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Research report on:

Design and Implementation Digitals ICs Tester

A Research Submitted in Partial fulfilment for the Requirements of the Degree of B.Sc. (Honours) in Electrical Engineering

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NOV 2018

بسم الله الرحمن الرحيم

قال تعالي :

(قَالُوْا سُبْحَانَكَ لاَ عِلْمَ لَناَ إِلاَّ مَا عَلَّمْتَنَا
إِنَّكَ أَنْتَ الْعَلِيمُ الْحَكِيمْ)

صدق الله العظيم

سورة البقرة، الأية (٣٢)

Dedication

I commit this venture to God Almighty my maker, my solid column, my wellspring of motivation, astuteness, information and comprehension. He has been the wellspring of my quality all through this program and on His wings just have I took off. I likewise commit this examination tenderly to My Mum and Father.

Acknowledgements

I have taken lots of effort to finish this dissertation, which I wouldn't have been able to finish without the help I received.
First, I would like to thank the Electrical Department in the University of Al-Sheikh Abd-Allah Albadri for giving me the chance to conduct this research.

I would like to thank my supervisor **MR.Mohammed Al-Noor Mustafa**, for giving information and steady supervision all throughout the journey. His redirections, inspiration and constructive criticism has helped me extremely.
Furthermore, I might want to demonstrate my appreciation to my family. Their support and consolation have roused me to complete this venture. Also, I might want to thank my folks to be comprehended amid the venture improvement time.

Special thanks to **Eng. Ahmed Salah Abdo** and **Eng. Nosiaba Abbas** for their Kindness, Supports and helpful.

Finally, I would like to acknowledge the great help I received from my companions. Their consultations has helped me to take care of the issues confronted in the venture.

Abstract

IC's is the main component of electronic circuit used for wide variety of purposes and functions. However, sometimes due to faulty ICs the circuit does not work. During the system failure it is not possible to check the whole circuit as it requires much time, and high cost. The main objective of this research is to design and implementation a prototype that would confirm whether the IC under consideration is working properly or not. The Digital Integrated Circuit Tester implemented as in this research is capable of testing 14 pin Integrated Circuits. First, the system welcomes the user and asks the user to select IC number of the IC to be tested as input from a 5x3-matrix keypad, which is implemented by 15 push buttons. It then checks the IC (in the pin socket) as per the IC number and gives output on the Liquid Crystal Display (LCD) by displaying "GOOD" or "BAD" .

المستخلص

تعتبر الدوائر المتكاملة المكون الرئيس للدوائر الإلكترونية, وهي تستخدم علي نطاق واسع في العديد من الأغراض. في بعض الأوقات تحدث أعطاب في الدوائر المتكاملة تتسبب في إيقاف عمل الدوائر الكهربية، هذه الحالات تتطلب عمل فحص كامل لمكونات النظام مما يتطلب وقت وجهد وتكلفة بالطرق العادية. الهدف الأساسي من البحث هو تصميم وتنفيذ جهاز فحص الدوائر المتكاملة الرقمية وتحديد حالتها إذا كانت تعمل أو لا تعمل. في هذا البحث تم تصميم الجهاز ليكون قادر علي فحص الدوائر المتكاملة المكونة من ١٤ رجل. في البداية يقوم النظام بعرض شاشة الترحيب ويطلب من المستخدم اختيار الشريحة المراد فحصها باستخدام لوحة المفاتيح، بعد ذلك يقوم بفحص الشريحة علي منفذ الاختبار وعرض النتائج علي الشاشة إذا كانت "جيدة" أو"سيئة".

Table of Contents

List of figures

Lists of tables

List of abbreviations

Abbreviation	Explanation
LCD	Liquid Cristal Display
GLCD	Graphical Liquid Cristal Display
ZIF	Zero Incretion Force
IC	Integration circuit
OP-Amp	Operation Amplifire
LED	Light Emitting Diode
RTC	Real Time Counter

Chapter One

Introduction

Chapter 1
Introduction

1.1 Background of study

The I.C testers used to test an ICs for any opens and/or shorts on any IC connection. The test of the IC is intended to insure that all common pins are connected to the same network of pins, independent pins make a connection to the die, and there are no shorted pins.

The present project related to digital IC tester for testing an ICs by applying test pattern signals to the IC and comparing response outputs from the IC and expected capable of correcting relative phase differences between a plurality of test pattern signals or plurality of strobe signals for logic determination of the response output from the IC being testes It's used to test the variety of IC's which consists of gates, sequential circuits, combinational circuits. The input signals are applied to the input pins of the IC and output is measured at the corresponding output pin.

1.2 Statement of the problem

The developed ICs testers in the market are few and their applications are limited. In the various systems, different IC's and components are connected to each other. During the system failure it is not possible to check the whole circuit as it requires much time, and high cost. Therefore, by checking only IC's and components on the chip the failure rate can be reduced by using the designed project.

1.3 Objective of the study

The main objective is to design and develop a digital ICs tester to achieve this objective:

1-Make easy and useful techniques to check the functionality of different kinds of ICs.

2- Help students to do their tests without damaging IC chips.

1.4 Evaluation

The design will be evaluated for functionality, ease of use and capable, easily controllable and extremely useful for basic needs.

1.5 Methodology

The design is for conducting quality control test of the integrated circuits for the normal operation. This process includes a verification of the truth table of the gates in the integrated circuit. The steps for conducting this project is described as follows:

Step1: Design electronic circuit for the System.

Step2: Preparations of hardware components.

Step3: Writing programming code required for controlling the whole system.

Step4: Connecting all parts of the design.

1.6 Chapters organization

This research contains fives chapters and they are organized as below:

Chapter 1: This chapter explains the introduction that includes objectives, problem statement, and methodology, evaluation, and simulation tools of this system.

Chapter 2: This chapter describes the revision about literature review and types of ICs tester and its classification.

Chapter 3: This chapter provides description the main components are used in this prototype such as Arduino Board, LCD display, keypad and ZIF socket and also describes software program used in this system.

Chapter 4: This chapter describes the implementation and result of system that which is describes the connection between components and the results of the program.

Chapter 5: This chapter summarizes the overall conclusion and explains about features recommendation for this project.

Chapter Two

Literature Review

Chapter 2

Literature Review

2.1 Overview

This chapter provide a literature review of an original method and a practical system implementation for testing different kind of integrated circuits (ICs), semiconductors technology, classifications of integrated circuits, logic gates ,fundamental testing method for ICs. In addition, this chapter basically to understand the main concepts and works that are related to our research.

2.2 Semiconductors Technology

A semiconductor material has an electrical conductivity value falling between that of a conductor – such as copper, gold etc. – and an insulator, such as glass. Their resistance decreases as their temperature increases, which is behavior opposite to that of a metal. Their conducting properties may be altered in useful ways by the deliberate, controlled introduction of impurities ("doping") into the crystal structure. Where two differently-doped regions exist in the same crystal, a semiconductor is created. The behavior of charge carriers, which include electrons, ions and electron holes at these junctions, is the basis of diodes, transistors and all modern electronics.

Some of the properties of semiconductor materials were observed throughout the mid-19th and first decades of the 20th century. The first practical application of semiconductors in electronics was the 1904 development of the cat's-whisker detector, a primitive semiconductor diode widely used in early radio receivers. Developments in quantum physics in turn allowed the development of the transistor in 1947 and the integrated circuit in 1958.

2.3 Integrated circuits

Integrated circuit (IC) is the most significant technological development of the 21st century if I may say. It has forever transformed the world of electronics. It has reduced the size of electronics from a refrigerator size to palm size electronics or even less. Unlike vacuum tubes used in early electronics, ICs dissipates less heat and as consumes less energy compared to vacuum tubes. Its reliability is not to be compared with that of vacuum tubes, it is very reliable. ICs have changed the fate of electronics. It has cut down the prices of electronics; it also changed the design of electronics from the use of discrete (separate) electronic components to hybrid solid-state devices, which combine discrete components with ICs. ICs are so small that you cannot see the connections between them unless with the help of a microscope. Thus, ICs are immensely in use in our electronics and almost all control devices an IC consists of interconnected transistors, capacitors, resistors, diodes etc. These components are interconnected with an external connecting terminals contained in a small package.

2.3.1 Integrated circuits classifications

Depending upon the functional utility, the Integrated circuits classifications are classified as linear ICs and digital ICs. From the point of view of structural considerations, ICs can be divided as monolithic ICs, thick-thin film ICs and hybrid ICs.

2.3.1.1Monolithic ICs

Monolithic microwave integrated circuits (MMICs), a new microwave technology have experienced a tremendous growth over the last five decades. Circuits had become extremely smaller, highly integrated, lower cost, and had found extensive applications in radar, electronic warfare, and various commercial fields. This paper is basically divided into two major sections: microwave integrated circuits (MICs) and monolithic microwave integrated circuits (MMICs) applications authored, respectively.

2.3.1.2 Hybrid or Multi chip ICs

As the name implies, “Multi”, more than one individual chips are interconnected. The active+ components that are contained in this kind of ICs are diffused transistors or diodes. The passive components are the diffused resistors or capacitors on a single chip. These components are connected by metalized patterns.

Hybrid ICs are widely used for high power-amplifier applications from 5W to more than 50W. Its performance is better than that of monolithic ICs.

2.3.1.3 Digital Integrated Circuits

These types of ICs work on the basic digital system i.e. two defined level which is 0's and 1's (in other words, Low and High or ON and OFF respectively). Microprocessor and Microcontroller is the example of digital ICs which contains millions of flip flops and logic gates.

2.3.1.4 Analog Integrated Circuits

Analog ICs work by processing continuous signals i.e. analog signal. OP-AMP (Operational Amplifier), NE 555 Timers and Sensors are the example of Analog ICs. These types of ICs are used for amplification, filtering, modulation, demodulation etc.

2.3.2 logic gates

A logic gate is an elementary building block of a digital circuit. Most logic gates have two inputs and one output. At any given moment, every terminal is in one of the two binary conditions *low* (0) or *high* (1), represented by different voltage levels. The logic state of a terminal can, and generally does, change often, as the circuit processes data. In most logic gates, the low state is approximately zero volts (0 V), while the high state is approximately five volts positive (+5 V).

There are seven basic logic gates: AND, OR, XOR, NOT, NAND, NOR, and XNOR. The AND gate is so named because, if 0 is called "false" and 1 is called "true," the gate acts in the same way as the logical "and" operator. The following illustration and table show the circuit symbol and logic combinations for an AND gate. (In the symbol, the input terminals are at left and the output terminal is at right.) The output is "true" when both inputs are "true." Otherwise, the output is "false."

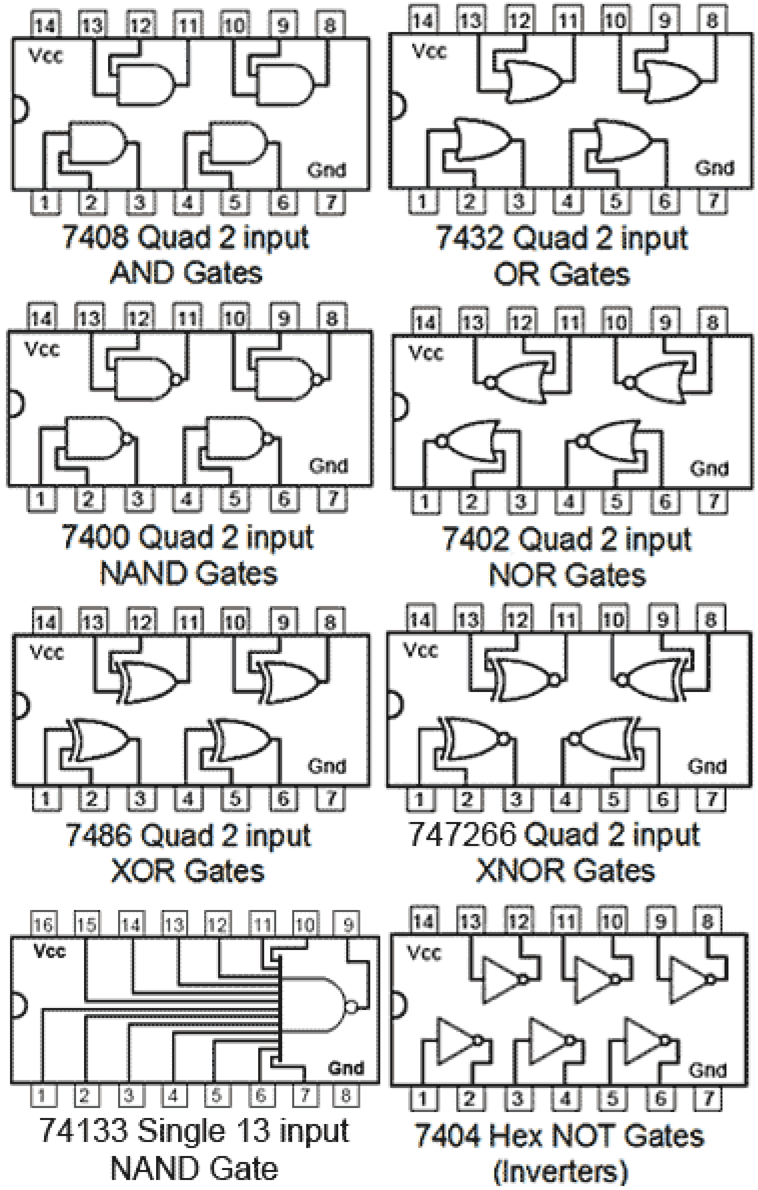

Figure 2.1: 74 Series Logic ICs

The OR gate gets its name from the fact that it behaves after the fashion of the logical inclusive "or." Either the output is "true" if or both of the inputs are "true." If both inputs are "false," then the output is "false". The XOR (exclusive-OR)gate acts in the same way as the logical "either/or." The output is "true" if either, but not both, of the inputs are "true." The output is "false" if both inputs are "false" or if both inputs are "true." Another way of looking at this circuit is to observe that the output is 1 if the inputs are different, but 0 if the inputs are the same.

A logical inverter, sometimes called a NOT gate to differentiate it from other types of electronic inverter devices, has only one input. It reverses the logic state. The NAND gate operates as an AND gate followed by a NOT gate. It acts in the manner of the logical operation "and" followed by negation. The output is "false" if both inputs are "true." Otherwise, the output is "true". The NOR gate is a combination OR gate followed by an inverter. Its output is "true" if both inputs are "false." Otherwise, the output is "false". The XNOR(exclusive-NOR)gate is a combination XOR gate followed by an inverter. Its output is "true" if the inputs are the same and "false" if the inputs are different.

Using combinations of logic gates, complex operations can be performed. In theory, there is no limit to the number of gates that can be arrayed together in a single device. But in practice, there is a limit to the number of gates that can be packed into a given physical space. Arrays of logic gates are found in digital integrated circuits (ICs). As IC technology advances, the required physical volume for each individual logic gate decreases and digital devices of the same or smaller size become capable of performing ever-more-complicated operations at ever-increasing speeds.

2.3.3Fundamental testing method

The integrated circuits (ICs) testing is a time consuming task. In order to get shorter test time, structural testing methods were developed. These testing methods were initially applied for digital IC-s, based on modeling faults and simulation the fault effect on the IC behavior in test conditions. The digital tested IC is powered, the gates works normally and the internal IC structure is verified.

Continuity Test

The test system allows you to test the IC for common-pin opens and for a short-Circuit between any pins with a single Continuity test step. Although the network of connection data can manually entered, this data is usually self-learned by the System from a known-good component. See the additional information labeled “Continuity Testing for Opens & Shorts”.

2.3.3.1 IC Test & IC Test Range setup

The System tests for the presence and orientation of the diodes that are present at all of the pins of the IC. These diodes are present to protect the input and output pins from electrostatic discharge by clamping the input voltage between the more positive supply voltage (e.g., VCC) and the more negative supply voltage (e.g., GND). The IC test range setup is used to limit the pins to be tested primarily for the self-learn of a known good IC.

and the more negative supply voltage (e.g., GND). The IC test range setup is used

Resistance Test

The test system provides resistance measurement in decade ranges using a constant current source with decade ranges from 0.1 to µA to 10mA. The measured value is displayed in ohms.A resistance measurement can be accomplished in several unique methods; 2-wire, 4-wire, 6-wire plus one test point (pin) to a set of other specified pins or from one-pin to all others.

Diode Test

The test system provides diode breakdown measurement in decade ranges using a constant current source with decade ranges from 0.1 µA to 10mA. The measured value is displayed as volts.

A diode measurement can be accomplished in several unique methods; 2-wire, 4-wire, 6-wire plus one test point (pin) to a set of other specified pins or from one-pin to all others.

Finally on the previous thirty years various Integrated circuits testing method that have been developed during different time span and brief description of the work . These are summarized below in Table 2.1.

Table 2.1: Literature Review

S. N	Work	Description	Year
1	USER PROGRAMMABLE INTEGRATED CIRCUIT INTERCONNECT ARCHITECTURE AND TEST METHOD	Programmable circuit with a flexible interconnect architecture that allows the implementation of field programmable semi-custom ICs with high complexity and performance	1986
2	SNGLE CHP CTESTER ARCHITECTURE	Test circuitry, which may be configured on a single test chip or active probe card for performing tests on integrated circuits at speed.	1991
3	SEMICONDUCTOR WAFER PACKAGE,METHOD AND APPARATUS FORCONNECTING TESTING C TERMINALS	Technology for Simultaneously testing a plurality of integrated circuits formed on a Semiconductor wafer in a wafer condition.	1994
4	INTEGRATED CIRCUIT (IC) TEST STRUCTURE WITH MONITOR CHAIN AND TEST WIRES	Integrated circuit (IC) testing apparatus, and more particularly to the construction of an IC Socket onto which semiconductor devices being tested	2015
5	DESIGIN AND IMPLEMENTAION DIGITALS IC'S TESTER	The main objective of this research is to design and implementation a prototype that would confirm whether the IC under consideration is working properly or not.	2018

Chapter Three

Design Components

Chapter 3
Design Components

3.1 Introduction

This project mainly consists of two parts, hardware design and software design. Hardware design consists of four parts major Arduino Mega, keypad, GLCD Display and ZIF socket.

3.2 Component Description

The main components used in this prototype are Arduino board, LCD display, keypad and ZIF socket.

3.2.1 Arduino board

Arduino is an embedded system built by a single integrated circuit. It consists of processor core, memory and programmable input and output peripherals.

3.2.1.1 Arduino Mega 2560

Arduino Mega 2560 is the big brother of the Arduino family uses a larger surface-mount microprocessor. The ATmega1280was updated at the same time as the Uno, and the microprocessor now used is the ATmega2560. The new version has 256 KB of flash memory compared to the 128 KB of the original. The Mega provides significantly increased input-output functionality compared to the standard Arduino, so with the increased memory, it is ideal for those larger projects that control lots of LEDs, have a large number of inputs and outputs, or need more than one hardware serial port the Arduino Mega has four. The boards have 54 digital input-output pins, 14 of which can provide PWM analog output, and 16 analog input pins. Communication is handled with up to four hardware serial ports. SPI communication and support for I2C/TWI devices is also available. The board also includes an ICSP header and reset button. An ATmega8U2 replaces the FTDI chipset used by its predecessor and handles USB serial communication. The Mega works with the majority of the shields available, but it is a good idea to check that a shield will be compatible with your Mega before purchasing it. Purchase the Mega when you have a clear need for the additional input-output pins and larger memory. See appendix C for the full technical specifications. Figure 3.1 shows The connections of the microcontroller with the peripherals.

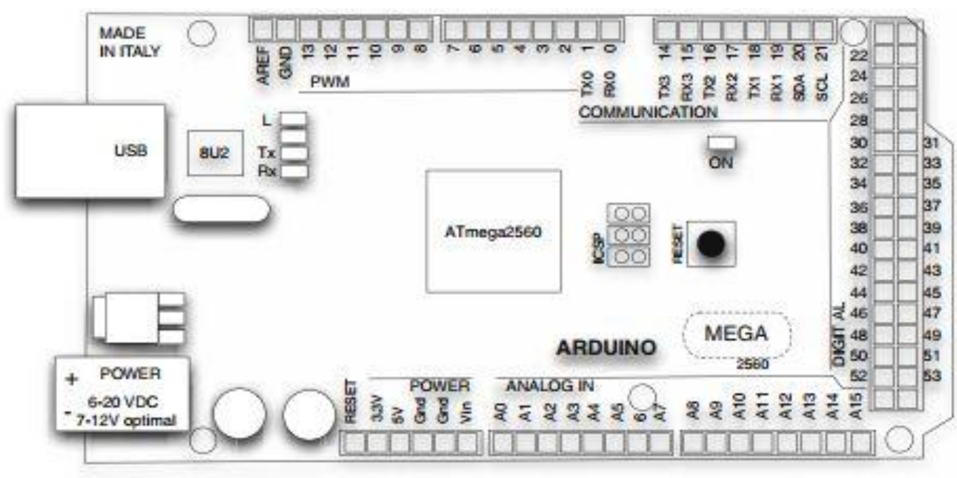

Figure 3.1: Arduino Mega2560 pins and layout

Pins Descriptions:

Controller Pins:

RESET (Reset input): A low level on this pin for longer than the 4-clock cycle will generate a reset. Arduino Mega has inbuilt reset circuit with push button to reset system and this pin can be used by other devices to reset controller.

XTAL1,XTAL2: Crystal (16Mhz) is connected to supply clock for controller with 2 bypass capacitor to ground.

AREF: This pin is used, when we use ADC for analog to digital conversion with external reference voltage for conversion and don't want to use internal 1.1V or 5v reference.

Digital Pins: From 0-53(digital) and 0-15(analog) can be use as input or output for digital transducer and output devices by pinMode() for pin direction, digitalWrite() to write pin and digitalRead() to read pin status.

Analog Pins (16): Analog pins: From 0-15(analog) can be used as analog input pin for ADC if not used than it work as normal digital pin. It can be used by pinMode() for pin direction, analogRead() to read pin status and get digital value for analog signal, care must be taken for internal or external reference voltage selection and Aref pin.

Alternative Pins Function:

SPI Pins: These pins are used for serial communication with SPI protocol for communication between two or more devices. SPI enable bit must be set to start communication with other devices.

I2C Pins: Digital pin 20 for SDA and 21 for SCK (Speed 400khz) to enable two wire communication with others devices. Function used are wire.begin() to start I2C conversion, with wire.Read() to read i2c data and wire.Write() to write i2c data.

PWM Pins: Digital pin 2-13 can be used as PWM output with analogWrite() to write pwm value from 0-255.It's alternative of DAC for low cost system to get analog signal at output by using filter.

USART Pins: This pin is used for serial UART communication with pc or other system for data sharing and logging. It is used with serialBegin() to set baud rate setting and start communication with serial.Println() to print array of char on other device output.

Pin change Interrupt Pins: This pin is used for pin change interrupt. Enable bit of pin change interrupt must be set with global interrupt enable.

Hardware Interrupt Pins:

Digital pin 18 – 21,2,3 hardware interrupt is used for interrupt services. Hardware interrupt must be enabled with global interrupt enable to get interrupt from other devices.

3.2.1.2 ATMega2560

The ATmega2560 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega2560 achieves throughputs approaching 1 MIPS per MHz allowing the system designed to optimize power consumption versus processing speed.

The Atmel®AVR® core combines a rich instruction set with 32 general-purpose working registers. All the 32 registers are directly connected to the Arithmetic Logic Unit (ALU), allowing two
independent registers to be accessed in one single instruction executed in one clock cycle. The resulting architecture is more code efficient while achieving throughputs up to ten times faster
than conventional CISC microcontrollers.

The ATmega2560 provides the following features:

- 64K/128K/256K bytes of In-System Programmable Flash with Read- While- Write capabilities.

- 4Kbytes EEPROM, 8 Kbytes SRAM.

- 54/86 general purpose I/O lines.

- 32 general purpose working registers.

- Real Time Counter (RTC).

- Six flexible Timer/Counters with compare modes and P WM, 4 USARTs.

- A byte oriented 2-wire Serial Interface.

- A 16-channel, 10-bit ADC with optional differential input stage with programmable gain, programmable Watchdog Timer with Internal Oscillator, an SPI serial port.

- EEE® std. 1149.1 compliant JTAG test interface.

- The On chip used for accessing Debug system and programming and six software selectable power saving modes.

- The Idle mode stops the CPU while allowing the SRAM.

- Timer/Counters, SPI port, and interrupt system to continue functioning.

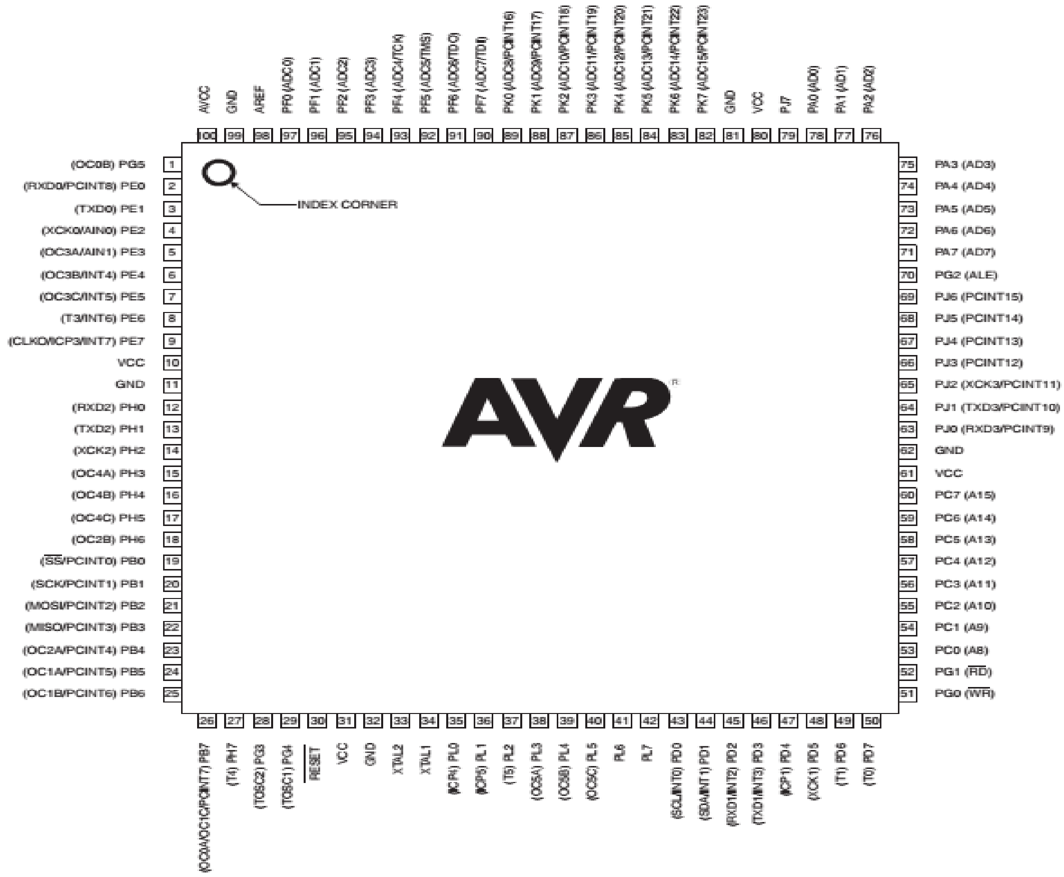

Figure 3.3: ATmega2560 ports

1. Ready to Use: The biggest advantage of Arduino is its ready to use structure. As Arduino comes in a complete package form, which includes the 5V regulator, a burner, an oscillator, a micro-controller, serial communication interface, LED and headers for the connections. You do not have to think about programmer connections for programming or any other interface.

2. Examples of codes: Another big advantage of Arduino is its library of examples present inside the software of Arduino.

3. Simple, clear programming environment Open source- Simplified and user-friendly programming language- Portable- Low power consumption.

4. Effortless functions: During coding of Arduino, you will notice some functions, which make the life so easy. Another advantage of Arduino is its automatic unit conversion capability.

5. Large community: There are many forums present on the internet in which people are talking about the Arduino. Engineers, hobbyists and professionals are making their projects through Arduino. You can easily find help about everything. Moreover, the Arduino website itself explains each and every functions of Arduino.

3.2.1.4 Arduino Disadvantages

1. Structure:

Yes, the structure of Arduino is its disadvantage as well. During building a project you have to make its size as small as possible. But with the big structures of Arduino we have to stick with big sized PCB's. If you are working on a small micro-controller like ATmega8 you can easily make your PCB as small as possible.

2. Cost:

The most important factor which you cannot deny is cost. This is the problem that every hobbyist, Engineer or Professional has to face. Now, we must consider that the Arduino is cost effective or not.

3. Open source- Simplified and user-friendly programming language Portable- Low power consumption.

3.2.2 LCD display screen

Liquid crystal displays (LCDs) modules display characters such as text and numbers are the most inexpensive and simplest to use of all LCDs. They can be purchased in various sizes, which are measured by the number of rows and columns of characters they can display. Some include a backlight and allow you to choose the color of the character and the background color.

3.2.2.1Graphic lcd modules

Graphic LCD modules are larger and more expensive than character modules, but they are also more versatile. You can use them not only to display text but also to draw lines, dots, circles, and more to create visual effects. It's available on the market with different sizes like 48x84, 128x64,…etc.

3.2.2.2 Nokia 5110 lcd 84x48

The Nokia 5110 is a basic graphic LCD screen for lots of applications. It was originally intended to be used as a cell phone screen. This one is mounted on an easy to solder PCB. It uses the PCD8544 controller, which is the same used in the Nokia 3310 LCD. The PCD8544 is a low power CMOS LCD controller/driver, designed to drive a graphic display of 48 rows and 84 columns. All necessary functions for the display are provided in a single chip, including on-chip generation of LCD supply and bias voltages, resulting in a minimum of external components and low power consumption. The PCD8544 interfaces to microcontrollers through a serial bus interface.

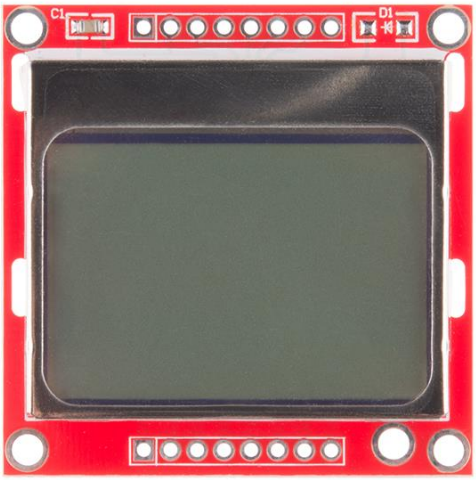

Fig 3.4 Nokia 5110 Graphical lcd

3.2.3 Keypad

Keypad is a set of buttons arranged in a block or "pad" which bear digits, symbols or alphabetical letters. Pads mostly containing numbers are This matrix keypad has built-in pushbutton contacts connected to row and column lines. A microcontroller can scan these lines for a button-pressed state. In the keypad library, the Propeller sets all the column lines to input, and all the row lines to input. Then, it picks a row and sets it high. After that, it checks the column lines one at a time. If the column connection stays low, the button on the row has not been pressed. If it goes high, the microcontroller knows which row (the one it set high), and which column, (the one that was detected high when checked). See the schematic in the "Circuit" section, above, for a visual reference of the keypad layout.

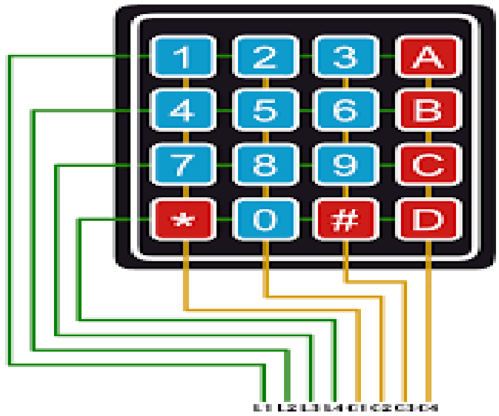

Figure 3.5: 4x4 Matrix keypad

3.2.4 IC ZIF Socket

A zero insertion force (ZIF) socket is a type of integrated circuit (IC) socket, which is designed so that it requires no force at all, except gravity, to insert an IC into the socket. This is achieved through the use of a slider or lever, which, when used, parts the spring-loaded contacts so that the IC can simply be placed on top of the socket with the pins meeting zero resistance as they are inserted into the openings between the contacts. When the lever or slider is moved back to its original position, the contacts close and grip the pins of the IC. The zero insertion force socket is an important innovation used to protect an IC from being damaged during insertion or from frequent removal and reinsertion from a socket. Most IC sockets require that the IC be pushed into sprung contacts which grip the pins through friction, with friction also acting as resistance during insertion. For an IC with hundreds of pins such as a processor (CPU), the total insertion force can be very large, and it carries a large chance of damaging the IC or even the board. Even with ICs which have a relatively smaller number of pins, removing it from a regular socket carries significant risk of bending the pins.

Figure 3.6 ZIF Socket

Chapter Four

Implementation and Result

Chapter 4

Implementation and Result

4.1 System Implementation

The digital integrated circuit tester implemented by using the embedded system. The embedded system processes the inputs and outputs from keypad and ZIF socket and displays the results on a GLCD display.

The basic function of the digital IC tester is to test a digital IC for correct logical functioning as described in the truth table. The designed model can test digital ICs having fourteen pins. Since it is programmable, any number of ICs can be tested. This model applies the necessary signals to the inputs of the IC, monitoring the outputs at each stage and comparing them with the outputs in the truth table. Any discrepancy in the functioning of the IC results in a fail indication, displays the faulty and good gates on the LCD. The testing procedure is accomplished with the help of keypad keys present on the main board design. The test has been accomplished with most commonly used digital IC's, mainly belonging to the 74 series family.

The basic blocks of the whole, system is shown in Figure 4.1. The main blocks are Arduino board, LCD display and ZIF socket.

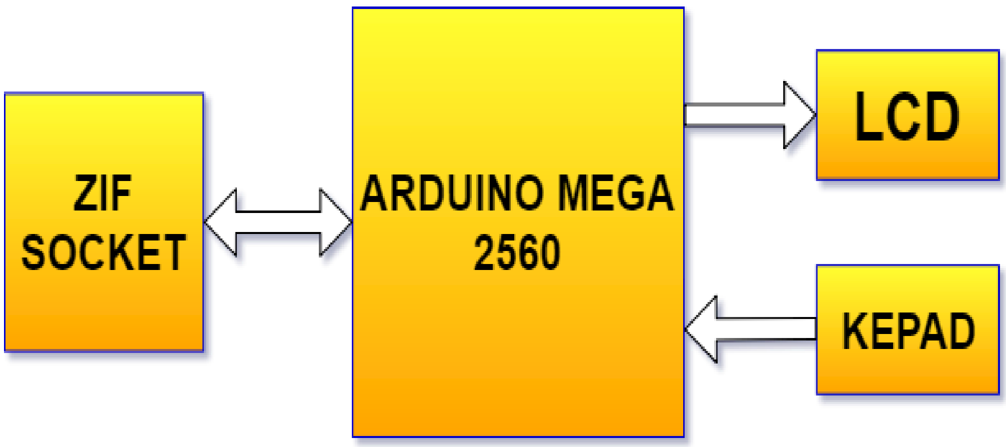

Figure 4.1: Basic block diagram of the system

4.2 Hardware design

The Hardware components of the digital IC tester can be discussed in three different units - Keypad unit, Display unit and control unit as follows:

i) Keypad Unit: The keypad, which used is a custom keypad consist of fifteens keys five rows and three column matrix keys and connected to digitals pins of the Arduino Mega board. The principle of detecting a key is by getting a logic value on the pin of the control unit.

ii) Display Unit: To display the result and for interaction with the user used Liquid Crystal Display.

iii) Control Unit: For implementing this device used an Arduino Mega 2560. This board have default pull-up resistors , so it does not need for external resistors.

The connections of the control unit with the other hardware units are shown in Figure 4.2.

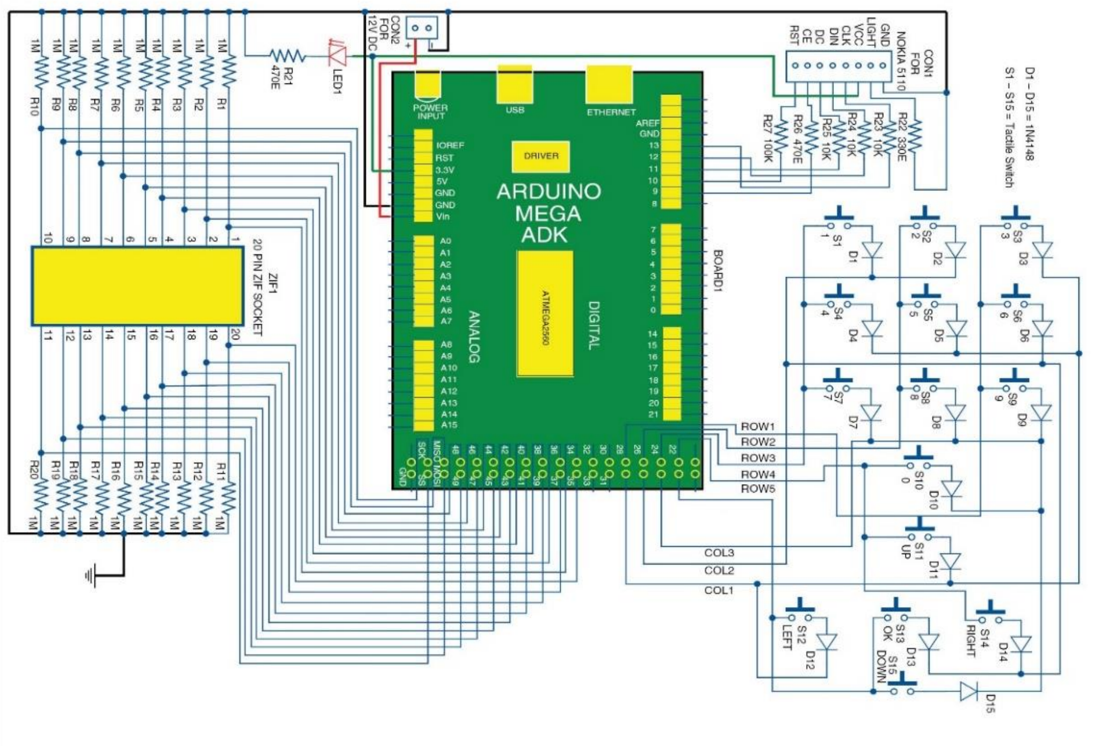

Figure 4.2: Hardware circuit

4.3 Result

The steps for conducting the verification test for quad-two inputs NAND, and NOR gates described as follows:

Step1: Feeding the two inputs of the chip (SN4011) and the chip (74LS32) gates with the first values in the truth table like shown on Table 4.1 and Table 4.2.

Table 4.1: NAND gate truth table

TRUTH TABLE FOR NAND GATE		
Input A	Input B	Output
0	0	1
0	1	1
1	0	1
1	1	0

Table 4.2: OR gate truth table

TRUTH TABLE FOR OR GATE		
Input A	Input B	Output
0	0	0
0	1	1
1	0	1
1	1	1

Step2: Checking the output states.

Step3: Ensuring that the output corresponds to the input values in the truth table are correct. If all the possible input values in the truth table give correct binary output value, proceed to test the other gates in the integrated circuit. If all the gates build in the integrated circuit, give correct results corresponding to the truth table, then the integrated circuit pass the test.

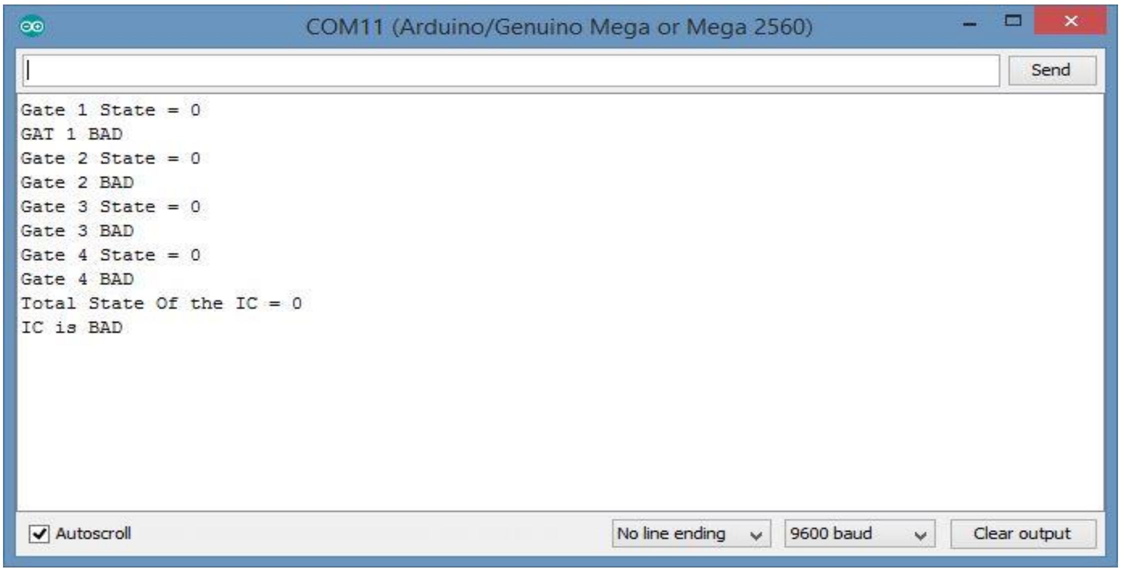

Fig 4.2: Status of the BAD gates

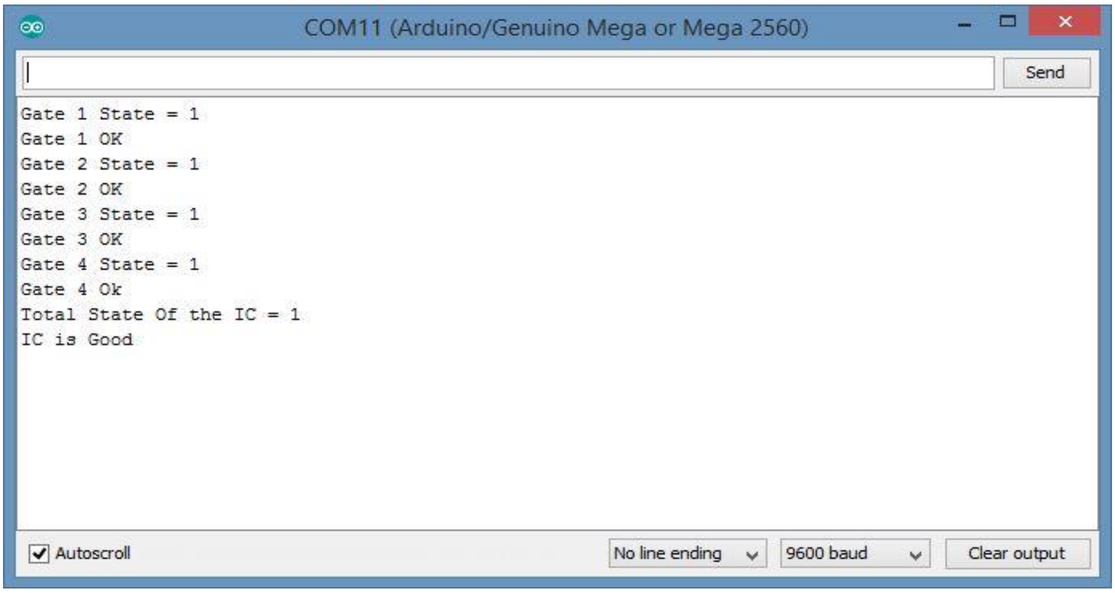

Fig 4.3: Status of the good gates

Steps 1,2 and 3 should be repeated for the other binary input values in the truth table. Now Any malfunction of one gate or more in the integrated circuit gives it fail in the test. The failed integrated circuit is considered unserviceable.

The integrated circuits subjected to quality control test are the flowing gates and the inverter as follows:

(1) The (SN4011), it includes quad two inputs NAND gates.

(2) The (74LS32), it includes quad two inputs OR gates.

4.4 The flowchart

The flowchart shown in Figure 4.4 describes the flowchart of the proposed software.

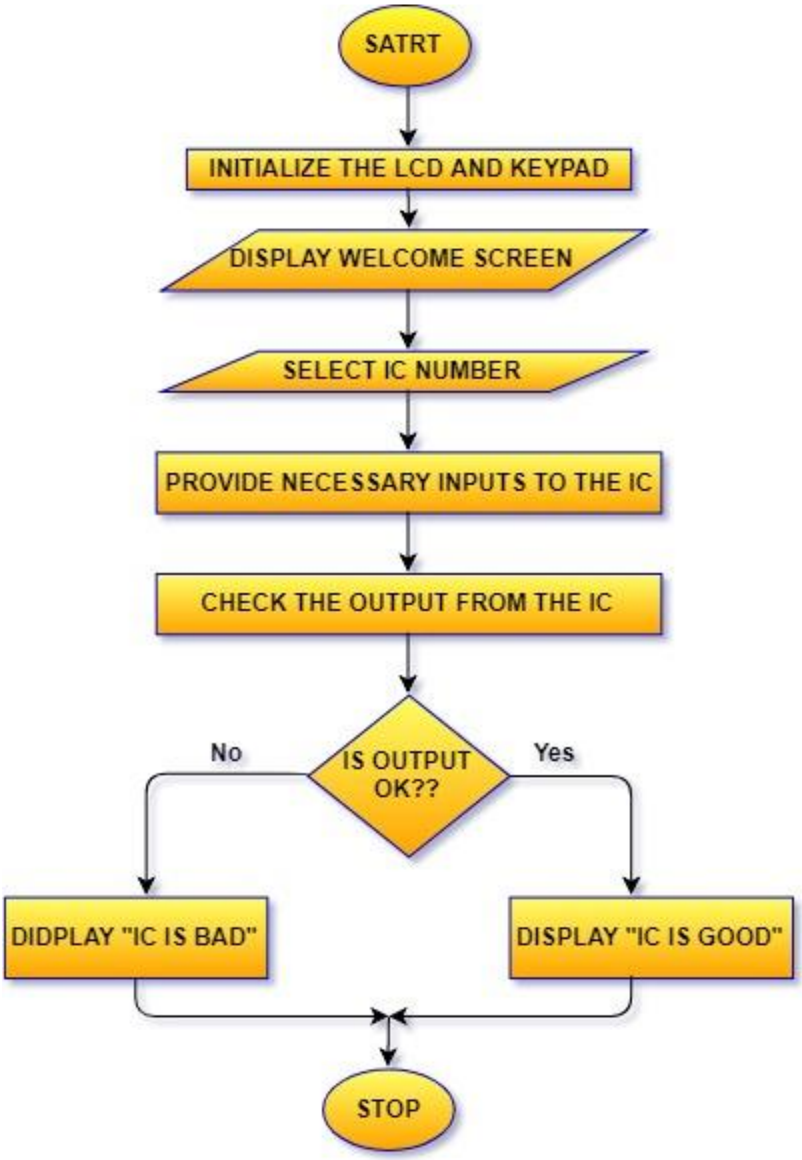

Figure 4.4: Flowchart

To test a particular digital IC, one needs to insert the IC into the IC socket and select the IC using the keypad and then processing starts. The IC number gets displayed in the LCD display unit.

Summary

The present prototype was successful in tests three samples of IC's (NAND, OR). The design is flexible so we can add extra IC bases and subroutines to test any other IC.

Chapter Five

Conclusions and Recommendations

Chapter 5

Conclusions and Recommendations

5.1 Conclusions

As a conclusion, this project includes the combination of Graphic LCD display, keypad, IC ZIF socket and Arduino Mega2560, to build a digital IC tester device for checking ICs. A prototype of version of Digital ICs tester has been tested in laboratory conditions and is successful at its major purpose of checking the functionality of different kinds of ICs.

5.2 Recommendations

This system is so open to be upgrade to give better execution, and here are a few proposals to be incorporated:

1- The number of supported ICs can be enhanced with the incorporation of new functions and libraries to the program. This required additinonal work and more time.

2- This porotype can be upgraded for analog ICs up to 14 pins. This is required more tests and more advanced tools.

3- Upgrade LCD screen to OLED toch-screen and using it instead of keypad and GLCD screen. This will add other costs.

References

[1] IC TESTER, Shigeru Sugamori, Gyoda, Japan, United States Patent, Aug. 13, 1982.

[2] Digital I.C. Tester, JOE FARR, Everyday Practical Electronics, October 2002.

[3] Interface an LCD with an Arduino, Tim Youngblood, April 16, 2015.

[4] John Wiley & Sons, Inc., Indianapolis, Indiana, "Android ™ Open Accessory Programming with Arduino", edition 2013.

[5] The Method And Circuit For Testing Integrated Circuits Using Terminal Characteristics, Adrian Virgil CRACIUN, 2018.

[6] An Overview on Monolithic Microwave Integrated Circuits, Satya Sai Srikant, January 2014.

Appendix A

1 Program

```
#include <lcd.h>
#include <keypad.h>
char key;
int x=0;
matrix_keypad inp(28,26,24,22,23,29,27,25);
nokia_lcd my(9,10,11,12,13);
void setup() {
inp.init();
int x=0;
  // put your setup code here, to run once:
}
int help()
{
  int temp;
  go1:
  my.erase();
  my.string("HELP",0,'c');
  my.string("*IC in Socket",1,'l');
  my.string("*Select IC no.",2,'l');
  //my.string("*Press OK",3,'l');
  my.string("*Wait 4 Result",3,'l');
  my.string("nxt",5,'c');
  my.string("ext",5,'l');
  temp=1;
  while(temp)
  {
    delay(0.5);
    key=inp.key_in();
    if(key=='l')
    {
      //my.erase();
      loop();
        return 0;
    }
    else if(key=='m')
      temp=0;
  }
  go2:
  my.erase();
  my.string("HELP",0,'c');
  my.string("*Proper ic no.",1,'l');
  my.string("(avoid dmage)",2,'l');
  my.string("*Dont use when",3,'l');
  my.string(" -no IC added",4,'l');
  my.string("nxt",5,'c');
  my.string("ext",5,'l');
  my.string("bck",5,'r');
  temp=1;
```

```
  while(temp)
  {
    delay(0.5);
    key=inp.key_in();
    if(key=='l')
    {
     // my.erase();
     loop();
      return 0;
    }
    else if(key=='m')
      temp=0;
    else if(key=='r')
      goto go1;
  }
  go3:
  my.erase();
  my.string("HELP",0,'c');
  my.string("*IC from LEFT",1,'l');
  my.string("*Use proprly!",2,'l');
  my.string("==GOOD LUCK==",4,'c');
  my.string("ext",5,'l');
  my.string("bck",5,'r');
  temp=1;
  while(temp)
  {
    delay(0.5);
    key=inp.key_in();
    if(key=='l')
    {
      loop();
      return 0;
    }
    else if(key=='r')
      goto go2;
  }
}
void ect(){
int key=inp.key_in();
   if(key=='r')
  {
    loop();
    }
}
void loop() {
//welcome();
my.erase();
  my.string("By M.MALIK",0,'c');
  my.string("I.C. TESTER",2,'c');
  my.string("-----------",3,'c');
  my.string("start",5,'l');
  my.string("help",5,'r');
    while(1)
      {
```

```
        delay(5);
        key=inp.key_in();
        if(key=='l')
        {
          Start();
         }
         if(key=='r')
         {
          help();

         }
        /*{
         return 0;
        }*/
      }
}
void Start(){
  my.erase();
  my.string("Press IC no:",0,'c');
  my.string("1.4011",1,'l');
  my.string("2.7432",2,'l');
  my.string("3.7408",3,'l');
  my.string("4.7486",4,'l');
  my.string("5.7404",5,'l');
  my.string("6.7401",1,'r');
  my.string("7.74**",2,'r');
  my.string("8.74**",3,'r');
  my.string("9.74**",4,'r');
  my.string("back",5,'r');
while(1)
  {
    delay(5);
        key=inp.key_in();
        if(key=='1')
        {
        Nand();
        }

         if(key=='2')
        {

    OR();
         }
         if(key=='r')
        {

    loop();
         }
  }
//-----------------|| 4011 ||----------------------------------------
}
int Nand(){
int outGate1=39; //Gate 1 output
int outGate2=37; //Gate 2 output
```

```
int outGate3=36 ; //Gate 3 output
int outGate4=38; //Gate4 output

pinMode(outGate1, INPUT);
pinMode(outGate2, INPUT);
pinMode(outGate3, INPUT);
pinMode(outGate4, INPUT);
pinMode(33, OUTPUT);
pinMode(35, OUTPUT);
pinMode(34, OUTPUT);
pinMode(32, OUTPUT);
pinMode(41, OUTPUT);
pinMode(40, OUTPUT);
pinMode(42, OUTPUT);
pinMode(43, OUTPUT);
pinMode(2, OUTPUT);
Serial.begin(9600);
digitalWrite(33, LOW);
digitalWrite(35, LOW);
digitalWrite(37, LOW);
digitalWrite(39, LOW);
digitalWrite(41, LOW);
digitalWrite(43, LOW);
digitalWrite(45, LOW);
digitalWrite(47, LOW);
delay(1000);
Serial.begin(9600);
int val1=digitalRead(outGate1);
Serial.print("Gate 1 Status = ");
Serial.println(val1);
delay(500);
if(val1==1)
{
  //Serial.println("Gate 1 OK");
  my.erase();
  my.string("Gate 1 OK",2,'c');
 delay(3000);
}
else {
  //Serial.println("GAT 1 BAD");
  my.erase();
  my.string("Gate 1 BAD",2,'c');
  delay(3000);
}
int val2= digitalRead(outGate2);
Serial.print("Gate 2 Status = ");
Serial.println(val2);
delay(1000);
if(val2==1)
{
 //Serial.println("Gate 2 OK");
 my.erase();
  my.string("Gate 2 OK",2,'c');
 delay(3000);
```

```
}
else {
  //Serial.println("Gate 2 BAD");
  my.erase();
  my.string("Gate 2 BAD",2,'c');
  delay(3000);
}
int val3= digitalRead(outGate3);
Serial.print("Gate 3 Status = ");
Serial.println(val3);
delay(1000);
if(val3==1)
 {
 //Serial.println("Gate 3 OK");
 my.erase();
  my.string("Gate 3 OK",2,'c');
 delay(3000);
}
else {
  //Serial.println("Gate 3 BAD");
  my.erase();
  my.string("Gate 3 BAD",2,'c');
  delay(3000);
}
int val4= digitalRead(outGate4);
Serial.print("Gate 4 Status = ");
Serial.println(val4);
delay(1000);
if(val4==1)
{
   //Serial.println("Gate 4 Ok");
   my.erase();
  my.string("Gate 4 OK",2,'c');
 delay(3000);
}
else {
  //Serial.println("Gate 4 BAD");
  my.erase();
  my.string("Gate 4 BAD",2,'c');
  delay(3000);
}
int totalState= val1*val2*val3*val4;
if(totalState==1)
{
  Serial.print("Total Status Of the IC = ");
  Serial.println(totalState);
  //Serial.print("IC is Good");
  my.erase();
  my.string("IC is Good",2,'c');
  my.string("exit",5,'r');
   delay(2000);
   int y=1;
   while(y)
   {
```

```
    y=1;
   ect();
   }
}
else{
  Serial.print("Total Status Of the IC = ");
  Serial.println(totalState);
  //Serial.print("IC is BAD");
  my.string("IC is BAD",2,'c');
  my.string("exit",5,'r');
  delay(2000);
   int y=1;
   while(y)
   {
    y=1;
   ect();
   }
 }
 exit(0);
  }
//----------------------|| OR Gate ||------------------------
int OR(){
int outGate1=39; //Gate 1 output
int outGate2=33; //Gate 2 output
int outGate3=42; //Gate 3 output
int outGate4=36; //Gate4 output
pinMode(outGate1, INPUT);
pinMode(outGate2, INPUT);
pinMode(outGate3, INPUT);
pinMode(outGate4, INPUT);
pinMode(32, OUTPUT);
pinMode(34, OUTPUT);
pinMode(35, OUTPUT);
pinMode(37, OUTPUT);
pinMode(38, OUTPUT);
pinMode(40, OUTPUT);
pinMode(41, OUTPUT);
pinMode(43, OUTPUT);
//pinMode(2,  OUTPUT);

digitalWrite(33, HIGH);
digitalWrite(35, HIGH);
digitalWrite(37, HIGH);
digitalWrite(39, HIGH);
digitalWrite(41, HIGH);
digitalWrite(43, HIGH);
digitalWrite(45, HIGH);
digitalWrite(47, HIGH);
delay(1000);
Serial.begin(9600);
int val1= digitalRead(outGate1);
delay(500);
if(val1==1)
{
```

```
  Serial.println("Gate 1 OK");
 my.erase();
  my.string("Gate 1 OK",2,'c');
 delay(4000);
}
else {
  Serial.println("GAT 1 BAD");
  my.erase();
  my.string("Gate 1 BAD",2,'c');
  delay(4000);
}
int val2= digitalRead(outGate2);
delay(1000);
if(val2==1)
{
 Serial.println("Gate 2 OK");
 my.erase();
  my.string("Gate 2 OK",2,'c');
 delay(4000);
}
else {
  Serial.println("Gate 2 BAD");
  my.erase();
  my.string("Gate 2 BAD",2,'c');
  delay(4000);
}
int val3= digitalRead(outGate3);
delay(1000);
if(val3==1)
 {
 Serial.println("Gate 3 OK");
 my.erase();
  my.string("Gate 3 OK",2,'c');
 delay(4000);
}
else {
  Serial.println("Gate 3 BAD");
  my.erase();
  my.string("Gate 3 BAD",2,'c');
  delay(4000);
}
int val4= digitalRead(outGate4);
delay(1000);
if(val4==1)
{
   Serial.println("Gate 4 Ok");
   my.erase();
  my.string("Gate 4 OK",2,'c');
 delay(4000);
}
else {
  Serial.println("Gate 4 BAD");
  my.erase();
  my.string("Gate 4 BAD",2,'c');
```

```
  delay(4000);
}
int totalState= val1*val2*val3*val4;
if(totalState==1)
{
my.erase();
  my.string("IC is Good",2,'c');
  my.string("exit",5,'r');
   delay(2000);
   int y=1;
   while(y)
   {
    y=1;
   ect();
   }
}
else{
  my.string("IC is BAD",2,'c');
  my.string("exit",5,'r');
      delay(2000);
   int y=1;
   while(y)
   {
    y=1;
   ect();
   }
 }
 exit(0);
  }
//-----------------|| 7400||----------------------------------------
int welcome()
{
  my.erase();
  my.string("By M.MALIK",0,'c');
  my.string("I.C. TESTER",2,'c');
  my.string("-----------",3,'c');
  my.string("start",5,'c');
  delay(1);
  }
}
```

Appendix B

Design Images

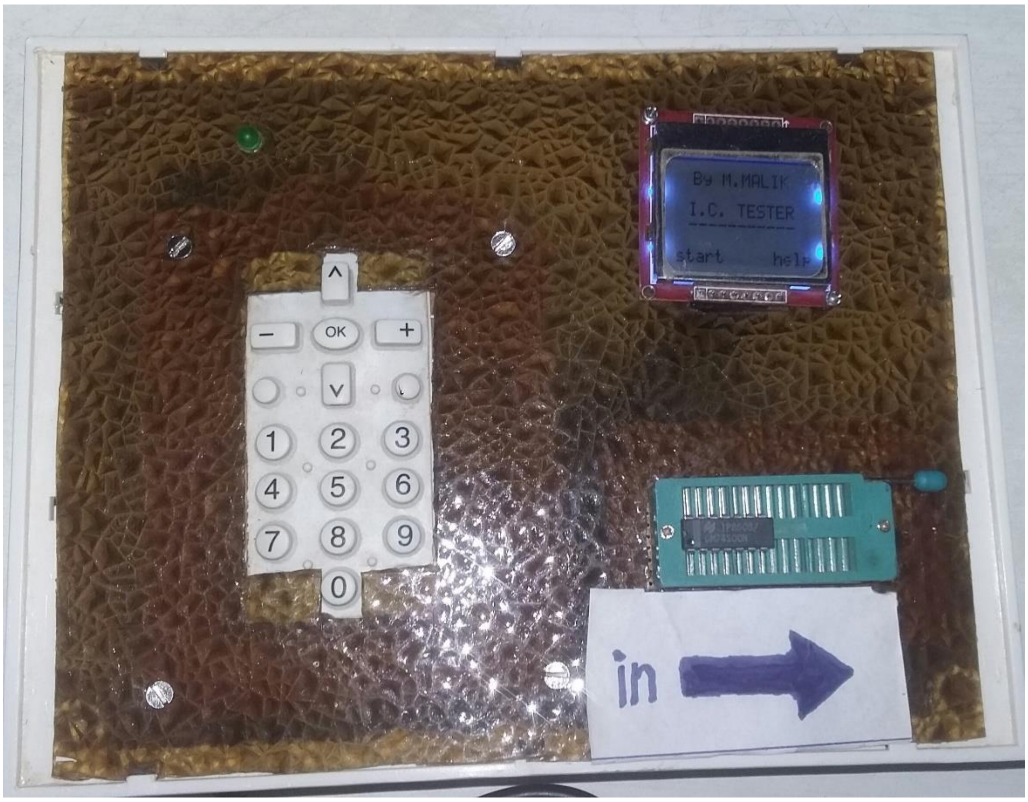

Figure 1: Digital IC's Tester