



**EAST WEST UNIVERSITY**

## **Design and Development of Arduino Based IC Tester**

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## DECLARATION

We, hereby declare that the project titled “**Design and Development of Arduino Based IC Tester**” is submitted to the Department of Electronics and Telecommunication Engineering, East West University under the supervisor of **Dr. Md. Habibur Rahman**. This is our original paper that reflects our work and was not submitted elsewhere for the award of any other degree or any other publication.

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## APPROVAL

This is to certify that the project titled as “**Design and Development of Arduino Based IC Tester**” being submitted by Md.Tanvir Nur, Mohammad Touhidul Islam and Junaid Iqbal Raju of Electronics and Communications Engineering Department, East West University, Dhaka in partial fulfillment for the requirement of the Degree of Bachelor of Electronics & Telecommunications Engineering, is a record of major project carried out by them. They have worked under our supervision and guidance and have fulfilled the requirement which to our knowledge have reached the requisite standard for submission of this dissertation

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## **ABSTRACT**

In the present world, everything is going to be more developed, attractive and user-friendly. IC's, the main component of each and every electronic circuit can be used for wide variety of purposes and functions. But sometime due to faulty ICs the circuit doesn't work. Indeed it is lot tedious work to debug the circuit and confirm whether the circuiting is creating problem or the IC itself is dead. So to come up with these sorts of problems we intend to make a project which would confirm whether the IC under consideration is working properly or not. Hence, the motive of this project is to develop a low-cost, computer independent and user friendly digital logic Integrated Circuit (IC) tester. The logic IC tester will be able to test the function of basic 74 series TTL Logic gates (AND, OR, NOR, NAND, XOR etc.). The logic IC functional tester can be operated in Personal Computer (PC) mode. Arduino IDE has been used to develop the user interface to transmit the instruction from computer to the Arduino through Universal Serial Bus (USB) interface for PC mode. Final result will be displayed on LCD. The logic IC functional tester is successfully built and well functional without any errors. In performance analysis chapter, we have showed the result of different types of ICs after testing those ICs.

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# CHAPTER 1

## INTRODUCTION

### 1.1 Goal

The primary purpose of the logic IC functional tester project is to construct a simple and inexpensive system which is suitable for testing the function of small scale chip. The system incorporates a friendly Graphical User Interface (GUI) which permits users with no programming expertise to generate tests and operate the system quickly and efficiently. The system also can be used in standalone mode without interface with Personal Computer (PC). The system also will provide data storage which can store the result as a reference for users. The tester system can be applied to standard TTL basic gate and common flip-flop Integrated Circuit (IC).

### 1.2 Background

The dramatic increase in the use of digital integrated circuits (ICs) has created a need for a fast accurate means of testing such ICs. An IC Tester is to be economically implemented for small or medium-scale users of such IC's (for example, in the lab) and provides a quick but thorough check of its functions with minimal operator action. The IC Tester can be used to test different ICs. The purpose of IC tester is to ensure IC components are in good condition for use. For testing an IC, different hardware circuits for different ICs are needed. This is the

main trouble and disadvantage. Hence, it is needed to construct an IC tester to surmount this problem.

### 1.3 Objective

The programmable test system will be designed so that end user has total control over testing of ICs. Hence, IC tester must allow users with no programming expertise to generate tests and operate system quickly and efficiently.

This IC tester should be able to test logic ICs in PC Mode. In the PC Mode, users can select available ICs in Preset list to be tested and the ICs are not available in list can be tested in Customized Testing. When the Arduino received a command from the Personal Computer through USB communication interface, it will respond by transmitting pulses to the testing circuit to start the test. After completed testing, the Arduino will send results back to 3 PC. The results can be stored in hard drive of PC. The test system must incorporate with friendly Graphical User Interface which allows users with or without programming knowledge to operate the tests.

Those ICs that can be tested on this IC tester are basic gate and common flip-flop. The models of basic gates are 74LS00 (NAND), 74LS02 (NOR), 74LS04 (NOT), 74LS08 (AND), 74LS32 (OR), 74LS86 (XOR) and 74LS266 (XNOR).

### 1.4 Literature

Although not same but some related works have been done by many researches. Some of the related literature have been reviewed and described below:

- i. Mirza Shoaib Ahmed and Et al. did a work titled “**MICROCONTROLLER BASED IC TESTER.**” In this work the authors have designed a microcontroller based IC tester where it can give the result of IC within a second. They tried to make sure that the device would be worked as less power consumer. Another special feature of that device is low cost. Its smaller size makes it unique than others IC tester. <sup>[1]</sup>
- ii. Liakot Ali and Et al. did the work titled “**Design of a low cost IC tester**”. In this work they have design a microcontroller based IC tester. The cost of that IC tester is cheaper than other devices. It is capable of testing combinational circuits as well

as sequential circuits with scan-path facilities efficiently. It can also be used for testing PCB (printed circuit board) interconnection faults. [2]

- iii. Md. Liakot Ali and Et al. also published a research paper and titled “**Challenges and directions for testing IC**”. Since integration and refining technology is increasing dramatically as a result more problems have been arise at the time of integrating circuit. A roadmap of semiconductor technology in the context of IC testing is shown in this paper. Researchers and manufacturers can get to know current challenges and directions of IC testing through this discussion. [3]
- iv. Sandhya Singh and Et al. also published a research paper titled “**FPGA Based Digital IC Tester**”. This paper describes the implementation of testing of CMOS digital integrated circuits for both functional and delay fault testing using reconfigurable field programmable gate array, XC3S500E. FGPA IC tester has many advantages over conventional IC testing. [4]
- v. D. Rama Krishna and Et.al have done the project and titled “**Microprocessor Based Digital IC Tester**”. In this project, they have tried to presents a method of testing digital IC by using microprocessor. [5]
- vi. [J. Trnka](#) and Et.al have done a research on the titled “**Practical Limit of IC Tester**”. In this paper they have mentioned all kind of limitations of IC tester in practical field. [6]
- vii. Miss.M.A.Tarkunde and Et.al have done a research on “**IC Tester using 89s52 Microcontroller**”. The proposed project is designed to confirm whether the IC under consideration is properly working or not. The proposed project can be used to check the IC’s of 74 series at gate level. [7]
- viii. Maribelle and Et.al did the work on “**Microcontroller Based Design of Digital IC Tester with Multi-Testing and Loop Testing Functions**”. This paper describes a microcontroller-based IC tester with dual logic gates testing. The

design is implemented by using STC12C5A32 microcontroller chip where the processing of the inputs and outputs was done by the microcontroller. [8]

- ix. S.Devika and Et.al have done the work on “**IC TESTER USING PIC MICROCONTROLLER**”. They have made the IC tester such a way that is of testing both digital and analog ICs having 14 pin(74 series) and 8 pin(IC 555,LM741) respectively. The heart of the IC tester is PIC 16F877A Microcontroller. [9]
- x. Bhaskar and Et.al have done a project on “**Digital IC tester with embedded truth table**”. This paper represents a proto-type IC tester that is highly capable, highly reliable as well as cost effective. They develop a program with different functions for checking different ICs. [10]

## 1.5 Motivation

The IC testers available in the market today are too costly for individuals to own. Therefore, we decided to construct an IC tester which is affordable and user-friendly. The motivation is to build an affordable IC tester for testing the function of 74 series TTL Logic Gates and common flip-flop ICs. The test sequence provide in the database facilitates the detection of defective ICs. Furthermore, the IC tester must be easy to operate, compact, lightweight, portable, and low power consumption. Next, the motivation is to provide an IC tester in portable mode which is easy and convenient to carry around. In addition, we wish to build an IC tester which provides result storage capability to users. Nowadays, virtually all desktop and laptop PCs on the market provide USB ports so the motivation is to provide an IC tester with USB interface communication to users. The Universal Serial Bus provides a single, standardized, easy-to-use way to connect to a computer.

## **1.6 Scope of work**

The project is separated into two parts which are the hardware and the software. Software implementation for this IC tester project is done by Mohammad Touhidul Islam; Md. Junaid Iqbal Raju, Md. Tanvir Nur under the supervision Dr. Md. Habibur Rahman. The program written would be able to control all the hardware parts. At the same time, hardware development is done by the same people.

## **1.7 IC tester in market**

This section focuses on the literature review of similar product done by others. As a result of growth in this market, the consolidation of competitors is an ongoing process. Comparing the IC tester in the market is important in order to define what feature and device are needed by users, and the quality of the IC tester can be improved as well. General summaries on different ways has been tried to implement the system, and compare their achievements then construct a unique IC tester for users.

### **1.7.1 SU-300 IC Tester**

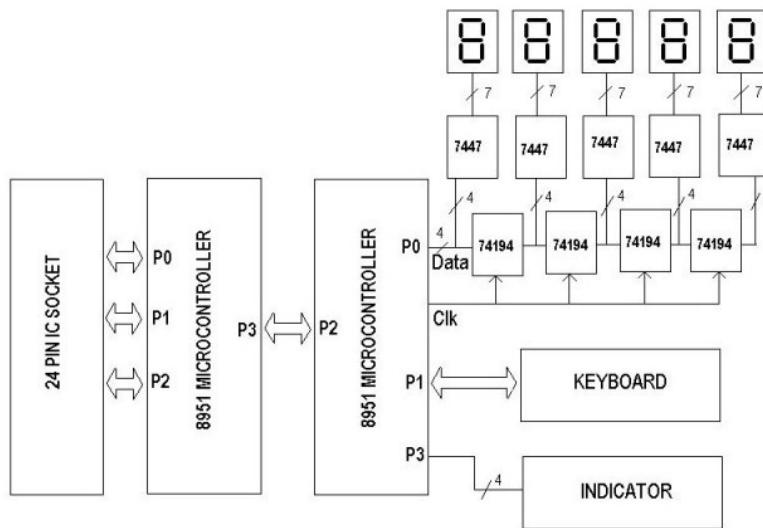


**Figure 1.1: SU-300**

### **1.7.2 Digital Based IC Tester**

This IC tester by Ranjith (2008) can test digital ICs having a maximum of 24 pins. Since it is programmable, any number of ICs can be tested within the constraint of the memory

available. This IC tester can be used to test a wide variety of ICs which includes simple logic gates and also sequential and combinational ICs like flip-flops, counters, shift registers and so on. It is portable and easy to use.



**Figure1.2: Block Diagram of Programmable Digital IC Tester<sup>[30]</sup>**

As shown in figure 2.1, it consists of two 8951 microcontroller ICs, a 24-pin IC socket, a keyboard unit, a display unit and indicators. By inserting a IC into the IC socket and enter the IC number using keyboard and then press the “ENTER” key can test a particular digital IC. The IC number is displayed in the 7-segment display unit. Four LEDs are provided as indicators. If the IC is being tested is a logic gate, then each of the 4 indicator LEDs correspond to the 4 gates of the IC. If inserted IC is not a logic gate, all the 4 LEDs work as a single indicator.<sup>[30]</sup>



### 1.7.3 Model 575A Digital IC Tester



**Figure 1.3: Digital IC Tester Model 575A<sup>[31]</sup>**

The Model 575A (from B&K Precision Corporation Company) is able to locate temperature related faults by using its unconditional or conditional loop testing modes. Unknown device identification is easily accomplished by selecting SEARCH from the menu, selecting the number of pins on the device and activating Search Mode. The 575A will search its library and identify the device, displaying possible functional equivalents for replacement. As part of the IC test, the specific IC number, the functional description of the device, and the status of faulty pins are scrolled through on the built-in display.<sup>[31]</sup>

#### **Features of Digital IC Tester Model 575A:**

1. Comprehensive device library covers most TTL, CMOS, and memory and interface devices.
2. Identifies unmarked and house-coded devices
3. 40 pin capabilities (NAND gates or CPUs)
4. Detects intermittent and temperature related faults
5. Displays diagnostic information for individual pins

## **CHAPTER 2**

### **RELATED INFORMATION**

#### **2.1 Integrated Circuit (IC)**

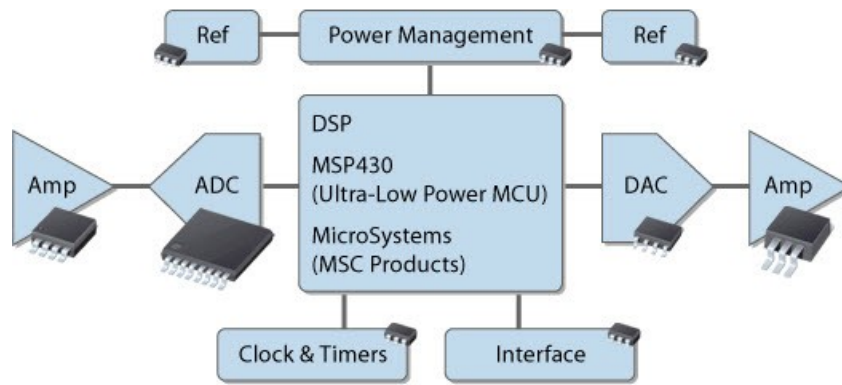
An integrated circuit (IC), sometimes called a chip or microchip, is a semiconductor wafer on which thousands or millions of tiny resistors, capacitors, and transistors are fabricated. An IC can function as an amplifier, oscillator, timer, counter, computer memory, or microprocessor. A particular IC is categorized as either linear (analog) or digital, depending on its intended application.

Linear ICs have continuously variable output (theoretically capable of attaining an infinite number of states) that depends on the input signal level. As the term implies, the output signal level is a linear function of the input signal level. Ideally, when the instantaneous output is graphed against the instantaneous input, the plot appears as a straight line. Linear ICs are used as audio-frequency (AF) and radio-frequency (RF) amplifiers. The operational amplifier (op amp) is a common device in these applications.

Digital ICs operate at only a few defined levels or states, rather than over a continuous range of signal amplitudes. These devices are used in computers, computer networks, modems, and frequency counters. The fundamental building blocks of digital ICs are logic gates, which work with binary data, that is, signals that have only two different states, called low (logic 0) and high (logic 1) <sup>[11]</sup>.

#### **2.2 Different Integrated Circuit**

There are different types of ICs; classification of Integrated Circuits is done based on various criteria. A few types of ICs in a system are shown in the below figure with their names in a tree format <sup>[12]</sup>

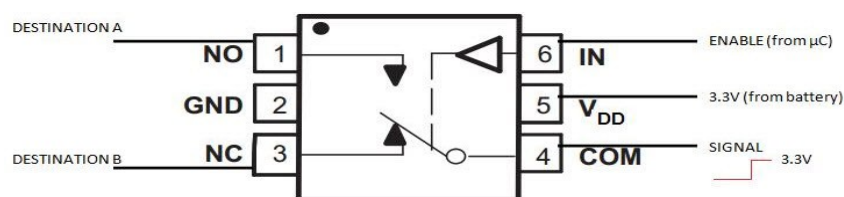


**Figure 2.1: Different Types of ICs** <sup>[25]</sup>

Based on the intended application, the IC are classified as analog integrated circuits, digital integrated circuits and mixed integrated circuits.

## 2.3 General type of IC

### 2.3.1 Switching IC



**Figure 2.2: Switching ICs**

Switches or Switching ICs are designed by using the transistors and are used for performing the switching operations. The above figure is an example showing an SPDT IC switch.

### 2.3.2 Audio Amplifier

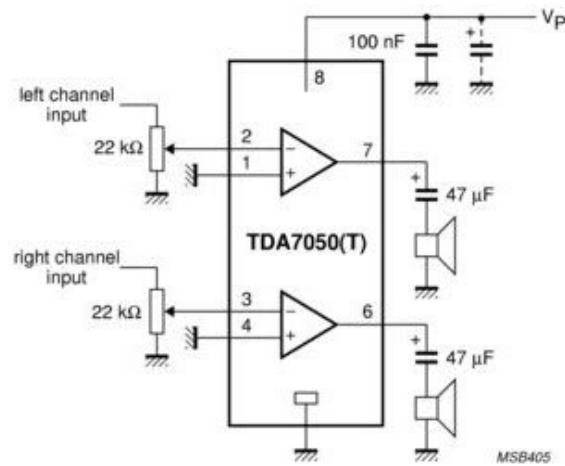


Figure 2.3: Audio amplifiers

The audio amplifiers are one of the many types of ICs, which are used for the amplification of the audio. These are generally used in the audio speakers, television circuits, and so on. The above circuit shows the low-voltage audio amplifier IC.

### 2.3.3 Operational Amplifier

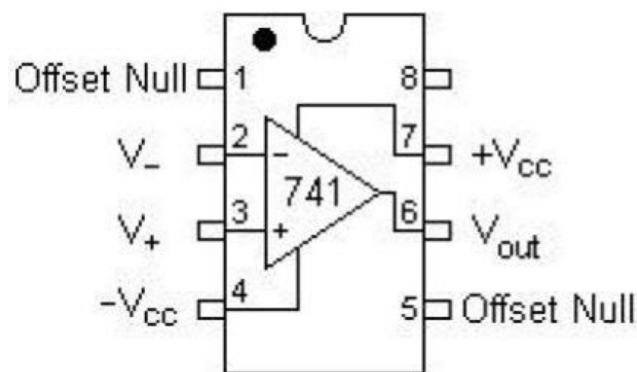


Figure 2.4: Operational amplifiers <sup>[28]</sup>

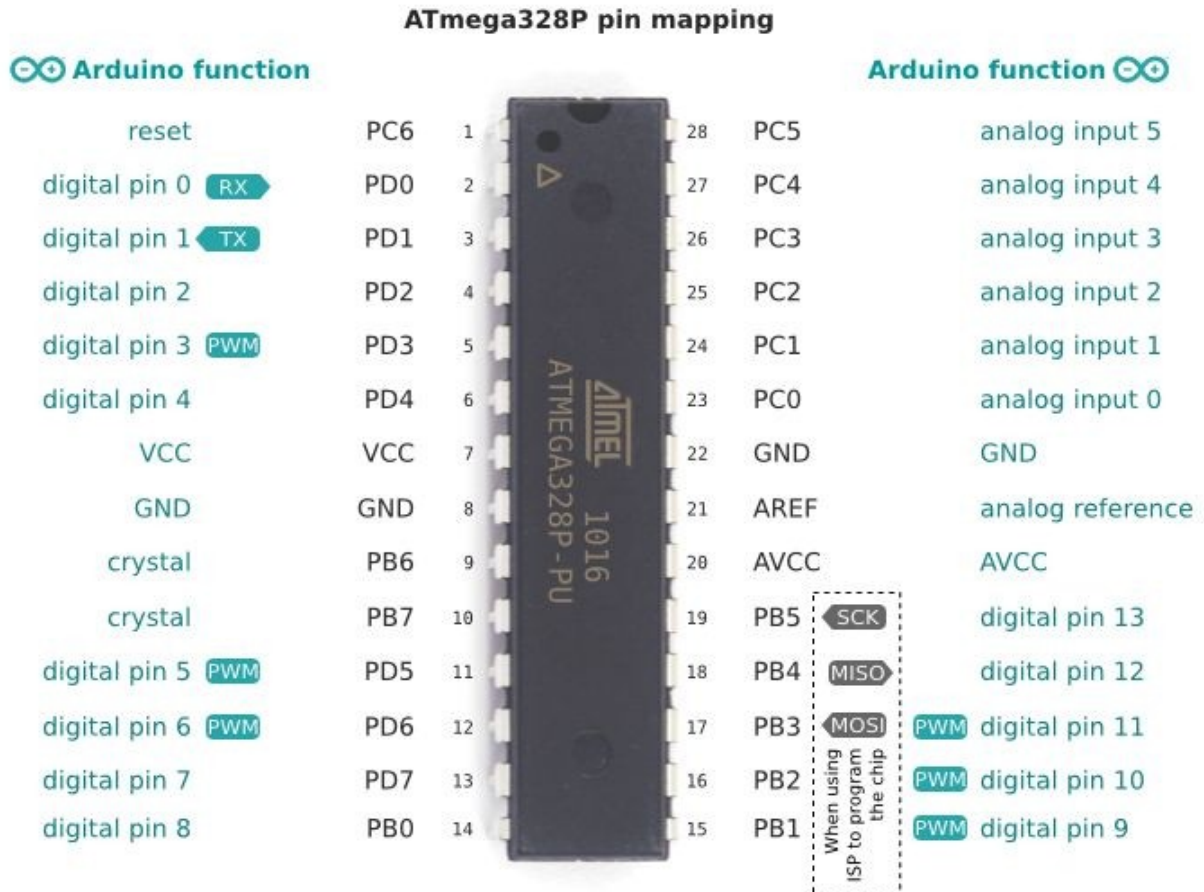
The operational amplifiers are frequently used ICs, similar to the audio amplifiers which are used for the audio amplification. These op-amps are used for the amplification purpose, and

These ICs work similar to the transistor\_amplifier circuits. The pin configuration of the 741 op-amp IC is shown in the above figure <sup>[13]</sup>

## 2.4 ATMEGA328P

The Atmel® Pico Power® ATmega328/P 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 ATmega328/P achieves throughputs close to 1MIPS per MHz this empowers system designed to optimize the device for power consumption versus processing speed <sup>[14]</sup>.

The ATmega328/P provides the following features: 32Kbytes of In-System Programmable Flash with Read-While-Write capabilities, 1Kbytes EEPROM, 2Kbytes SRAM, 23 general purpose I/O lines, 32 general purpose working registers, Real Time Counter (RTC), three flexible Timer/Counters with compare modes and PWM, 1 serial programmable USARTs, 1 byte-oriented 2-wire Serial Interface (I2C), a 6-channel 10-bit ADC (8 channels in TQFP and QFN/MLF packages) , a programmable Watchdog Timer with internal Oscillator, an SPI serial port, 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. The Power-down mode saves the register contents but freezes the Oscillator, disabling all other chip functions until the next interrupt or hardware reset. In Power-save mode, the asynchronous timer continues to run, allowing the user to maintain a timer base while the rest of the device is sleeping. The ADC Noise Reduction mode stops the CPU and all I/O modules except asynchronous timer and ADC to minimize switching noise during ADC conversions. In Standby mode, the crystal/resonator oscillator is running while the rest of the device is sleeping. This allows very fast start-up combined with low power consumption. In Extended Standby mode, both the main oscillator and the asynchronous timer continue to run. Reliability Qualification results show that the projected data retention failure rate is much less than 1 PPM over 20 years at 85°C. <sup>[15]</sup>



**Figure 2.5: Pin Configuration of ATmega328p<sup>[24]</sup>**

### 2.4.1 Pin Description

- VCC: Digital supply voltage
- GND: Ground.
- Port B (PB [7:0]) XTAL1/XTAL2/TOSC1/TOSC2: Port B is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port B output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port B pins that are externally pulled low will source current if the pull-up resistors are activated. The Port B pins are tri-stated when a reset condition becomes active, even if the clock is not running. Depending on the clock selection fuse settings, PB6 can be used as input to the inverting Oscillator amplifier and input to the internal clock operating circuit. Depending on the clock selection fuse settings,

PB7 can be used as output from the inverting Oscillator amplifier. If the Internal Calibrated RC Oscillator is used as chip clock source, PB [7:6] is used as TOSC [2:1] input for the Asynchronous Timer/Counter2 if the AS2 bit in ASSR is set.

- Port C (PC [5:0]): Port C is a 7-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The PC [5:0] output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port C pins that are externally pulled low will source current if the pull-up resistors are activated. The Port C pins are tri-stated when a reset condition becomes active, even if the clock is not running.
- PC6/RESET: If the RSTDISBL Fuse is programmed, PC6 is used as an I/O pin. Note that the electrical characteristics of PC6 differ from those of the other pins of Port C. If the RSTDISBL Fuse is not programmed, PC6 is used as a Reset input. A low level on this pin for longer than the minimum pulse length will generate a Reset, even if the clock is not running. Shorter pulses are not guaranteed to generate a Reset. The various special features of Port C are elaborated in the Alternate Functions of Port C section.
- Port D (PD [7:0]): Port D is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port D output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port D pins that are externally pulled low will source current if the pull-up resistors are activated. The Port D pins are tri-stated when a reset condition becomes active, even if the clock is not running.
- AVCC: AVCC is the supply voltage pin for the A/D Converter, PC [3:0], and PE [3:2]. It should be externally connected to VCC, even if the ADC is not used. If the ADC is used, it should be connected to VCC through a low-pass filter. Note that PC[6:4] use digital supply voltage, VCC
- AREF: AREF is the analog reference pin for the A/D Converter.
- ADC [7:6] (TQFP and VFQFN Package Only): In the TQFP and VFQFN package, ADC [7:6] serve as analog inputs to the A/D converter. These pins are powered from the analog supply and serve as 10-bit ADC channels. <sup>[16]</sup>

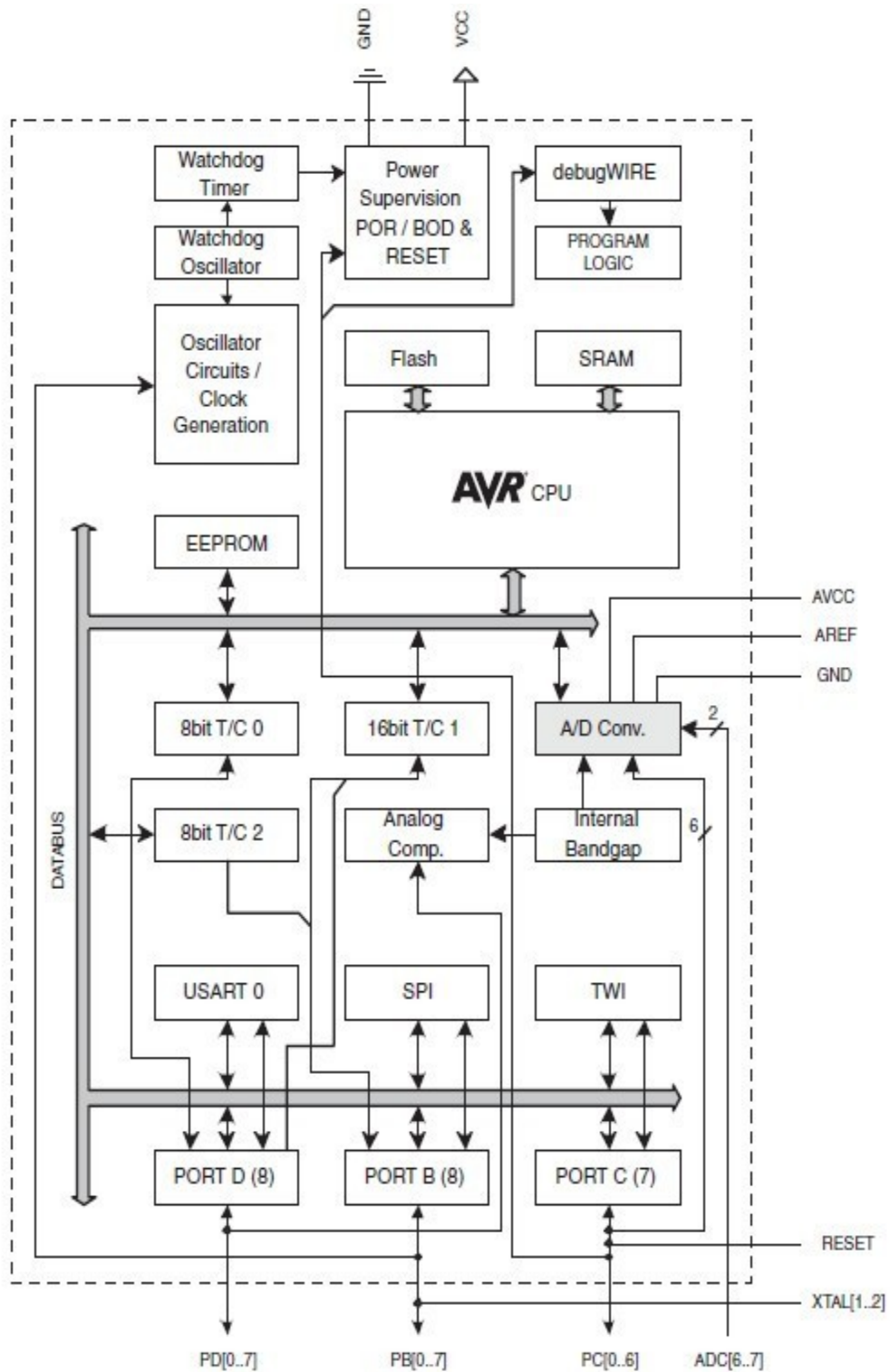


Figure 2.6: Block diagram of AVR Microcontroller <sup>[26]</sup>



## 2.5 Arduino

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital Input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega8U2 programmed as a USB-to-serial converter <sup>[17]</sup>



**Figure 2.7: Arduino Uno Board** <sup>[18]</sup>

The Arduino Uno can be powered via the USB connection or with an external power supply. The power source is selected automatically. External (non-USB) power can come either from an AC-to-DC adapter (wall-wart) or battery. The adapter can be connected by plugging a 2.1mm center-positive plug into the board's power jack. Leads from a battery can be inserted in the Ground and Vin pin headers of the POWER connector. The board can operate on an external supply of 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may be unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts.

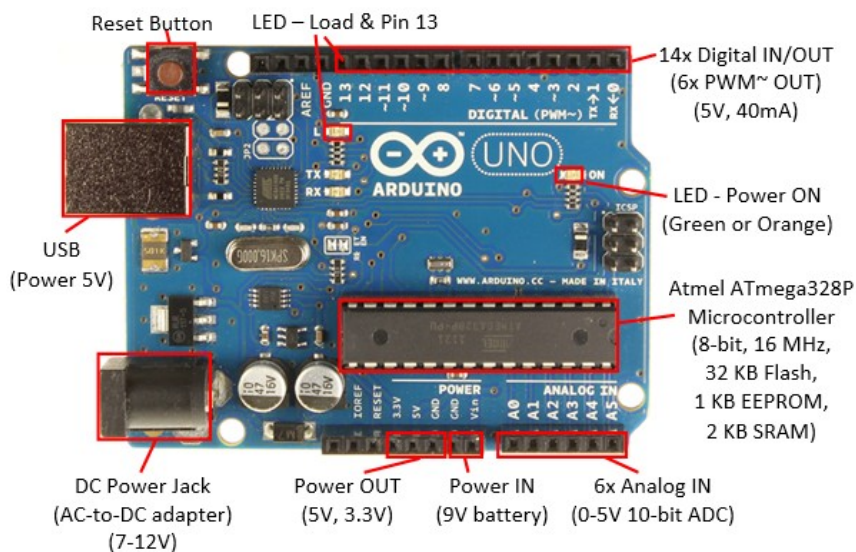
## 2.5.1 Power pins of Arduino

**VIN.** The input voltage to the Arduino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.

**5V.** the regulated power supply used to power the microcontroller and other components on the board. This can come either from VIN via an on-board regulator, or be supplied by USB or another regulated 5V supply.

**3V3.** A 3.3 volt supply generated by the on-board regulator. Maximum current draw is 50 mA.

**GND.** Ground pins. <sup>[19]</sup>



**Figure 2.8: Arduino Uno Specification** <sup>[27]</sup>

### Specification table:

Microcontroller	ATmega328
Operating Voltage	5V
Input Voltage	7-12V
Input Voltage (limits)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
Analog Input Pins	6
DC Current per I/O Pin	40mA
DC Current for 3.3V Pin	50Ma

## 2.5.2 Arduino Pin Mapping

In standard Orangutan and 3pi documentation, it uses the same convention that Atmel uses in its ATmega328 datasheet, referring to pins by their associated ports. For example, pin PD7 is pin 7 of port D. This convention is used because each port is controlled by its own AVR registers, and the bits of these registers correspond to individual pins.

The Arduino insulates the user from this level of detail, referring to the I/O pins as digital pins 0 to 13 and analog inputs 0 to 7. Note that this terminology can be a bit misleading since analog inputs 0 to 5 can also be used as general purpose digital I/O pins (referred to as digital pins 14 to 19). To see exactly how the mega168/328 pins are mapped to Arduino pins we have to visit their website. This page shows a 28-pin DIP package chip while the Orangutans carry smaller 32-pin MLF packages that contain two additional dedicated analog inputs: ADC6 and ADC7. In the Arduino environment, these pins become Arduino analog inputs 6 and 7, respectively <sup>[20]</sup>.

## Atmega328 Pin Mapping

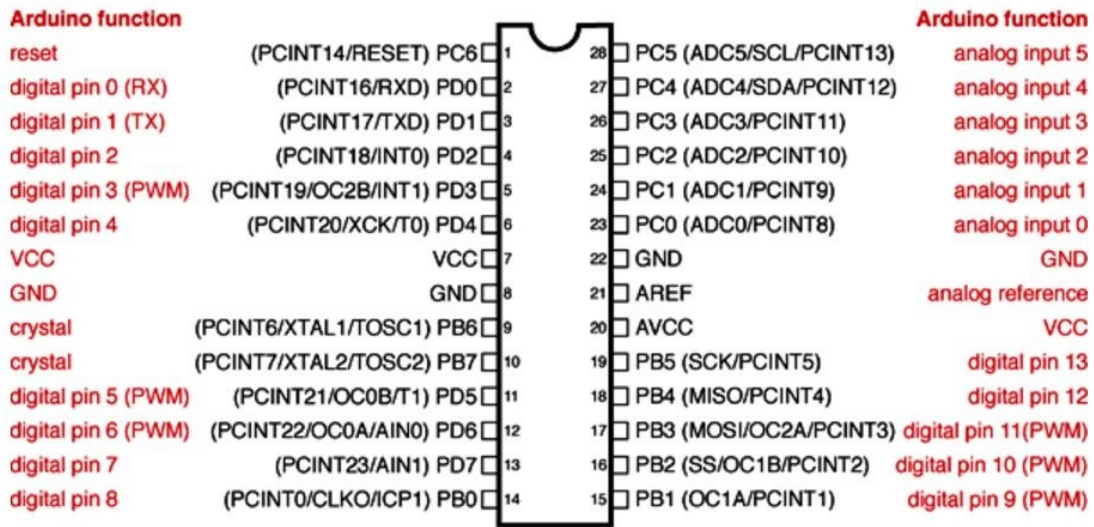
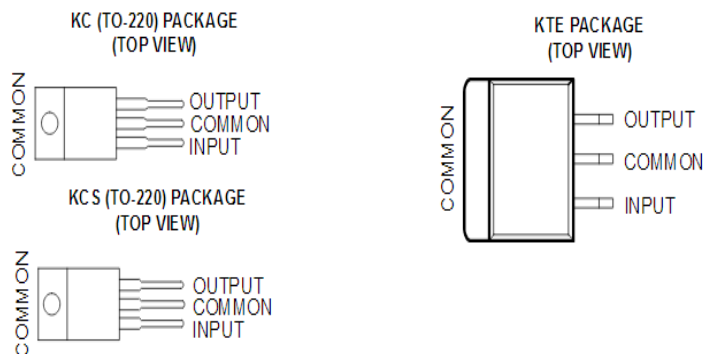


Figure 2.9: ATmega328P to Arduino Pin Mapping <sup>[21]</sup>.

### 2.5.3 Voltage Regulator LM7805

It is a 3-Terminal 1A Positive Voltage Regulator. This series of fixed-voltage integrated-circuit voltage regulators is designed for a wide range of applications. These applications include on-card regulation for elimination of noise and distribution problems associated with single-point regulation. Each of these regulators can deliver up to 1.5 A of output current. The internal current-limiting and thermal-shutdown features of these regulators essentially make them immune to overload. In addition to use as fixed-voltage regulators, these devices can be used with external components to obtain adjustable output voltages and currents, and also can be used as the power-pass element in precision regulators. <sup>[22]</sup>

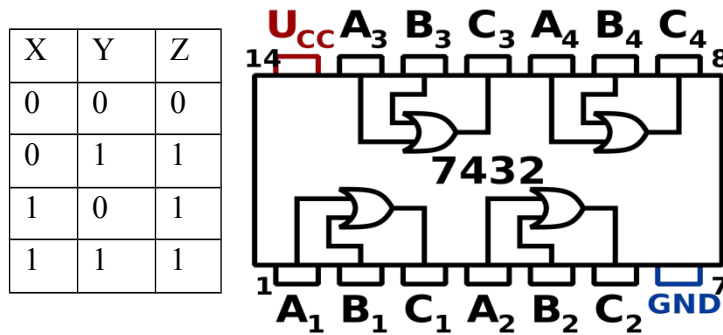


**Figure 2.10: Pin-configuration of LM785 Voltage Regulator** <sup>[29]</sup>

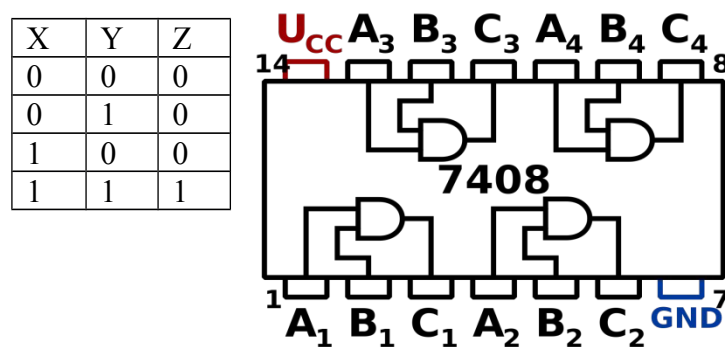
**Specification**

- 3-Terminal Regulators
- Output Current up to 1.5
- Internal Thermal-Overload Protection
- High Power-Dissipation Capability
- Internal Short-Circuit Current Limiting
- Output Transistor Safe-Area Compensation

**2.6 Different Type gate Description**

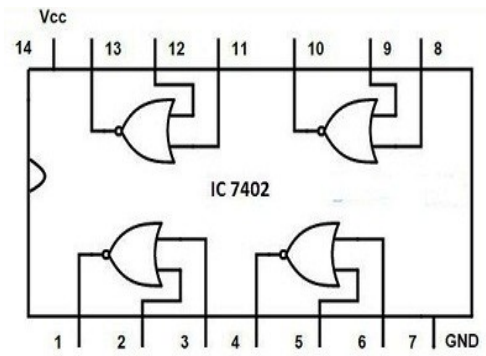


The OR gate output is at logic 1 when one or more of its inputs are at logic 1, otherwise the output is at logic 0.



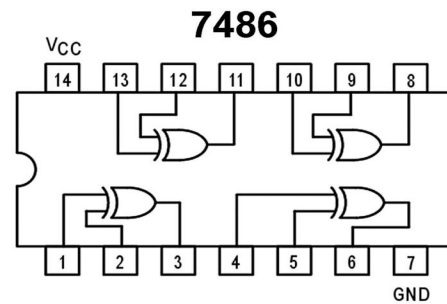
The AND gate output is at logic 1 when and only when all its inputs are at logic 1, otherwise the output is at logic 0.

X	Y	Z
0	0	1
0	1	0
1	0	0
1	1	0

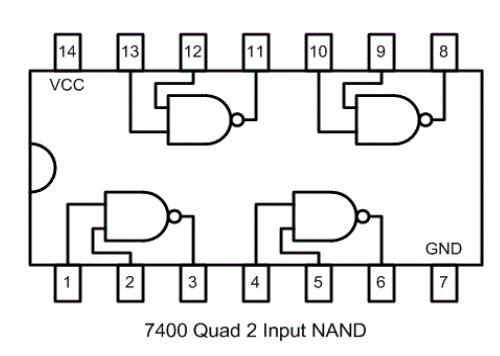


The NOR gate output is at logic 0 when one or more of its inputs are logic 1. If all the inputs are logic 0, the output is at logic 1.

X	Y	Z
0	0	1
0	1	1
1	0	1
1	1	0



The XOR gate output is at logic 1 when one and only one of its inputs is at logic 1. Otherwise the output is logic 0.



The NAND gate output is at logic 0 when, and only when all its inputs are logic 1, otherwise the output is at logic 1. [23]

## **CHAPTER 3**

### **DESIGN AND DEVELOPMENT**

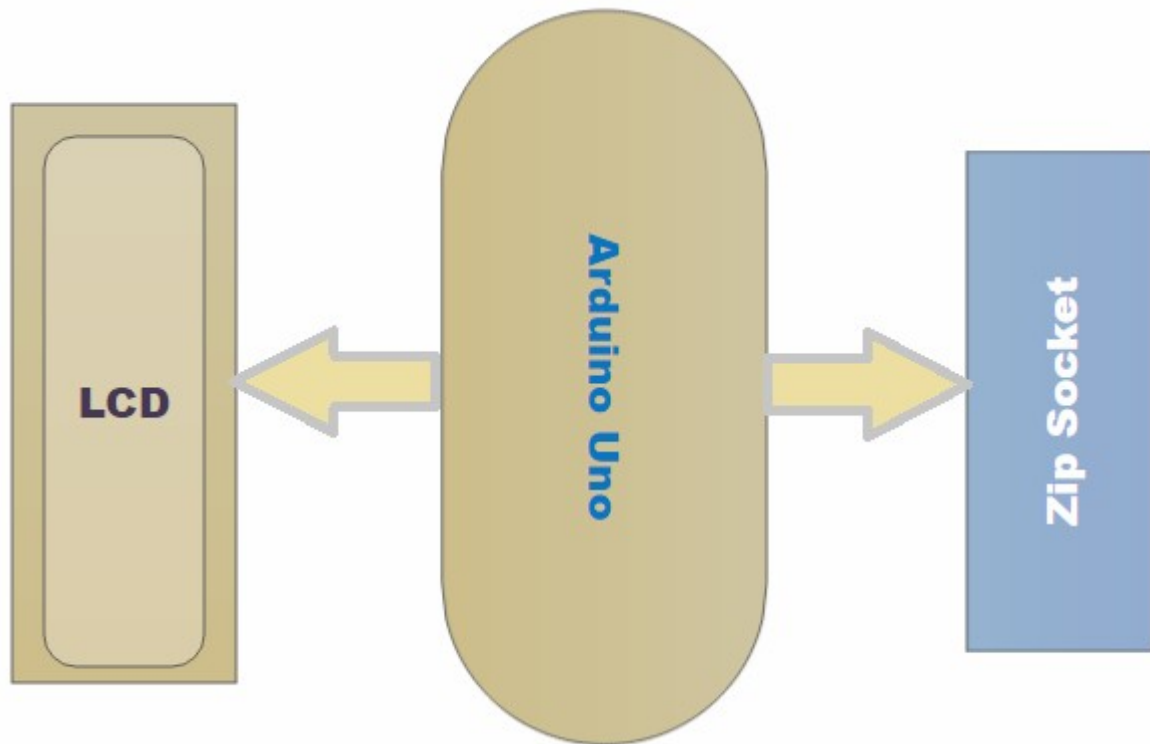
This chapter explains on how this project will be implemented. It included each process from the beginning until the end of this project. Each process and method of how software design and development will be performed in this project is explained in detail.

#### **3.1 Hardware Implementation**

In this section we have explained overall circuit connection for logical IC functional tester and showed all schematic diagrams of IC tester.

##### **3.1.1 Block diagram of project**

Here block diagram actually shows structural design circuit of ARDUINO based IC tester that's we have applied in our project. In our project we mainly used three components which are already showed in block diagram. The components are LCD display, ARDUINO, IC with ZIP socket. In this project ARDUINO is interacting with both LCD and zip socket.



**Figure 3.1: Block Diagram of IC tester**

### **3.1.2 LCD and Arduino**

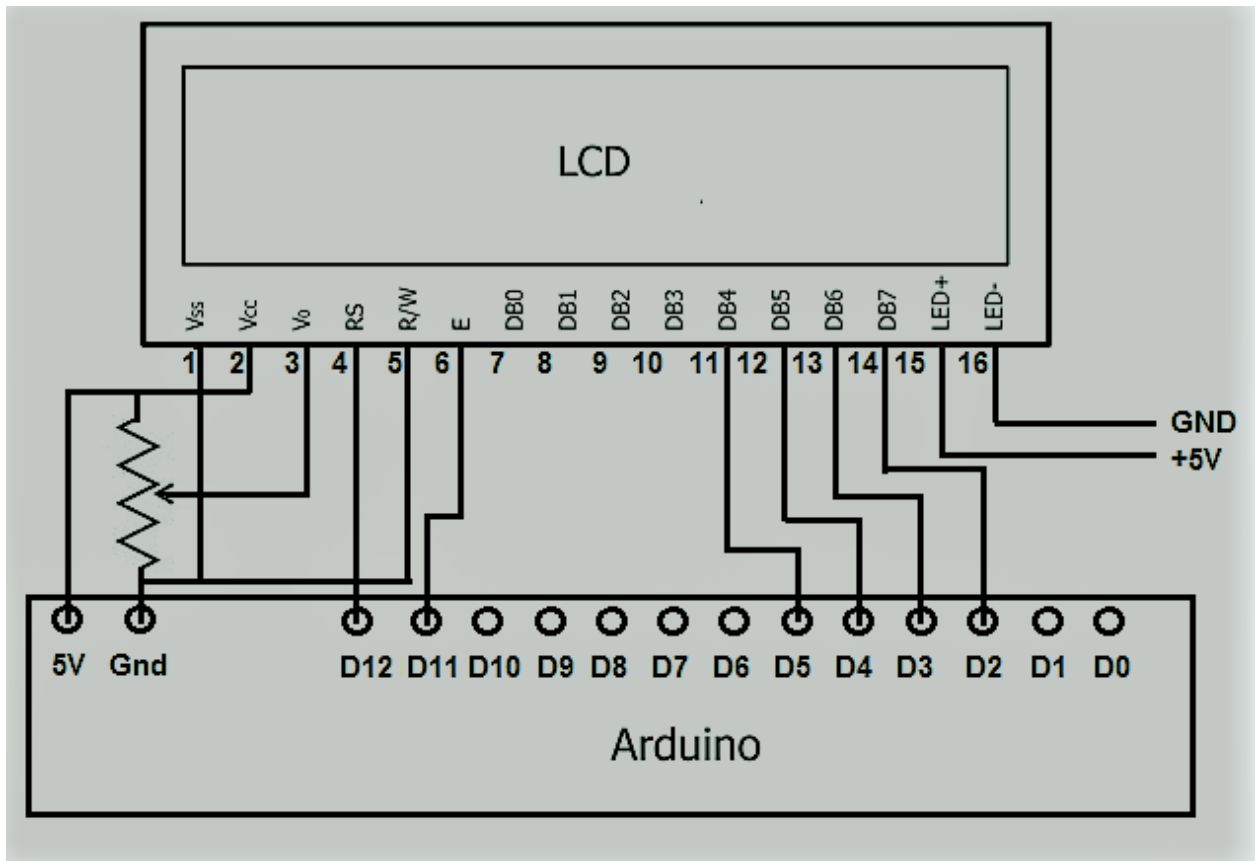
First part of our block diagram is LCD and Arduino. In this section we are going to describe functions of LCD and Arduino. We are also going to derive how both ARDUINO and LCD interacting at a time. Arduino acts as brain of circuit. It controlled LCD, serial to USB and ZIF socket by sending and receiving commands. Serial to USB converter is used to connect circuit and Personal Computer (PC) so data can be transmitted and received from PC to circuit. LCD allows us to show the output of the program.

### **3.1.3 Arduino and ZIF Socket**

Second part of the block diagram is Arduino interact with ZIF socket. ZIF socket is used for users place their model ICs that wish to test in the circuit. The output pin of the Arduino works as input pin of IC. The output pin of the IC connected in input pin of Arduino.

### **3.1.4 Arduino and LCD**

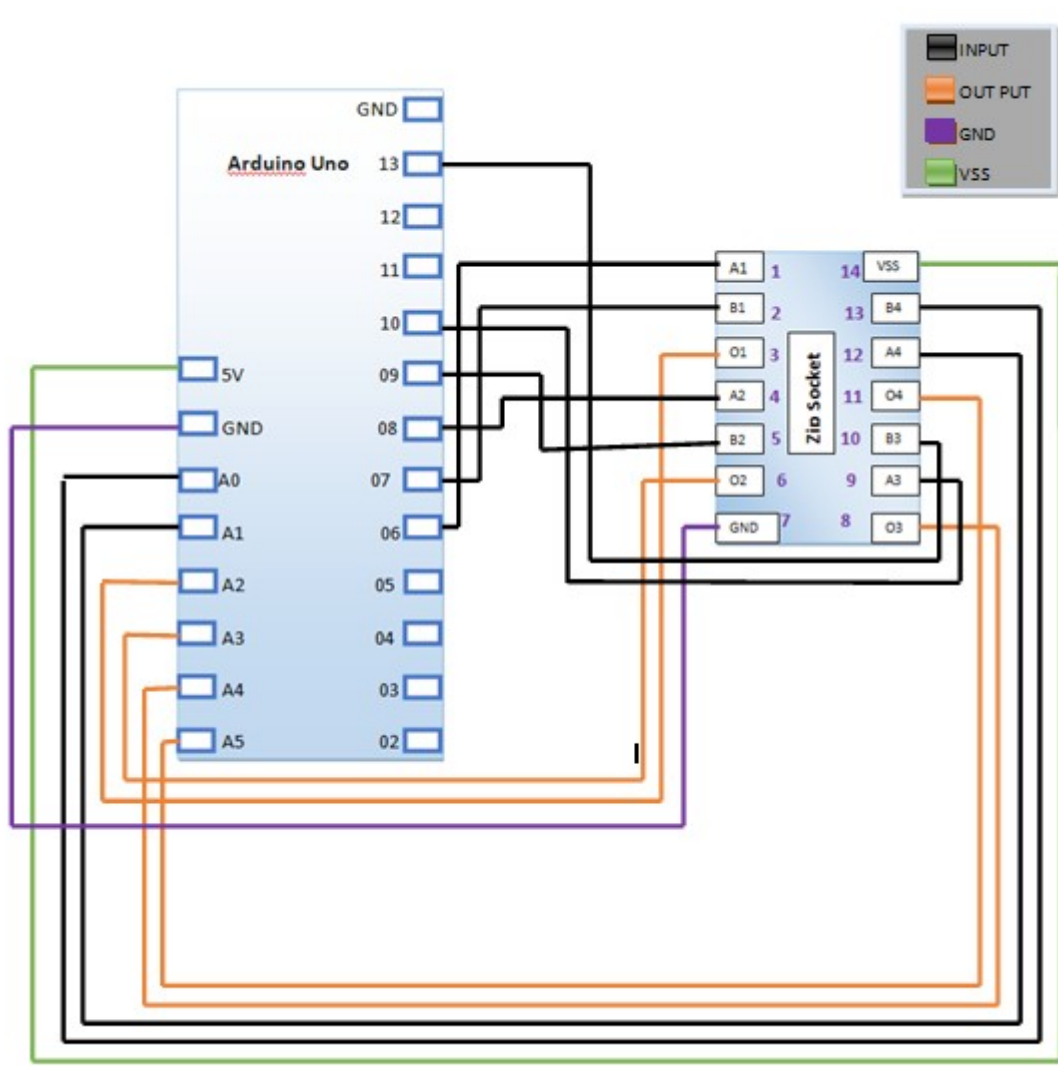




**Figure 3.2: Schematic Diagram of ARDUINO and LCD**

LCD ground pin VSS is connected with Ground pin of Arduino. The supply voltage of LCD pin VCC is connected with 5v pin of Arduino. LCD pin Vo is also connected with GND of Arduino where Vo pin use as adjust the contrast of the LCD. RS pin of LCD is connected with the digital pin 12 of Arduino. RS pin works for controlling our writing data in the LCD memory. R/W pin that selects reading mode or writing mode is connected with digital pin D11 of Arduino. Data bits pin of LCD DB4, DB5, DB6 and DB7 is connected with digital pin D5, D4, D3, D2 of Arduino. Data bit pins are used to send command or data to the LCD. The 15, 16 number pins of LCD are connected with 5v and GND respectively to on the LCD display.

### **3.1.5 Arduino and ZIF Socket**



**Figure 3.3: Schematic Diagram of Arduino and ZIF Socket**

Here we have explained the circuit connections between Arduino and ZIF socket. How both are actually works in our implemented project that's we are going to explain.

First of all, we are using ZIF socket so that user can insert and remove ICs from existing circuit.

This circuit diagram of this project design such a way so that we can check all major types IC of 74 series such as 7400, 7432, 7408 etc. In 74 series ICs have about 2 inputs 4 gate. For example, of 7432(OR) IC have 2 inputs 4 OR gate. That means internal schematic diagram of 7432 has designed with 4 OR gate where it has 8 inputs and 4 outputs pin. Total number of pin is 14 of 7432 IC. Extra 2 pins have used for VCC and GND.

Now first input pin of IC is connected with Arduino pin 6. Arduino Pin 6 considered as output pin of Arduino. We set it OUTPUT by coding command of Arduino. As a result, the value of OUTPUT pins of Arduino is input value of IC. 2<sup>nd</sup> input pin of IC is connected with Arduino pin 7. 3<sup>rd</sup> pin of IC is an OUTPUT pin of IC (for OR gate) is connected with Arduino analog pin A2. Similarly, IC pins 4, 5, 9, 10, 12, 13 are connected with Arduino pins 8, 9, 10, 13, A0, A1. Output pins of IC 6, 8, 11 are connected with A2, A3, A4, A5 pins of Arduino.

### **3.1.6 Full Schematic Diagram of IC Tester**

Here we have drawn full schematic diagram of IC tester. In this diagram we showed all connections of LCD and ZIF socket with Arduino. The output of the IC tester will display in LCD.

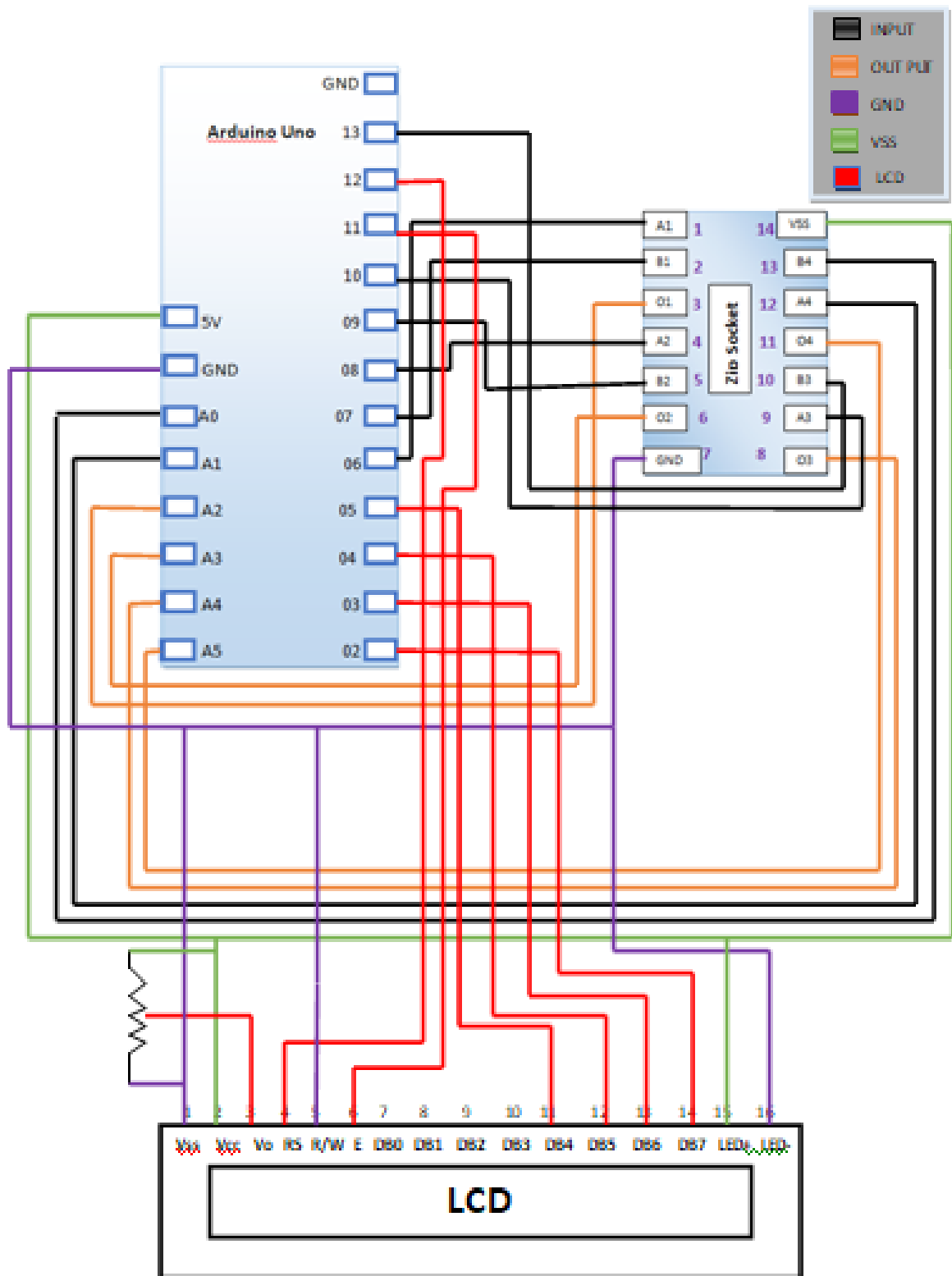


Figure 3.4: Schematic Diagram of IC tester

## 3.2 Software Implementation

In order to implement these design aims, it was first necessary to understand the logic IC functional tester. Hence, research and studies on the project need to be carried out. This is a programmable based project, so the tester can be totally control by programming must be designed. An unexpected condition may occur during the process and development so the knowledge about the corresponding solutions was attained through testing the application and trying each method.

### 3.2.1 Flow Char

The flowchart basically shows in detail how the project is programmed. The flow chart of the testing algorithm was then generated. All information about the software development methodology is available at this flow chart. The flow chart served as the basis for the source code written for the Arduino. After that, the source code will be programmed into the microcontroller. Testing and calibration will be done to make the IC tester perform optimally and correctly. Mistakes may be found then will be troubleshot and be corrected.

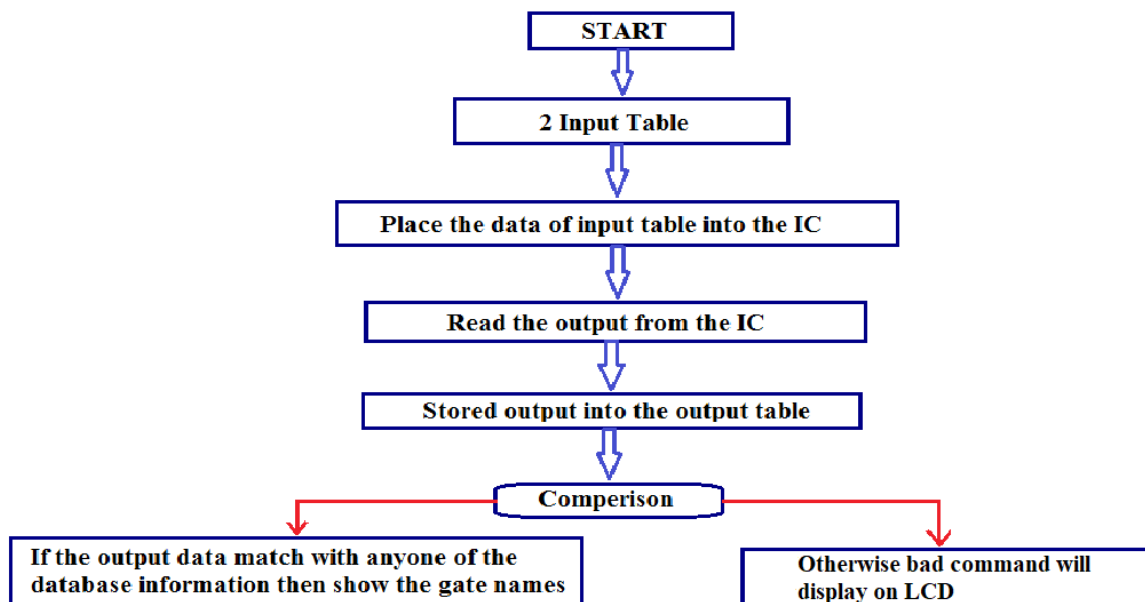


Figure 3.5: Flowchart of the IC tester

### 3.2.3 Operation

The IC tester has developed such a way so that it can be user friendly. Its every operation is understandable to the users. User will be able to check different types of IC manually by using this IC tester. Mainly IC tester is depending on the program beside the hardware implementation. Arduino is playing very important role in this project. Because it is interacting with both IC and LCD. The result of the IC tester will display on LCD. In this project implementation, we have used the concept of C programming language to develop the program in Arduino. After the hardware implementation, we need to upload corresponding code of the project. If we want to upload the program, first of all we need to connect the IC tester with PC by using USB cable of Arduino. Then we can upload the program easily into the IC tester by using uploading option of Arduino.

In programming implementation, we have used mainly three tables which are input table, output table of internal 4 gate of 74 series ICs and Database table where different types of output gates has stored there.

**Input table**

A	B	G1	G2	G3	G4
0	0	0	0	0	0
0	1	0	0	0	0
1	0	0	0	0	0
1	1	0	0	0	0
		1	1	1	1

**Output table**

First output table for 4 AND gate. Output table will change dynamically.

Here we have used 4 types of input combinations for two input gate such as AND, OR, NAND and X-OR gate of different types of IC. The combinations are 0,0 0,1, 1,0, 1,1 using in internal 4-gates of 74 series IC. Then we get the 4 output for 4-internal gates of IC according to the first input combination is 0,0. Similarly for 0,1 1,0 1,1 combinations we get the output of 4-internal gates in same way.

**Database Table**

AND	OR	NAND	NOR	XOR
0	0	1	1	0
0	1	1	0	1
0	1	1	0	1
1	1	1	0	0

**Table: Different types of output of Gate**

We create a database table where output of different types of gate such as AND, OR, NAND, X-OR has stored there. Then program compared the output value of gate1, gate2, gate3 and gate4 with database. After the comparison if the output value of gate1 is matched with any output gate of database such as AND gate, the program will send the results to the LCD. The result means LCD will display the gate name such as AND gate. If the output value is not matched with database table, BAD command will display on LCD. Similarly the program will check others three gate in same way. If the value of output matched with database, LCD will display the gate names.

## **CHAPTER 4**

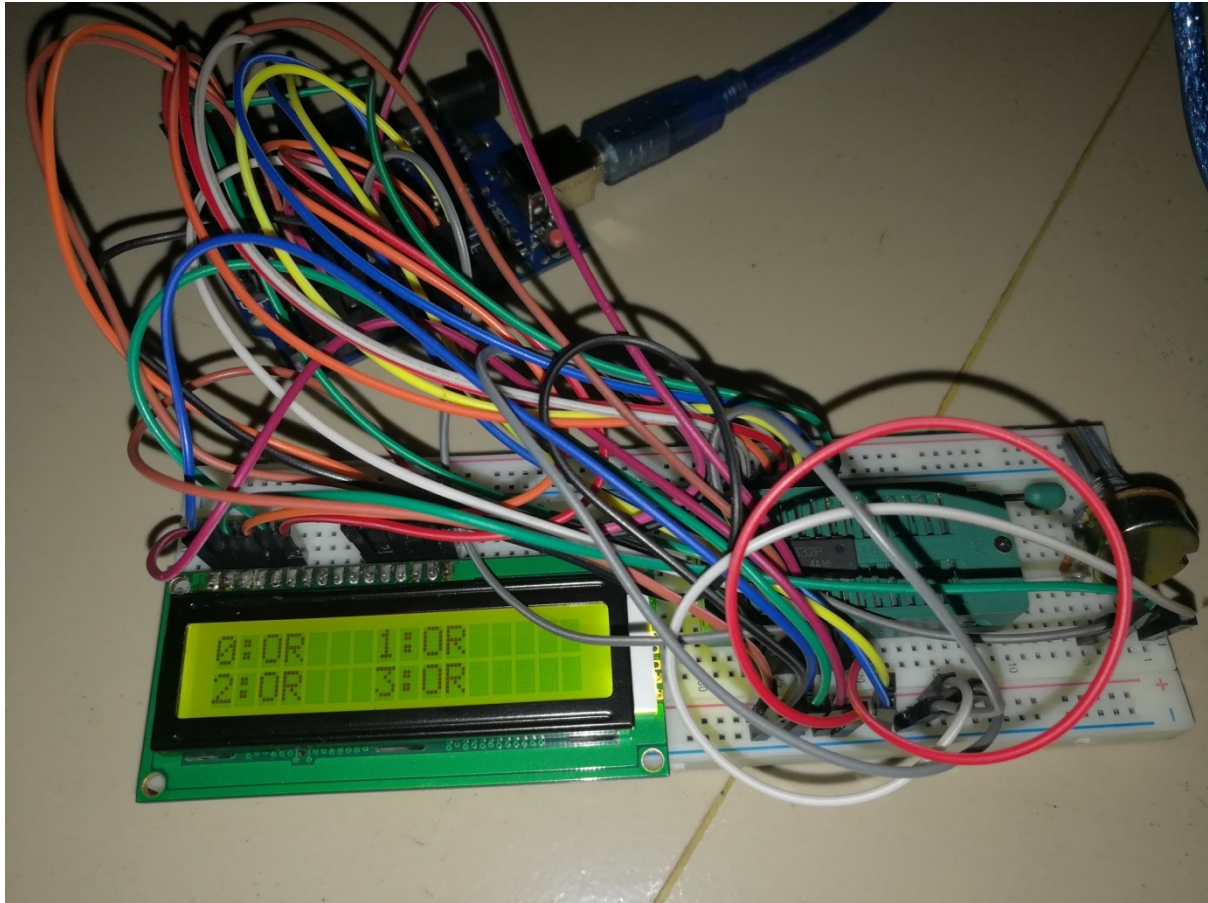
### **PERFORMANCE ANALYSIS**

All the apparatus of the system are connected according to the circuit diagram. The system has been tested different types of IC. IC tester is working correctly according to the logic designed within a second. Also IC tester is able to check both proper and defective IC properly. LCD display is showing the result according to the command. The detail implementation result of the system is describing below:

#### **4.1 OR GATE OF 7432 IC**

Here we have shown that IC tester is working properly for 7432 IC. IC tester have checked the all internal gates of IC and identified what kind of gates has been used to design its schematic diagram. Then it is showing the result on LCD display according to the program.



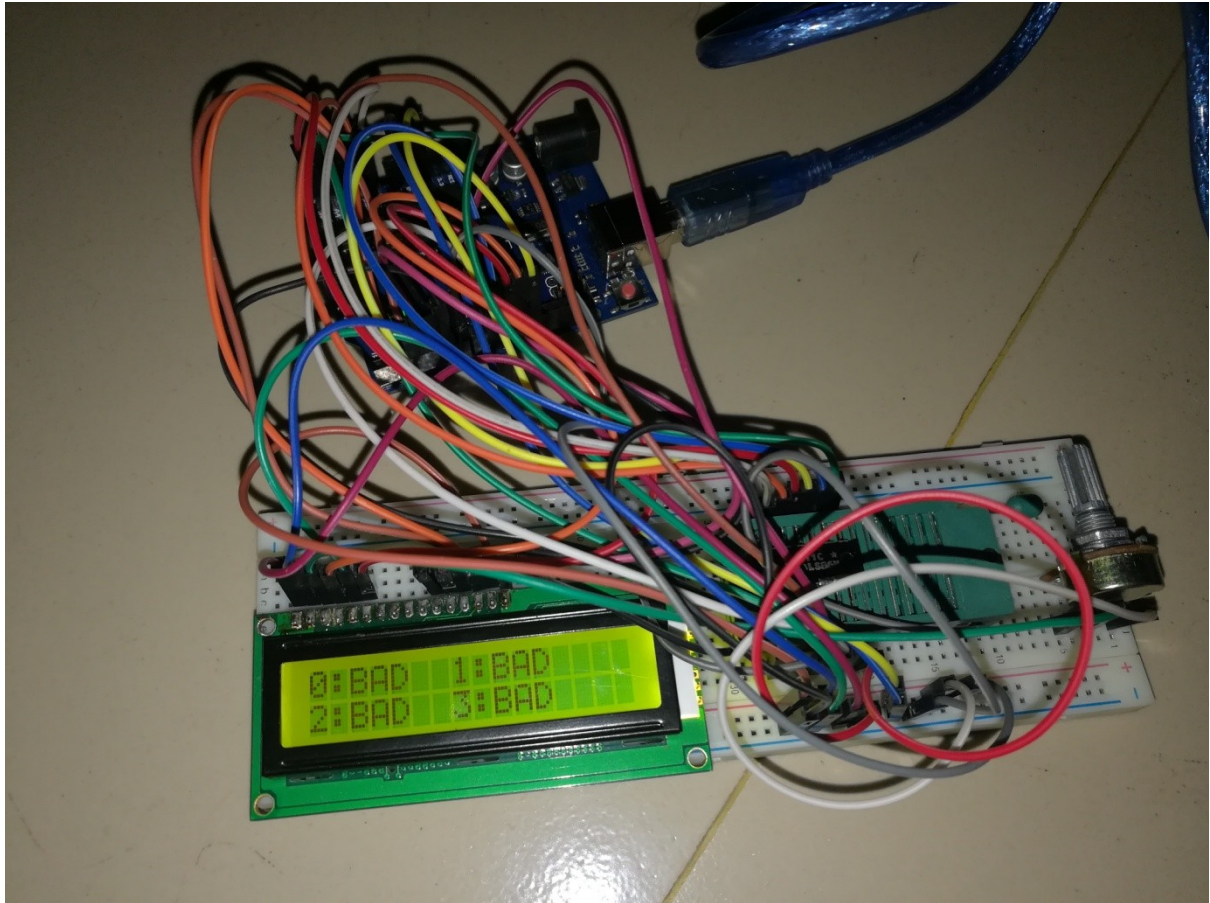


**Figure 4.1: Testing 7432(OR) IC**

Here we have seen that IC tester is showing 4 OR gate on LCD display that means every gates of that IC is okay.

## **4.2 Defective XOR gate of 7486 IC**

Here we have used the defective IC to test the IC tester so that we can ensure that IC tester is working properly. We have used the defective X-OR gate. IC tester has tested 4-internal gates of that IC and identified that every gate of that IC is defective. That's why BAD command is showing on LCD display according to the program.

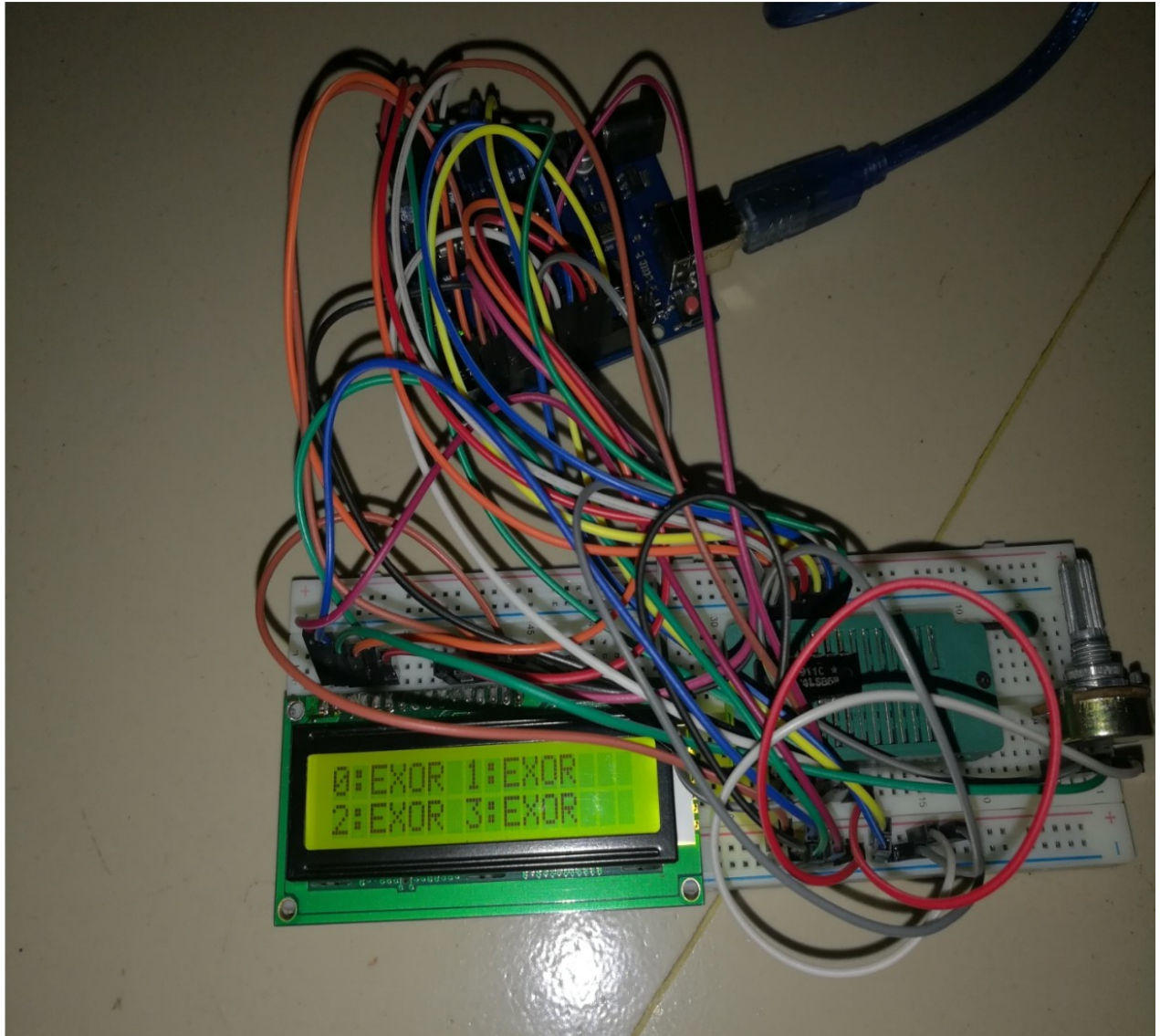


**Figure 4.2: Testing 7432(X-OR) IC**

### **4.3 X-OR gate of 7486 IC**

Similarly we have checked another IC which is X-OR gate. IC tester also checked its internal 4 gates and identified that all gates are okay of that IC. As a result it is showing the gates name of that IC. That means whole IC is okay because its 4 gates are okay.

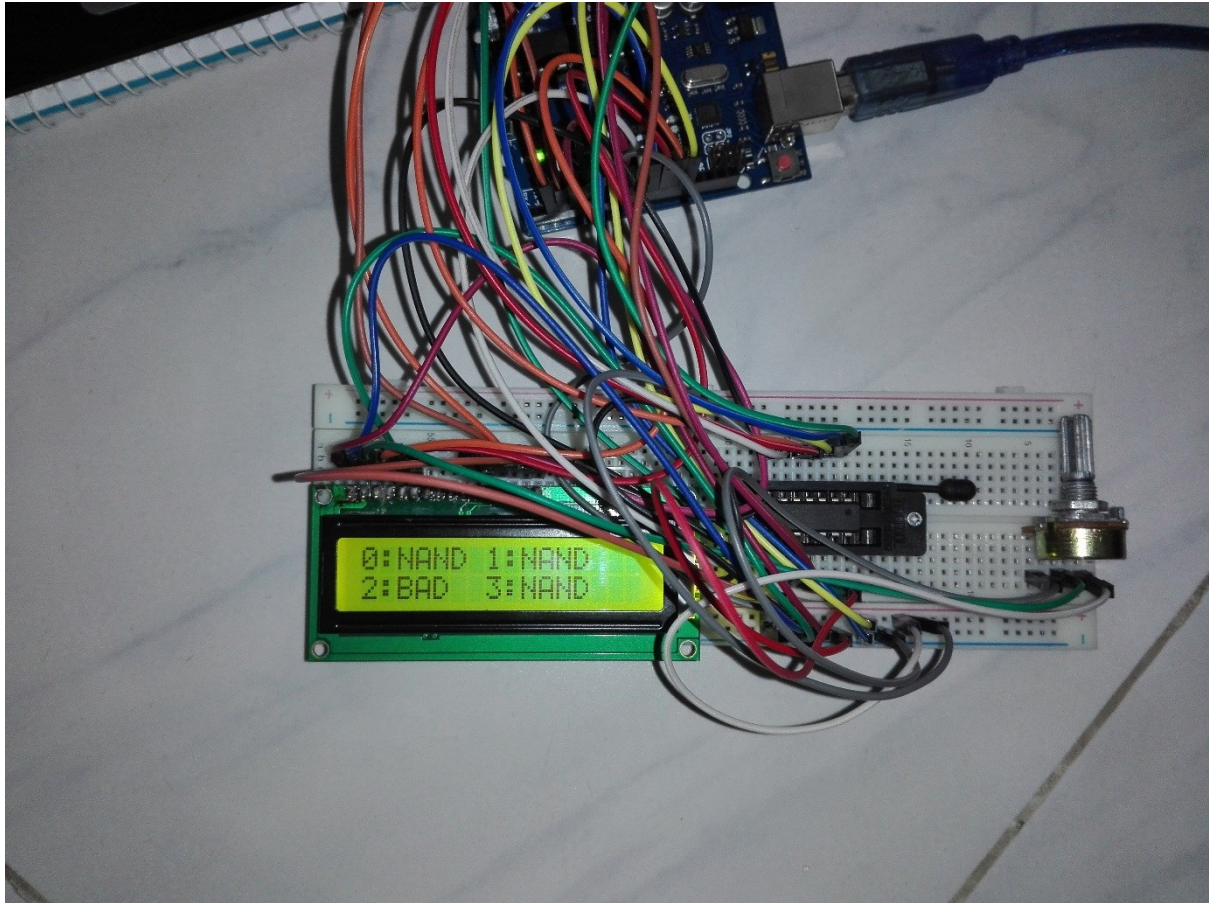




**Figure 4.3: Testing 7486(X-OR) IC**

#### **4.4 NAND gate of 7400 IC**

We have checked the 7400 IC which contain 4 two input NAND gate. IC tester have checked its 4 internal gates and identified that three gates are okay. But it also identified that 3 number gates is defective. As a result it shows bad command instead of gate names.

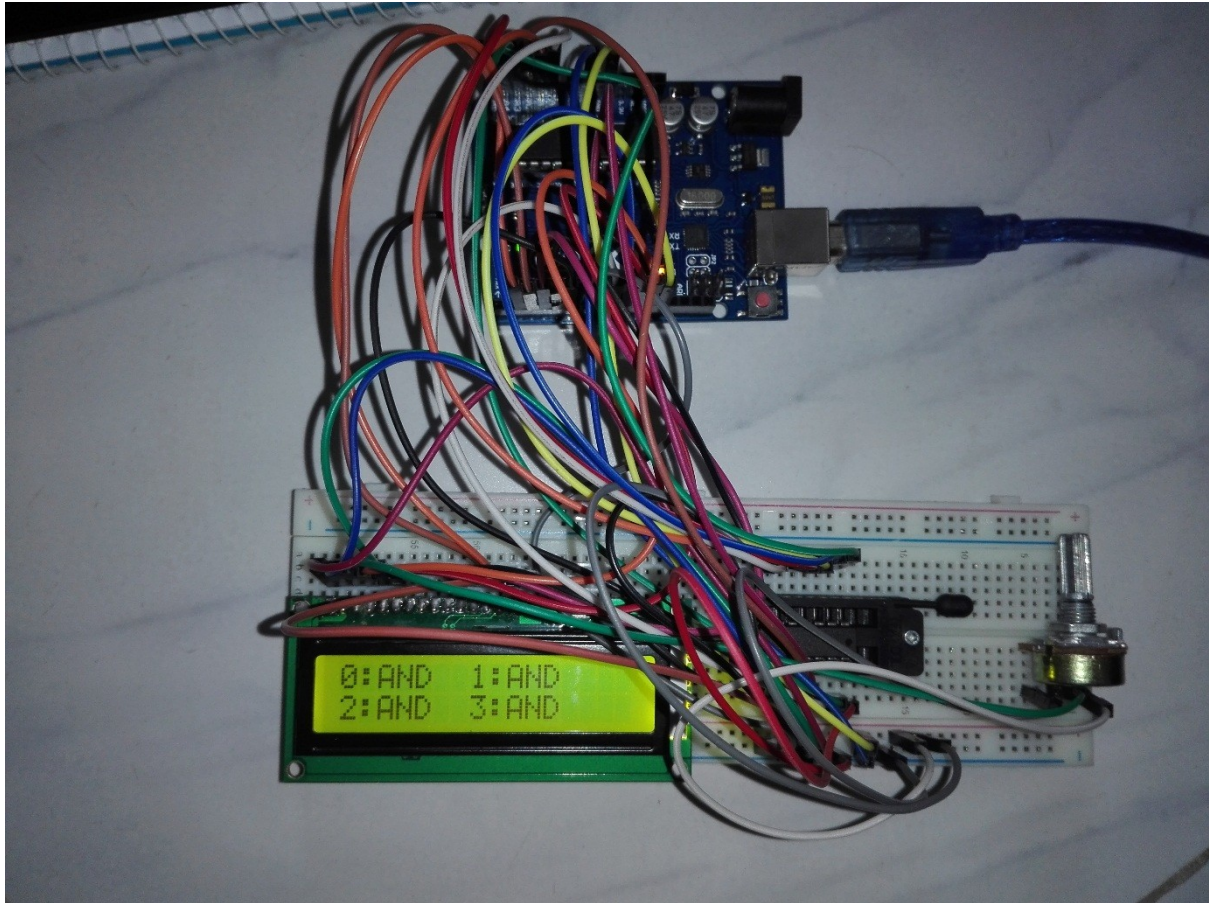


**Figure 4.4: Testing 7400(NAND) IC**

#### **4.5 AND gate of 7408 IC**

We have checked the 7408 IC which contain 4 two input AND gate. IC tester have checked its 4 internal gates and identified that all gates are okay. As a result it is showing the gates names. That means whole IC is okay.





**Figure 4.5: Testing 7408(AND) IC**

## **CHAPTER 5**

### **DISCUSSIN AND CONCLUSION**

After the several months of development and debugging, finally the project has been successfully completed. The project's aim and the main objectives have been accomplished properly. The Logic IC Functional tester is basically an Arduino -based project and gives response to the user within a few second. The Logic IC Functional tester is able to test basic gate (74LS08 AND, 74LS32 OR, 74LS00 NAND, 74LS86 XOR) of 14 pins. There have many ways to build an IC tester. But we have made the IC tester such a way so that it can be user friendly. Users just need to set up the IC on the ZIF socket properly. After that user will get desire result from the tester about IC. There have lots of projects on the IC tester but most of them are microcontroller based. Arduino based IC testers are rare. Some of the Arduino -based IC testers are also available but those are not so much user friendly and cost is too high with comparatively other project. We have used fewer components to accomplish our project. That's why our IC tester is looking very simple but effective.

#### **5.1 Challenges**

User can test only 4 IC by using the IC tester which has been made by us. That's the big limitation of that project. But there has a valid reason behind that limitation. Internal schematic diagram of 74LS08 AND, 74LS32 OR, 74LS00 NAND, 74LS86 XOR are same. But our main target was IC tester could check at least 8 IC. Internal schematic diagram of rest 4 IC are not same like 74LS08 AND. As a result, user will not be able to check others IC without valid IC for that project.

The easiest way to fix that problem is to modify the code. If user can modify the code then he or she will be able to check others IC like X-NOR and NOR. The main challenge of the project is how it can be made more effective for the user to check all of the 8 IC without modifying code. For this we need to do more research on that project and to find out a very good algorithm to fix this problem.

## **5.2 Future recommendation**

This project has an extremely large potential to be improved in many ways. The system has already been developed but much additional features can be built and integrated to this project so that it can work as a perfect whole. For example Keypad can be used in this project. If the user types the model number of ICs from keypad, IC tester will check all things of that IC. Finally it will collect the all information from database and it will check internal gates of that IC. Then result will be displayed on the LCD. On this way this project can be made more effective.

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# APENDIX A

## ATmega328P pin mapping

### Arduino function

- reset
- digital pin 0 **RX**
- digital pin 1 **TX**
- digital pin 2
- digital pin 3 **PWM**
- digital pin 4
- VCC
- GND
- crystal
- crystal
- digital pin 5 **PWM**
- digital pin 6 **PWM**
- digital pin 7
- digital pin 8



### Arduino function

- analog input 5
- analog input 4
- analog input 3
- analog input 2
- analog input 1
- analog input 0
- GND
- analog reference
- AVCC
- digital pin 13 **SCK**
- digital pin 12 **MISO**
- digital pin 11 **PWM**
- digital pin 10 **PWM**
- digital pin 9 **PWM**

When using ISP to program the chip

## APPENDIX B

```
// include the library code:
#include <LiquidCrystal.h>

// initialize the library with the numbers of the interface pins
LiquidCrystal lcd(12, 11, 5, 4, 3, 2);
int o1,i,j,k;
bool input[4][2]={0,0,0,1,1,0,1,1};
int output[5][4]={0,0,0,0,0,0,0,0,0,0,0,0,0,0,6,6,6,6};
bool f, db[4][5] = {0,0,1,1,0,0,1,1,0,1,0,1,1,0,1,1,1,0,0,0};

void setup() {
  // set up the LCD's number of columns and rows:
  //pinmode(output_pin, OUTPUT);
  pinMode(6,OUTPUT);
  pinMode(7,OUTPUT);
  pinMode(8,OUTPUT);
  pinMode(9,OUTPUT);
  pinMode(10,OUTPUT);
  pinMode(13,OUTPUT);
  pinMode(A0,OUTPUT);
  pinMode(A1,OUTPUT);
  pinMode(A4,INPUT);
  pinMode(A5,INPUT);
  pinMode(A2,INPUT);
  pinMode(A3,INPUT);
  Serial.begin(9600);
}

void loop() {
  //Give different input combinations from the input table and measure the outputs
  lcd.begin(16, 2);
  lcd.print("          ");
  lcd.setCursor(0,1);
  lcd.print("          ");
```

```

for(i=0;i<4;i++)
  output[4][i]=6;
for(i=0;i<4;i++)
{

  //Testing gate 1
  digitalWrite(6,input[i][0]);
  digitalWrite(7,input[i][1]);
  o1= digitalRead(A2);
  output[i][0]=o1;
  //lcd.print(o1);

  //Testing gate 2
  digitalWrite(8,input[i][0]);
  digitalWrite(9,input[i][1]);
  o1= digitalRead(A3);
  output[i][1]=o1;
  //lcd.print(o1);

  //Testing gate 3
  digitalWrite(10,input[i][0]);
  digitalWrite(13,input[i][1]);
  o1= digitalRead(A4);
  output[i][2]=o1;
  //lcd.print(o1);

  //Testing gate 4
  digitalWrite(A0,input[i][0]);
  digitalWrite(A1,input[i][1]);
  o1= digitalRead(A5);
  output[i][3]=o1;
  //lcd.print(o1);
  //delay(20);
}

```

```

//Comparing with data base
for(k=0;k<4;k++)//col of output
{
    for(i=0;i<5;i++)//index of col of db
    {
        f=1;
        for(j=0;j<4;j++)//row of output and db
        {
            if(output[j][k]!=db[j][i])
            {
                f=0;
                break;
            }
        }
        if(f==1) output[4][k]=i;
    }
}

for(i=0;i<4;i++)
{
    if(output[4][i]==0)
    {
        lcd.setCursor((i%2)*7,i/2);
        lcd.print(i);
        lcd.print(":AND ");
    }
    //printf("Gate %d %s\n",i+1,"AND");
    else if (output[4][i]==1)
    {
        lcd.setCursor((i%2)*7,i/2);
        lcd.print(i);
        lcd.print(":OR ");
    }
    //printf("Gate %d %s\n",i+1,"OR");
}

```

```

else if (output[4][i]==2)
{
    lcd.setCursor((i%2)*7,i/2);
    lcd.print(i);
    lcd.print(":NAND");
}
//printf("Gate %d %s\n",i+1,"NAND");
else if (output[4][i]==3)
{
    lcd.setCursor((i%2)*7,i/2);
    lcd.print(i);
    lcd.print(":NOR ");
}
//printf("Gate %d %s\n",i+1,"NOR");
else if (output[4][i]==4)
{
    lcd.setCursor((i%2)*7,i/2);
    lcd.print(i);
    lcd.print(":EXOR");
}
//printf("Gate %d %s\n",i+1,"EOR");
else
{
    lcd.setCursor((i%2)*7,i/2);
    lcd.print(i);
    lcd.print(":BAD ");
}
//printf("Gate %d %s\n",i+1,"BAD");
}
delay(5000);
}

```