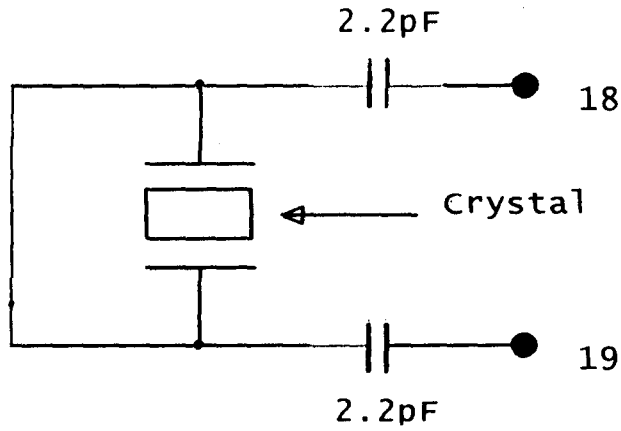


Fig 3.7 crystal clock circuit

3.9 DESIGN CALCULATION

For an n-digit display, the current through each segment is nx I_f ,where I_f is the continuos forward current through each segment.

For a 10mA continous segment current ,a 4-digit display system requires 40mA through each digit to produce the same brightness a 10mA segment current would (the 40mA is pulsed in a multiplexed display)

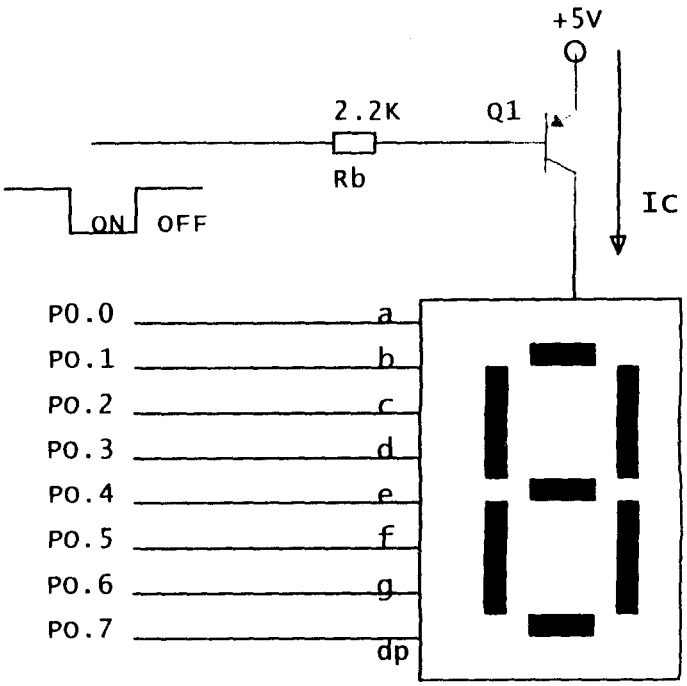


Fig 3.8 seven segment display unit

For an eight 8-segment display,the peak current through the display is ;

8x10x4= 320mA.

$I_C = 320mA$

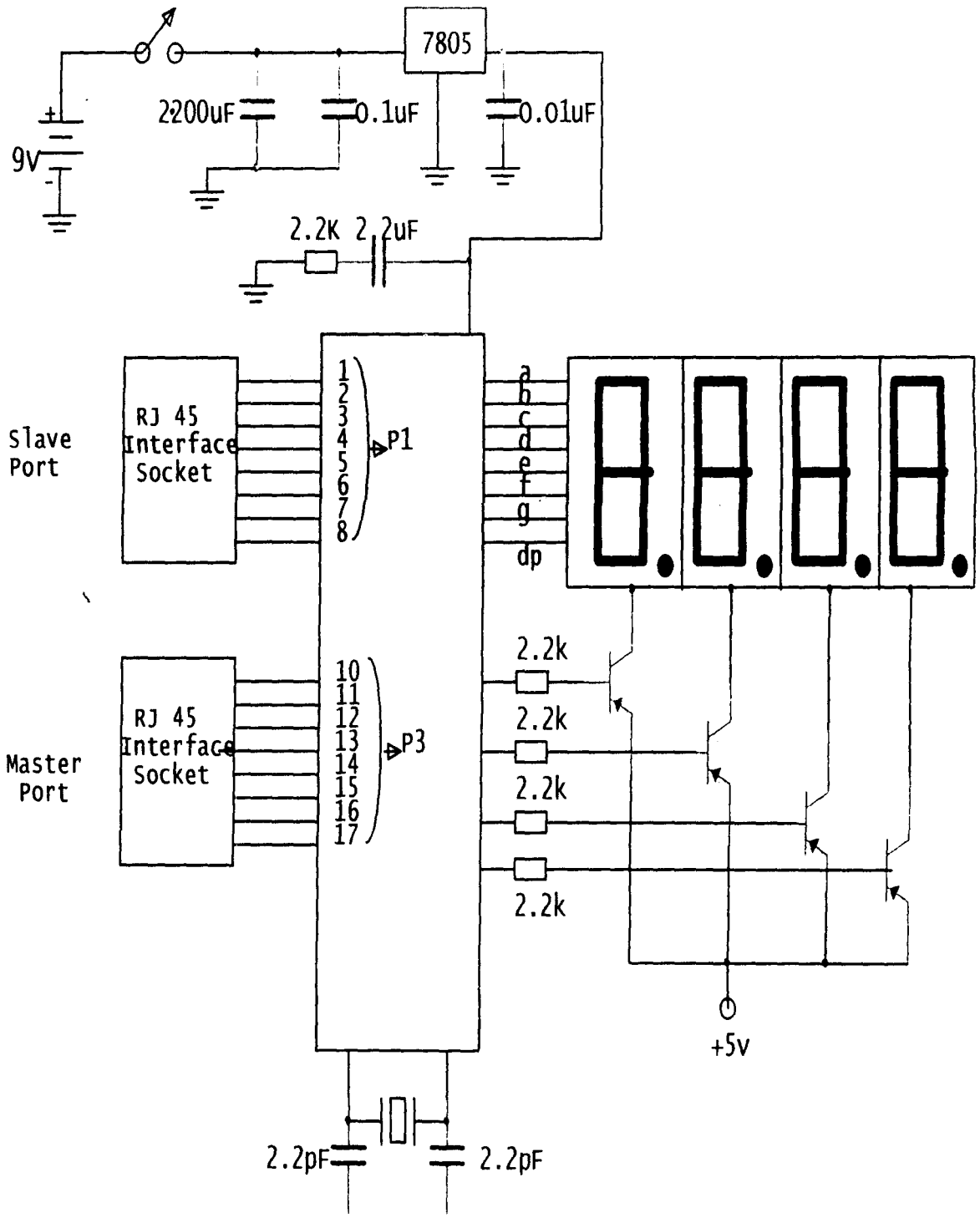
The gain of the digit driver (25A1015GR) is 200 typical.

$$I_B = \frac{Ic}{Hfe} = \frac{.320}{200} = 0.0016A$$

$$R_B = \frac{VCC - VBE}{IB} = \frac{5 - 4.3}{0.0016} = 2687.5\Omega = 2.7K\Omega \ [2]$$

A 2.2kΩ base resistance was used to allow for a fairly brighter display

CIRCUIT DIAGRAM OF A LAN CABLE TESTER



CHAPTER FOUR

TESTS, RESULTS AND DISCUSSION

4.1 LAYOUT OF COMPONENT ▸

Proper component layout in the circuit board makes it possible to make some changes on the bread board as the need arises, the breadboard layout makes it possible to identify and rectify faults. in the design of this project the dimension of the project was put into consideration so as to make the project construction portable .having been satisfied with the behaviour of the circuit ,it is then transferred to the vero board where the components are carefully soldered,

4.2 ARRANGEMENT AND SOLDERING OF COMPONENT ON VERO BOARD

Soldering was done with great care and in accordance with the general laid down rules for soldering .the components were laid on the vero board and care was taken to avoid short circuit.

Soldering was achieved with the use of soldering iron, the heat of the soldering iron was applied near the legs of the components, care was taken to ensure iron temperature was not too high so as to protect the components from overheating or damage. care was also taken to ensure proper contact, the solder in all cases was allowed to flow along the rail, the excess solder was then sucked out with a lead sucker, insulated cables where used to link terminals that were far from each other .the component on the vero board was properly laid to achieve the desired result and to avoid any fault,

4.3 TOOLS USED IN DESIGN AND CONSTRUCTION

- Breadboard was first used in carrying out the construction of the design ,after assurance of its pragmatisim it was transferred to the vero board
- Soldering iron and lead were used in soldering the components on the vero board
- A digital multimeter was used to carry out the tests e.g continuity test, voltage and current measurement

Suction tube was used to suck soldering misplaced leads from the vero- board to avoid short circuit and ensure clean construction.

4.4 MAKING A NETWORK CABLE READY FOR TESTING

Needed tools:

- CAT 5 Cable-bulk category 5,5e or 6 cable
- RJ45 ends
- Crimper for the RJ45
- Wire Cutters- to cut and strip the cable if necessary

4.4.1 TESTING OF THE CABLE

After the soldering was done, the circuit was traced and tested using a multimeter to ensure that there was no short circuit or open circuit during the soldering. The configured and crimped cable was tested by inserting one of the terminal into the master port and the other to the slave port, "cable found" was displayed across the seven segment display, showing

there's continuity in the cable, then the cable type and speed is displayed depending on the cable inserted, the result is given in the table below.

Cable name	Connection type	Continiuty	Speed
RJ45	Straight	Cable found	100 base T
RJ45	Straight	Cable found	10 base T
RJ45	Cross	Cable found	100 base T
RJ45	Cross	Cable found	10 base T

Table 4.1 Tests and Results

Finaly a bad cable was crimped, due to lack of continuity,the system does not recorgnise the cable,hence it takes no action

4.5 RESULT

The aim of the Project was achieved the Auto lan cable tester processes the input received from the inserted cable and gives out an expected out put displayed on the four digit seven segment display ,this indicates that the Project design and construction was a success,

4.6 DISCUSSION OF RESULT

The Output displayed on the seven segment display depends on the nature of the crimped cable plugged into the RJ45 female port. When the auto lan cable tester is switched on ,in the absence of any inserted cable It displays Name and Matric Number

of the student and the Project title i.e "Auto Lan Cable Tester". But when a cable is inserted the Four digit seven segment display is required to display the continuity of the pin assignment already programmed into the microcontroller chip, the configuration of the cable and the cable speed this is done to ease the work of network engineers who may need to crimp lots of cables, The Engineeer will be able to increase speed whiler compensating for time lost and inefficiency

4.7 LIMITATION

- During the construction of the project, there were some problems arising due to bad components this was notably taken care of by changing the components for better ones.
- There was also challenge in locating alphanumeric display unit in the market,hence I substituted by using seven segment display unit

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

The design and construction of an Auto LAN cable tester has been actualized, the device detects satisfactorily the cable configurations of UTP.

The Auto LAN cable tester is a vital instrument in the computer networking, especially in local area networks; it will enable the network Engineer to do their work faster with fewer errors, The Auto LAN cable tester is digital and portable, making it easy to read, handy and easy to carry around. It enables the engineer know the correctness of the cable in use after crimping, by checking for continuity between cable ends, the cable type and the cable speed.

The Auto LAN cable tester employs the use of a microcontroller, which serves as the main brain of the instrument, it accepts the input signals and gives out an output based on what as been processed, this output is displayed on the 4 digit seven segment display unit which can be read easily even in the dark

The project as brought to the core a simple approach to configure and test LAN cables for any computer network that runs under Ethernet.

5.2 RECOMMENDATION

Since the Auto LAN cable tester checks for continuity and configuration of RJ45 cross and straight cables with their speeds, and then displays the output on the four digit

REFERENCE

[1] Introduction to Networking basics (N+) by karrox

[2] A text book of electrical technology by B. L. & A. K. Theraja[1]

[3] Microsoft Encarter Library Permium 2007

[4] http://www.howstuffworks.com

[5] http://www.wikipedia.com

[6] Embedded Ethernet And Internet complete by Jan Axelson

[7] Assembley language step by step by Jeff Duntemann

[8] http://www.duxcw.com

[9] Electronic component guide (ECG)

[10] http://www.datacottage.com/nch/troperation.htm

[11] Sybex cisco certified network associate guide 5th edition by Todd Lammle

[12] http:// www.cable tran.com www

[13] http:// www.darpa.mil

APPENDIX

```
INCLUDE 89c51.mc

'copyright Adeniran onikepo 2004/20879EE

data_0 DATA 08h

data_1 DATA 09h

data_2 DATA 0ah

data_3 DATA 0bh

mask DATA 0ch

temp DATA 0dh

digit_1_Dx BIT p2.3

digit_2_dx BIT p2.2

digit_3_dx BIT p2.1

digit_4_Dx BIT p2.4

data_port EQU p0

cable_detected BIT 00h

stack EQU 60

45_Cross_100_Detected BIT 01h

45_Straight_100_Detected BIT 02h

11_Detected BIT 03h

45_Cross_10_detected BIT 04h

45_straight_10_detected BIT 05h
```

```
master_port EQU p1
slave_port EQU p3



;new addition
s_mask EQU 10010010b
t_mask EQU 10000111b
r_mask EQU 11001110b
c_mask EQU 11000110b
p_mask EQU 10001100b
a_mask EQU 10001000b
f_mask EQU 10001110b
i_mask EQU 11001111b
l_maks EQU 11000111b
j_mask EQU 11100001b
4_mask EQU 10011001b
5_mask EQU 10010010b
1_mask EQU 11111001b
2_mask EQU 10100100b
e_mask EQU 10000110b
0_mask EQU 11000000b
o_mask EQU 10100011b
g_mask EQU 10010000b
```

```
h_mask EQU 10001011b
b_mask EQU 10000011b
l_mask EQU 11000111b
d_mask EQU 10100001b
u_mask EQU 11000011b
n_mask EQU 10101011b



;rj 45 socket pinout assignment
;1 -p1.4
;2 -p1.0
;3 -p1.5
;4 -p1.1
;5 -p1.6
;6 -p1.2
;7 -p1.7
;8 -p1.3
; the above also applies to p3 interfaced with socket 2

;connection for straight cable
;1 -1    ;p1.4 - p3.4
;2 -2    ;p1.0 - p3.0
```

```
;3 -3 ;p1.5 - p3.5
;4 -4 ;p1.1 - p3.1
;5 -5 ;p1.6 - p3.6
;6 -6 ;p1.2 - p3.2
;7 -7 ;p1.7 - p3.7
;8 -8 ;p1.3 - p3.3
;
;connection for rj45 cross cable
;1 - 3;p1.4 - p3.5
;2 - 6;p1.0 - p3.2
;3 - 1;p1.5 - p3.4
;4 - 7;p1.1 - p3.7
;5 - 8;p1.6 - p3.3
;6 - 2;p1.2 - p3.0
;7 - 4;p1.7 - p3.1
;8 - 5;p1.3 - p3.6



;*********************************************************************************8
org 0000h
start_up:       MOV sp,#stack
                ACALL sys_init
mainloop1:      ACALL show_id1
                ACALL show_id2
```

```
mainloop:   ACALL re_init
            ACALL test_Cable
            JNB cable_detected,mainloop1
            ACALL show_cable_detected
            ACALL show_Result
            ACALL re_init
            SJMP mainloop1

;*****************************************************************************

re_init: CLR 45_cross_100_detected
            CLR 45_cross_10_detected
            CLR 11_detected
            CLR 45_straight_100_detected
            CLR 45_straight_10_detected
            CLR cable_detected
            RET

;*****************************************************************************

sys_init:   ACALL reset_delay
            MOV master_port,#0ffh
            MOV slave_port, #0ffh
            CLR 45_cross_100_detected
            CLR 45_cross_10_detected
            CLR 11_detected
            CLR 45_straight_100_detected
```

```
                CLR 45_straight_10_detected
                CLR cable_detected
                RET
;*************************************************************************

show_cable_Detected:    CLR cable_Detected
                        MOV DPTR,#cable_detected_msg
                        MOV R5,#12
                        ACALL write_data
                        RET

cable_detected_msg:     DB 0ffh
                        DB c_mask
                        DB a_mask
                        DB b_mask
                        DB l_mask
                        DB e_mask
                        DB 0ffh
                        DB 10001110b
                        DB 10100011b
                        DB 01100011b
                        DB 10101011b
                        DB 10100001b

;*************************************************************************
```

```
test_cable:   CLR cable_detected
              MOV master_port,#0ffh
              MOV slave_port,#0ffh
              ACALL test_11
              JB cable_detected, exit_test_cable
              ACALL test_45_straight_100
              JB cable_detected, exit_test_cable
              ACALL test_45_straight_10
              JB cable_detected, exit_test_Cable
              ACALL test_45_Cross_100
              JB cable_Detected,exit_test_cable
              ACALL test_45_cross_10
exit_test_Cable:          RET
```

```
test_11:      CLR master_port.5
              ACALL debounce_key
              JB slave_port.5, flag_error_11
              SETB master_port.5
              CLR master_port.4
              ACALL debounce_key
```

```
                    JB slave_port.4, flag_error_11
                    SETB master_port.4
                    CLR master_port.3
                    ACALL debounce_key
                    JB slave_port.3, flag_error_11
                    SETB master_port.3
                    CLR master_port.2
                    ACALL debounce_key
                    JB slave_port.2,flag_error_11
                    SETB master_port.2
                    SETB 11_detected
                    SETB cable_detected
flag_error_11:RET

;*****************************************************************************

test_45_Cross_10:   CLR master_port.7
                    ACALL debounce_key
                    JB slave_port.5, flag_error2
                    SETB master_port.7
                    CLR master_port.6
                    ACALL debounce_key
                    JB slave_port.2,flag_error2
                    SETB master_port.6
                    CLR master_port.5
```

```
                    JB slave_port.2,flag_error2
                    SETB master_port.6
                    CLR master_port.5
                    ACALL debounce_key
                    JB slave_port.7,flag_error2
                    SETB master_port.5
                    CLR master_port.2
                    ACALL debounce_key
                    JB slave_port.6, flag_error2
                    SETB master_port.2
                    SETB 45_cross_10_detected
                    SETB cable_detected
flag_error2:    RET

;*************************************************************************8
8

test_45_straight_10:CLR master_port.4
                    ACALL debounce_key
                    JB slave_port.4, flag_error
                    SETB master_port.4
                    CLR master_port.0
                    ACALL debounce_key
                    JB slave_port.0, flag_Error
                    SETB master_port.0
```

```
                    CLR master_port.5
                    ACALL debounce_key
                    JB slave_port.5, flag_error
                    SETB master_port.5
                    CLR master_port.2
                    ACALL debounce_key
                    JB slave_port.2, flag_error
                    SETB master_port.2
                    SETB 45_straight_10_detected
                    SETB cable_detected
flag_error:         RET

;*************************************************************************************
8888

test_45_straight_100:CLR master_port.0
                    ACALL debounce_key
                    JB slave_port.0, flag_error100
                    SETB master_port.0

                    CLR master_port.1
                    ACALL debounce_key
                    JB slave_port.1, flag_Error100
                    SETB master_port.1
```

```
CLR master_port.2
ACALL debounce_key
JB slave_port.2, flag_error100
SETB master_port.2

CLR master_port.3
ACALL debounce_key
JB slave_port.3, flag_error100
SETB master_port.3

CLR master_port.4
ACALL debounce_key
JB slave_port.4, flag_error100
SETB master_port.4

CLR master_port.5
ACALL debounce_key
JB slave_port.5, flag_Error100
SETB master_port.5

CLR master_port.6
ACALL debounce_key
JB slave_port.6, flag_error100
SETB master_port.6
```

```
                    CLR master_port.7
                    ACALL debounce_key
                    JB slave_port.7, flag_error100
                    SETB master_port.7

                    SETB 45_straight_100_detected
                    SETB cable_detected

flag_error100:  RET

;*****************************************************************************
8

test_45_cross_100:CLR master_port.2
                    ACALL debounce_key
                    JB slave_port.0, flag_error100a
                    SETB master_port.2

                    CLR master_port.0
                    ACALL debounce_key
                    JB slave_port.2, flag_Error100a
                    SETB master_port.0

                    CLR master_port.6
                    ACALL debounce_key
```

```
JB slave_port.3, flag_error100a
SETB master_port.6

CLR master_port.5
ACALL debounce_key
JB slave_port.4, flag_error100a
SETB master_port.5

CLR master_port.3
ACALL debounce_key
JB slave_port.6, flag_Error100a
SETB master_port.3

CLR master_port.7
ACALL debounce_key
JB slave_port.1, flag_error100a
SETB master_port.7

CLR master_port.1
ACALL debounce_key
JB slave_port.7, flag_error100a
SETB master_port.1

CLR master_port.4
ACALL debounce_key
```

```
                JB slave_port.5, flag_error100a
                SETB master_port.4

                SETB 45_cross_100_detected
                SETB cable_detected

flag_error100a: RET

;*************************************************************************88

show_id1:       MOV DPTR,#id_msg_1
                MOV R5,#26
                ACALL write_data
                RET

id_msg_1:       DB 0ffh
                DB 10001000b
                DB 10100001b
                DB 10000110b
                'DB 10101011b ; n chk this
                DB 11001000b
                DB 11111001b
                'DB 10001111b ; r
                DB 11001110b
```

```
DB 10001000b
'DB 10101011b
DB 11001000b
DB 0ffh
DB 01000000b
DB 0ffh
DB 0ffh
DB 10100100b
DB 11000000b
DB 11000000b
DB 10011001b
DB 0ffh
DB 10100100b
DB 11000000b
DB 10000000b
DB 11111000b
'DB 10011000b
DB 10011000b
DB 10000110b
DB 10000110b
DB 0ffh

;change the lenght of this message
show_id2:          MOV DPTR,#id_msg_x
```

```
                MOV R5,#22
                ACALL write_data
                RET

id_msg_X:       DB 0ffh
                DB a_mask
                DB u_mask
                DB t_mask
                DB o_mask
                DB 0ffh
                DB l_mask
                DB a_mask
                DB n_mask
                DB 0ffh
                DB c_mask
                DB a_mask
                DB b_mask
                DB l_mask
                DB e_mask
                DB 0ffh
                DB t_mask
                DB e_mask
                DB s_mask
                DB t_mask
                DB e_mask
```

```
                    DB r_mask

;*************************************************************************************
*****g

show_Result:   JBC 45_cross_10_detected, go_Show_45_cross_10
                    JBC 45_straight_10_detected, go_show_45_straight_10
                    JBC 11_detected, go_show_11a
                    JBC 45_cross_100_detected, go_show_45_cross_100a
                    JBC 45_straight_100_detected, go_show_45_straight_100a
                    RET

go_Show_11a:  AJMP go_Show_11
go_show_45_straight_100a:    AJMP go_show_45_straight_100
go_Show_45_cross_100a:              AJMP go_show_45_cross_100

go_Show_45_cross_10:MOV DPTR,#45_cross_10_msg
                    MOV R5,#26
                    ACALL write_data
                    RET

45_Cross_10_msg:    DB 0ffh
                    DB r_mask
                    DB j_mask
                    DB 4_mask
```

```
DB 5_mask
DB 0ffh
DB 1_mask
DB 0_mask
DB b_mask
DB a_mask
DB s_mask
DB e_mask
;DB t_mask
DB 1_mask
DB 0_mask
DB 0ffh
DB c_mask
DB r_mask
DB o_mask
DB s_mask
DB s_mask
DB 0ffh
DB c_mask
DB a_mask
DB b_mask
DB l_mask
DB e_mask
```

```
go_Show_45_straight_10:     MOV DPTR,#45_straight_10_msg
                            MOV R5,#29
                            ACALL write_data
                            RET

45_straight_10_msg:db 0ffh
                    DB r_mask
                    DB j_mask
                    DB 4_mask
                    DB 5_mask
                    DB 0ffh
                    DB 1_mask
                    DB 0_mask
                    DB b_mask
                    DB a_mask
                    DB s_mask
                    DB e_mask
                    ;DB t_mask
                    DB 1_mask
                    DB 0_mask
                    DB 0ffh
                    DB s_mask
                    DB t_mask
                    DB r_mask
                    DB a_mask
```

```
                DB i_mask
                DB g_mask
                DB h_mask
                DB t_mask
                DB 0ffh
                DB c_mask
                DB a_mask
                DB b_mask
                DB l_mask
                DB e_mask

go_show_45_cross_100:   MOV DPTR,#45_cross_100_msg
                        MOV R5,#27
                        ACALL write_data
                        RET

45_cross_100_msg:   DB 0ffh
                    DB r_mask
                    DB j_mask
                    DB 4_mask
                    DB 5_mask
                    DB 0ffh
                    DB 1_mask
```

```
DB 0_mask
DB 0_mask
DB b_mask
DB a_mask
DB s_mask
DB e_mask
DB 1_mask
DB 0_mask
;DB t_mask
DB 0ffh
DB c_mask
DB r_mask
DB o_mask
DB s_mask
DB s_mask
DB 0ffh
DB c_mask
DB a_mask
DB b_mask
DB l_mask
DB e_mask
```

```
go_Show_45_straight_100:MOV DPTR,#45_straight_100_msg
                        MOV R5,#30
                        ACALL write_data
                        RET

45_straight_100_msg:  DB 0ffh
                      DB r_mask
                      DB j_mask
                      DB 4_mask
                      DB 5_mask
                      DB 0ffh
                      DB 1_mask
                      DB 0_mask
                      DB 0_mask
                      DB b_mask
                      DB a_mask
                      DB s_mask
                      DB e_mask
                      ;DB t_mask
                      DB 1_mask
                      DB 0_mask
                      DB 0ffh
                      DB s_mask
                      DB t_mask
                      DB r_mask
```

```
                DB a_mask
                DB i_mask
                DB g_mask
                DB h_mask
                DB t_mask
                DB 0ffh
                DB c_mask
                DB a_mask
                DB b_mask
                DB l_mask
                DB e_mask

;*******************************************************************************
go_Show_11:     MOV DPTR,#11_msg
                MOV R5,#11
                ACALL write_data
                RET
11_msg:         DB 0ffh
                DB r_mask
                DB j_mask
                DB 1_mask
                DB 1_mask
                DB 0ffh
                DB c_mask
```

```
                DB a_mask
                DB b_mask
                DB l_mask
                DB e_mask

;*********************************************************************************8

write_display:  MOV data_port, data_0
                CLR digit_1_dx
                ACALL delay_2_show
                SETB digit_1_dx
                CLR digit_2_dx
                MOV data_port, data_1
                ACALL delay_2_Show
                SETB digit_2_Dx
                CLR digit_3_dx
                MOV data_port, data_2
                ACALL delay_2_Show
                SETB digit_3_dx
                CLR digit_4_Dx
                MOV data_port, data_3
                ACALL delay_2_show
                SETB digit_4_Dx
                RET
```

```
;*****************************************************************************
**888


write_data:         ACALL blank_display
                    ;MOV R1,#2
                    MOV R1,#1
                    MOV temp, R5
write_data_loop_a:mov R5, temp
write_data_loop:    CLR A
main_loop:          PUSH acc
                    MOVC A,@a+dptr
                    MOV mask, A
                    ACALL shift_now
                    POP acc
                    INC A
                    DJNZ R5, main_loop
                    MOV mask,#0ffh
                    ACALL shift_now
                    MOV mask,#0ffh
                    ACALL shift_now
                    MOV mask,#0ffh
                    ACALL shift_now
                    MOV mask,#0ffh
                    ACALL shift_now
                    ACALL blank_display
```

```
                    DJNZ R1, write_data_loop_a
                    RET

;*****************************************************************************
**88
shift_now:          MOV data_0, data_1
                    MOV data_1, data_2
                    MOV data_2, data_3
                    MOV data_3, mask
                    MOV R2,#40
re_Write:           ACALL write_display
                    DJNZ R2, re_write
                    RET
;*****************************************************************************
*888

blank_display:  MOV data_0,#0ffh
                    MOV data_1, #0ffh
                    MOV data_2, #0ffh
                    MOV data_3, #0ffh
                    ACALL write_display
                    RET
;*****************************************************************************
*888
delay_2_Show:       MOV R7,#5
reload:             MOV R6,#0
```

```
                    DJNZ R6, $
                    DJNZ R7, reload
                    RET

;*************************************************************************8
reset_Delay:    MOV R0,#0
reset_loop:     CALL debounce_key
                DJNZ R0, reset_loop
                RET
;*************************************************************************
debounce_key:   MOV R7,#0
                    DJNZ R7,$
                    MOV R7,#0
                    DJNZ R7,$
                    MOV R7,#0
                    DJNZ R7,$
                    MOV R7,#0
                    DJNZ R7,$
                    MOV R7,#0
                    DJNZ R7,$
                    RET
```