A Project Report

On

" PASSWORD BASED HOME SECURITY "

Submitted in Partial Fulfillment of the Requirement Of

Project-III (BIT206CO)

Of

Bachelor of Information Technology

Submitted to:

Purbanchal University

Biratnagar, Nepal

Submitted by:

Sagar Upadhyaya (333659)

Shubham Ghimire (333661)

Ashim Sapkota (333638)

KANTIPUT CITY COLLEGE

Putalisadak, Kathmandu

March 23, 2023

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Project Supervisor

Er. Rabi Shrestha

KANTIPUT CITY COLLEGE

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CERTIFICATE OF TOPIC APPROVAL SHEET

It is hereby informed that the topic selected by Sagar Upadhyaya, Shubham Ghimire, and Ashim Sapkota of BIT third semester project has been found suitable and as per the credit assigned by Purbanchal University (PU), Biratnagar, Nepal. The Project Committee has approved the following topic and supervisor for the mentioned students. This project has been completed for the prescribed period and the project embodied the result of their investigation conducted during they worked as full-time student of this institution.

Topic Approved: Password Based Home Security

_____	_____
Er. Saroj Pandey	Er. Rabi Shrestha
HOD, Department of Information Technology	Project Supervisor
Kantipur City College	Kantipur City College

CERTIFICATE FROM SUPERVISOR

This is to certify that the project titled Password Based Home Security submitted by Sagar Upadhyaya, Shubham Ghimire, and Ashim Sapkota to the Department of Information Technology, School of Science and Technology at Kantipur City College, Kathmandu, Nepal towards the requirement for Project-III is an original work carried out by them under my supervision and guidance.

_____

Er. Rabi Shrestha
Department of Information Technology
Kantipur City College
(Project Supervisor)

ACKNOWLEDGEMENT

We would like to acknowledge all who have encouraged and inspired us directly or indirectly to complete this project. At first, we desire to express our deepest sense of gratitude to Purbanchal University for giving us the opportunity to present ourselves this report within the scheduled time.

We want to thank Kantipur City College for providing this opportunity by approving our project. We are incredibly grateful to our supervisor Er. Rabi Shrestha for continuously supporting and guiding us in our project and providing his valuable time to complete our project.

We also are very thankful to rest of the teacher who were also helpful for providing us the idea to prepare this project and for continuously motivating us to focus on our project.

We are fortunate enough to get the encouragement and feedback from our teachers and friends. Lastly, many thanks to all the people for their suggestions, feedback and support which was the most in completing our project successfully.

This project has been a wonderful experience where we have learnt and experienced many beneficial things.

With regards

Sagar Upadhyaya
Shubham Ghimire
Ashim Sapkota

ABSTRACT

Password Based Home Security is a password-based door locking system which is a security solution that restricts access to a specific area by verifying the correct password entered by the user. The system is comprised of a keypad that prompts the user to enter a pre-set password, which is then verified. If the password is correct, the system grants access to the user, otherwise, the door remains locked.

This system offers a range of benefits over traditional key-based systems, including increased security, convenience, and flexibility. Passwords can be easily changed, and the system can be programmed to grant access only to authorized individuals. Overall, a password-based door locking system is an effective and reliable security solution that offers a high level of protection against unauthorized access. By using strong passwords and implementing appropriate security measures, this system can provide peace of mind to homeowners, businesses, and other organizations.

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CHAPTER 1: INTRODUCTION

1. Introduction

Password Based Door Lock System using 8051 Microcontroller is a simple project where a secure password will act as a door unlocking system wherein once the correct code or password is entered, the door is opened, and the concerned person is allowed access to the secured area. If the password is wrong, then door would remain closed, denying access to the person.

1.1 Project Background

The need for security and access control has become increasingly important in today's society, with businesses, organizations, and homeowners seeking reliable and efficient solutions to safeguard their properties and assets. Traditional key-based locking systems have proven to be vulnerable to theft, tampering, and duplication, prompting the development of more sophisticated and advanced security measures such as biometric authentication, smart cards, and password-based systems.

A password-based door locking system is a popular security solution that has gained popularity due to its ease of use, flexibility, and reliability. The system uses a pre-set password to grant access to authorized users while denying entry to unauthorized individuals. This system is particularly useful for businesses and organizations that need to restrict access to sensitive areas such as data centers, server rooms, and confidential files.

The project aims to design and implement a password-based door locking system that can provide a high level of security and access control. The system will be designed to be user-friendly, reliable, and easy to maintain, using readily available components and technologies.

The project involves several stages, including research, design, testing, and implementation. The system is tested extensively to ensure that it meets the required standards and specifications.

Overall, the project will provide a valuable contribution to the field of security and access control, providing a reliable and efficient solution for businesses and organizations that need to protect their assets and sensitive information.

1.2 Project Significance

The password-based door locking system is a highly significant project with several important implications for the field of security and access control. Some of the most notable significance of this project include:

1. Improved Security: Password-based door locking systems provide a higher level of security than traditional key-based systems. This is because passwords can be easily changed and restricted to authorized users only, making it difficult for unauthorized individuals to gain access.
2. Convenience: Password-based systems are convenient to use since users do not need to carry keys around with them. Additionally, users can easily change their passwords when necessary, making it easy to maintain access control.
3. Cost-Effective: Password-based systems are cost-effective since they do not require expensive hardware or software. This makes them a practical solution for small businesses and homeowners.
4. Flexibility: Password-based systems are highly flexible and can be customized to meet the specific needs of individual users. For instance, passwords can be programmed to allow access to specific areas only or at specific times of the day.

1.3 Problem Solving Statement

Many building's, rooms require a secure door locking system to prevent unauthorized access. Traditional lock-and-key systems have limitations and can be easily compromised. To address this problem, a password-based door locking system can be implemented. However, the challenge is to design a system that is both secure and user-friendly, with an easy-to-use interface for setting and entering the password. The system should also be reliable, durable, and cost-effective to implement and maintain. Therefore, the problem statement is to design and develop a password-based door locking system that addresses these challenges and meets the security requirements.

1.4 Objectives

- To provide genuine security :

  The primary objective of a password-based door locking system is to provide security by allowing access only to authorized individuals who know the correct password. This prevents unauthorized access and helps to protect the contents of the building or room.

- To digitalize the locking system :

  Password-based door locking systems are often more convenient than traditional key-based systems, as users do not need to carry physical keys or worry about losing them. Instead, they only need to remember their password.

1.5 Features

- Secure password will act as a door unlocking system
- LCD display shows if the access is granted or not
- Multiple user support
- Buzzer makes alarming sound if wrong code entered

1.6 Team structure and roles

Team Members	**Task Performed**
Sagar Upadhyaya	Coding, Debugging and Hardware implementation
Shubham Ghimire	Logic development, Coding & Debugging, Research and Design
Ashim Sapkota	Research & Design and hardware implementation

CHAPTER 2: SYSTEM ANALYSIS

2.1 Literature Review

During our research we found some door locking project that has already been developed which varies in their working mechanism. Some were password based, some of them worked on fingerprint sensor, some worked on Movement Sensor, message verification and so on. But after overall research we choose to develop password based door locking system that suits our academic project using 8051 microcontroller.

Project References: Door Locking System

2.2 Feasibility Study

In a feasible study we performed feasibility analysis of a current system and the proposed system. Feasibility study is done in our project to identify the deficiencies in the current system and find the objective of the proposed system. There are many types of study that we have considered in our project. Following are the major study we performed while developing this project.

2.2.1 Technical Feasibility

Here we analyze the technical aspects of the project. The various technical aspects such as hardware and software were taken into consideration while developing this project. Further we also make sure that this software is feasible for the person who uses it.

2.2.2 Schedule Feasibility

In this feasibility study we prepared our planned Gantt chart according to our development model.

2.2.3 Economic Feasibility

Here we deal with the cost benefit of the project. Since this project is developed to meet our academic project, therefore there is no any refund.

2.2.4 Operational Feasibility

We develop this project with the minimum hardware specification tm make this project of low cost and affordable. The user will enjoy with this system which is easy to understand and operate by few steps.

2.3 Required Components

- 8051 Microcontroller

- 8051 Development Board
- 8051 Programmer
- 4×4 Matrix Keypad
- 16×2 LCD
- Electric Lock
- 10KΩ Potentiometer
- Connecting wires
- Power Supply

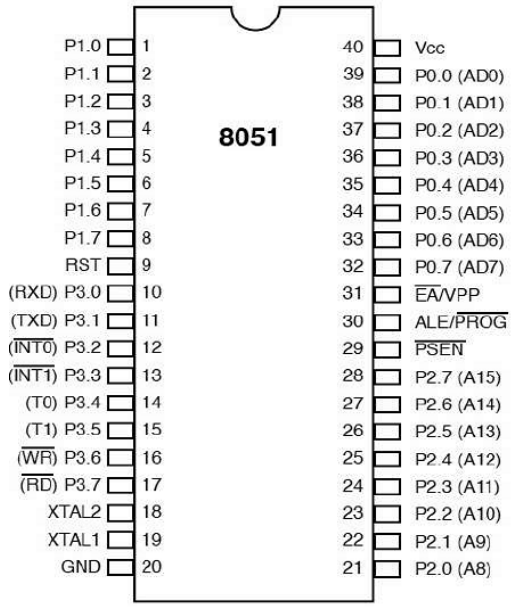
- 8051 Microcontroller

  The 8051 microcontroller is an 8-bit microcontroller that was first introduced in 1980 by Intel. It has been widely used in a variety of embedded systems, including automotive, industrial, medical, and consumer electronics applications.

  The 8051 microcontroller is based on a Harvard architecture, which means that it has separate memory spaces for program code and data. It has a simple and efficient instruction set with 111 instructions that operate on 8-bit data.

  The basic features of the 8051 microcontroller include:

  1. 4 KB of on-chip ROM (read-only memory) for program code storage.
  2. 128 bytes of on-chip RAM (random-access memory) for data storage.
  3. Four 8-bit I/O ports for connecting to external devices.
  4. Two 16-bit timer/counters for timing and counting applications.
  5. A serial communication interface (UART) for serial communication.
  6. Interrupt control circuitry for handling external and internal interrupts.

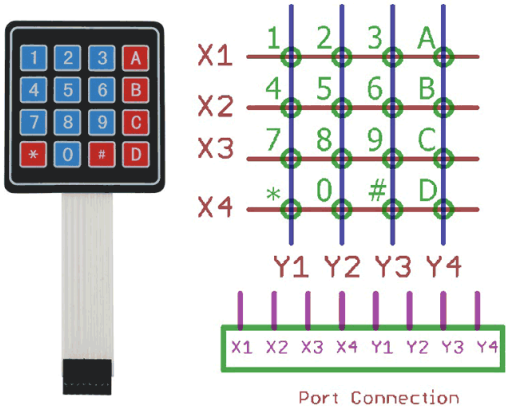


- 4*4 Matrix Keypad

  A 4x4 matrix keypad is a commonly used input device in electronics projects, which provides a simple way to get user input. It consists of a 4x4 grid of buttons, with each button corresponding to a unique combination of row and column. Here's how it works:

  Each button is connected to a specific row and column of the matrix. When a button is pressed, it creates a connection between the corresponding row and column lines. By scanning through each row and checking which column lines are connected, the microcontroller can determine which button was pressed.

  To use a 4x4 matrix keypad with a microcontroller, you need to connect the row and column lines to the microcontroller's GPIO pins. You can then use software to scan through the rows and check which column lines are connected to detect which button was pressed.



- Electric Lock

  An electric lock is a type of lock that can be operated using an electrical current. It's commonly used in access control systems, such as in homes, offices, and other secure areas.

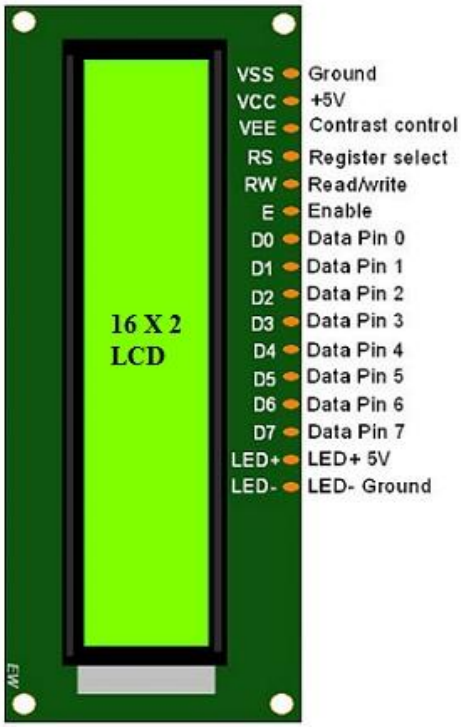
  To use an electric lock, you need to install it in the door frame and connect it to a power source, such as an electrical outlet or battery. You also need to connect it to a control system, such as a keypad to control when the lock is activated.

  Overall, electric locks provide a convenient and secure way to control access to a space, and can be a good option for home or business security.

- 16*2 LCD

A 16*2 LCD (Liquid Crystal Display) is a type of alphanumeric display that can display 16 columns and 2 rows of characters. Each character is made up of a matrix of pixels that can be turned on or off to create the desired character or symbol.

To use a 16*2 LCD, you typically need to connect it to a microcontroller that will send it the necessary data and commands to display the desired characters or symbols. The LCD itself typically has a built-in controller chip that handles the low-level details of driving the individual pixels, so you don't need to worry about the details of how the display works.



2.4 Applications of Password Based Door Lock System

Password-based door locking systems have a wide range of applications in various fields such as :

1. Residential: Password-based door locking systems can be used in homes to provide a convenient and secure way for homeowners to enter their homes without needing to carry a physical key.
2. Commercial: Many businesses use password-based door locking systems to control access to their buildings or specific areas within the building, such as storage rooms or employee-only areas.
3. Educational: Schools and universities use password-based door locking systems to secure classrooms, laboratories, and other areas within the campus.
4. Healthcare: Password-based door locking systems can be used in healthcare settings, such as hospitals or clinics, to control access to sensitive areas, such as patient records or medication storage rooms.
5. Hospitality: Hotels and resorts use password-based door locking systems to provide secure access to guest rooms and other areas within the facility.
6. Government: Password-based door locking systems are used in government buildings to control access to secure areas, such as offices or data centers.
7. Industrial: Password-based door locking systems can be used in industrial settings, such as factories or warehouses, to control access to equipment or inventory storage areas.

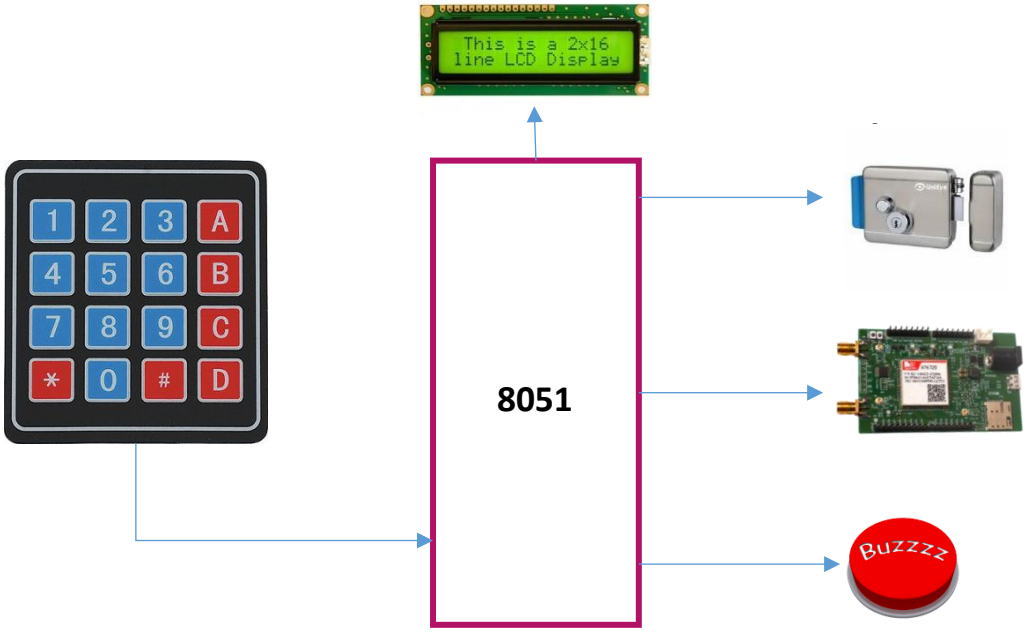
Overall, password-based door locking systems are a versatile and secure solution for controlling access to various types of buildings and areas.

2.5 Working Principle

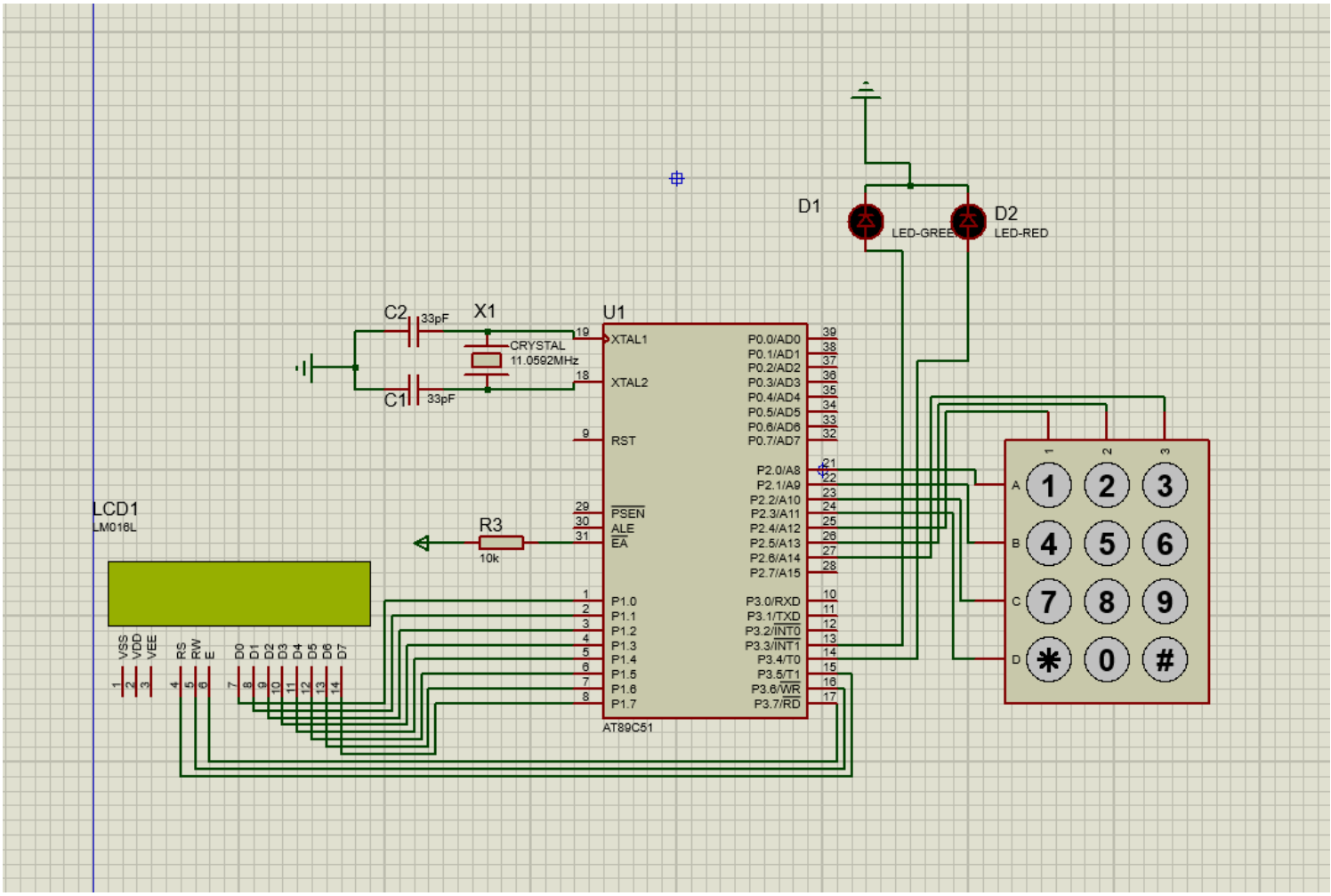
- The main component in the circuit is 8051 controller. In this project, a 4×4 Matrix Keypad is used to enter the password.
- If entered password is matched with the pre stored data of the memory of the microcontroller then electric lock will function to run in a specific direction required for opening the door
- If the entered password doesn't match with the pre stored password then the door remains locked and the buzzer makes alarming sound.

CHAPTER 3: SYSTEM DESIGN

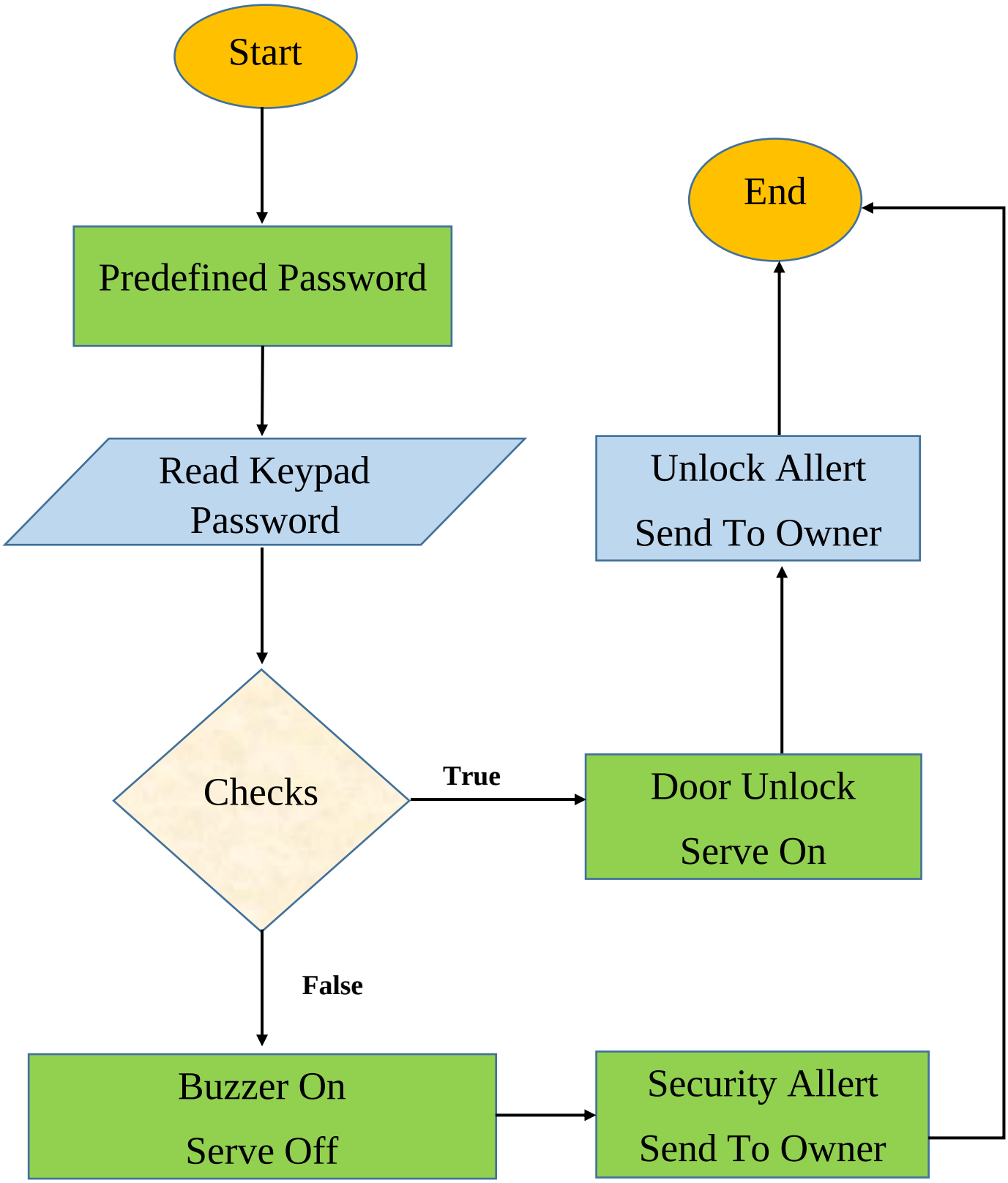
3.1 Block Diagram



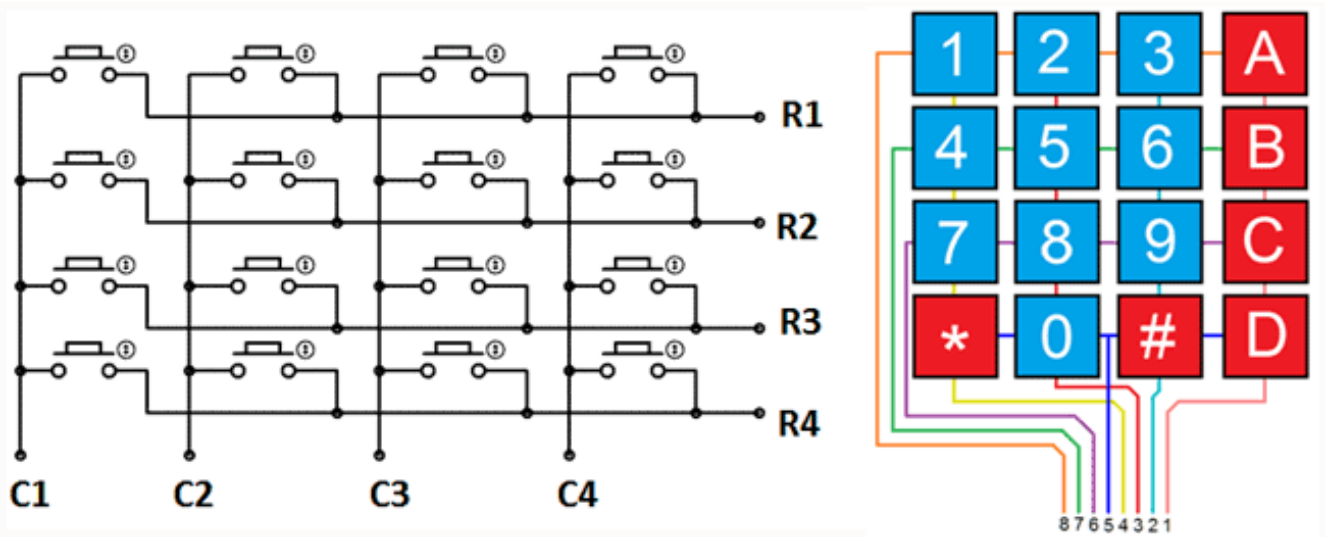
3.2 Circuit Diagram



3.3 Flowchart



3.4 Keypad Working Principle



3.5 Gantt Chart

Task Name	2022-2023					
	October 1	November 1	December 1	January 1	February 1	March 23
System Analysis						
System Design						
System Implementation						
Debugging and Testing						
Documentation						

CHAPTER 4: SYSTEM DEVELOPMENT AND IMPLEMENTATION

4.1 Programing platform (Tools and technologies used)

4.1.1 Software Specifications

Computer software specification we have used for development:

- Operating System: Windows 10
- Software: Keil and Proteus
- Programming Language: C

4.1.2 Hardware Specifications

Computer hardware specification we have used for development:

- Processor: core-i7
- RAM: 8GB
- HDD: 1 TB

CHAPTER 5: TESTING AND DEBUGGING

Testing no.	Testing objective	Problem	Solution
1	Check if the 16*2 LCD display is working properly	High contrast text output	Use of potentiometer solved contrast problem
2	Check if keypad is working properly	Multiple input can be detected while pressing the key once	Adding delay while taking input solved this problem
3	Check if buzzer is working properly	Buzzer did not make sound when user input wrong password	Buzzer with low voltage requirement was added instead of high one

CHAPTER 6: CONCLUSION AND FUTURE ENHANCEMENT

6.1 Conclusion

In conclusion, a password-based door locking system can provide a level of security to a building or room. It requires the user to input a correct password to gain access, which can prevent unauthorized access by individuals who are not authorized to enter.

However, the security level of such a system depends heavily on the strength and complexity of the password chosen by the user. Weak or easily guessable passwords can compromise the security of the system, while strong passwords can greatly enhance its effectiveness.

Additionally, password-based systems can have their limitations, such as the potential for forgotten or lost passwords, the need for frequent password updates, and the potential for hacking attempts.

Overall, a password-based door locking system can be a useful tool in providing security, but it should be implemented thoughtfully and with appropriate measures to ensure its effectiveness and reliability.

6.2 Future enhancement

- We will make it more effective adding more security modules

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APPENDIX

Product Name: 16x2 Character LCD Display Module

Description: A liquid crystal display module that can display 16 columns of 2 rows of characters.

Specifications:

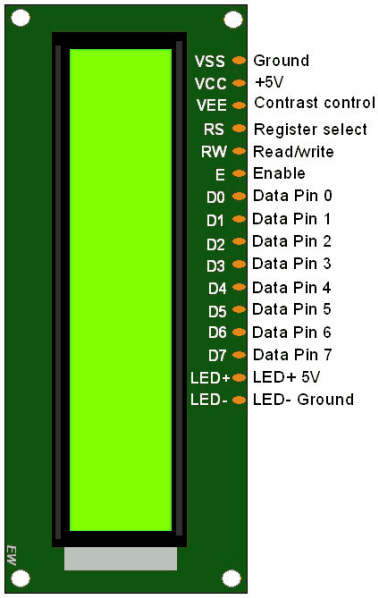
- Display format: 16 characters x 2 lines
- Character size: 5mm x 8mm
- Viewing area: 64.5mm x 14.5mm
- Dot size: 0.55mm x 0.55mm
- Dot pitch: 0.60mm x 0.60mm
- Duty cycle: 1/16
- Operating voltage: 4.5V to 5.5V
- Operating temperature: -20°C to +70°C
- Storage temperature: -30°C to +80°C
- Controller: HD44780 or equivalent
- Backlight: LED or EL

Features:

- Easy to use interface with 4-bit or 8-bit parallel interface
- Supports multiple languages including English, Chinese, Japanese, and Korean
- Built-in character set includes 208 characters
- Custom characters can be programmed
- Backlight can be turned on or off
- Low power consumption
- RoHS compliant

Applications:

- Industrial control systems
- Office automation equipment
- Medical instruments
- Automotive electronics
- Consumer electronics



Product Name: 4x4 Matrix Keypad

Description: A 16-button keypad designed for use with microcontroller projects.

Specifications:

- Dimensions: 69mm x 76mm x 9mm
- Weight: 12g
- Operating Voltage: 5V
- Maximum Current: 30mA
- Key Pins: 8 (4 rows, 4 columns)
- Output: Digital signal via keypad matrix

Features:

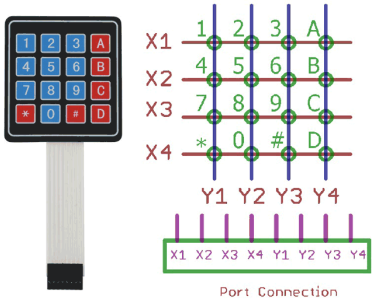
- 16 keys with a 4x4 layout
- Low power consumption
- Compact and easy to use
- No additional hardware required
- Durable and long-lasting design

Applications:

- Microcontroller projects
- Robotics
- Security systems
- Access control
- Automation

Certifications:

- RoHS
- CE



Product Name: Electric Lock

Description: A compact electric lock designed for use with microcontrollers, ideal for use in projects such as home automation systems, security systems, and access control systems.

Specifications:

- Power supply: 5V DC
- Maximum current draw: 300mA
- Operating temperature: -20°C to 60°C
- Material: Stainless steel
- Finish: Brushed metal
- Dimensions: 1.5 inches x 1.5 inches x 0.5 inches
- Weight: 0.5 pounds
- Lock mechanism: Solenoid
- Compatibility: Compatible with most microcontrollers, including Arduino and Raspberry Pi

Features:

- Low power consumption for efficient operation with microcontrollers
- Solenoid lock mechanism for secure locking and unlocking
- Can be controlled with digital signals from a microcontroller
- LED indicator for lock status
- Easy to install and integrate with microcontroller projects
- Suitable for use in small spaces

Applications:

- Home automation systems
- Security systems
- Access control systems
- Smart lock systems

Certifications:

- CE
- RoHS

80C51 8-bit microcontroller family 4K/8K/16K/32K Flash

89C51/89C52/89C54/89C58

DESCRIPTION

The 89C51/89C52/89C54/89C58 contain a non-volatile FLASH program memory that is parallel programmable. For devices that are serial programmable (In System Programmable (ISP) with a boot loader), see the 89C51RC+/89C51RD+ datasheet.

Both families are Single-Chip 8-bit Microcontrollers manufactured in advanced CMOS process and are derivatives of the 80C51 microcontroller family. All the devices have the same instruction set as the 80C51.

SELECTION TABLE FOR FLASH DEVICES

ROM/EPROM Memory Size (X by 8)	RAM Size (X by 8)	Programmable Timer Counter (PCA)	Hardware Watchdog Timer
Multi-Time Programmable (MTP) devices:			
89C51			
4 k	128	No	No
89C52/54/58			
8 k/16 k/32 k	256	No	No
Serial In-System Programmable devices:			
89C51RC+			
32 k	512	Yes	Yes
89C51RD+			
64 k	1024	Yes	Yes

FEATURES

- 80C51 Central Processing Unit
- On-chip FLASH Program Memory
- Speed up to 33 MHz
- Full static operation
- RAM expandable externally to 64 k bytes
- 4 level priority interrupt
- 6 interrupt sources
- Four 8-bit I/O ports
- Full-duplex enhanced UART
  - Framing error detection
  - Automatic address recognition
- Power control modes
  - Clock can be stopped and resumed
  - Idle mode
  - Power down mode
- Programmable clock out
- Second DPTR register
- Asynchronous port reset
- LowEMI (inhibit ALE)
- 3 16-bit timers
- Wake up from power down by an external interrupt

ORDERING INFORMATION

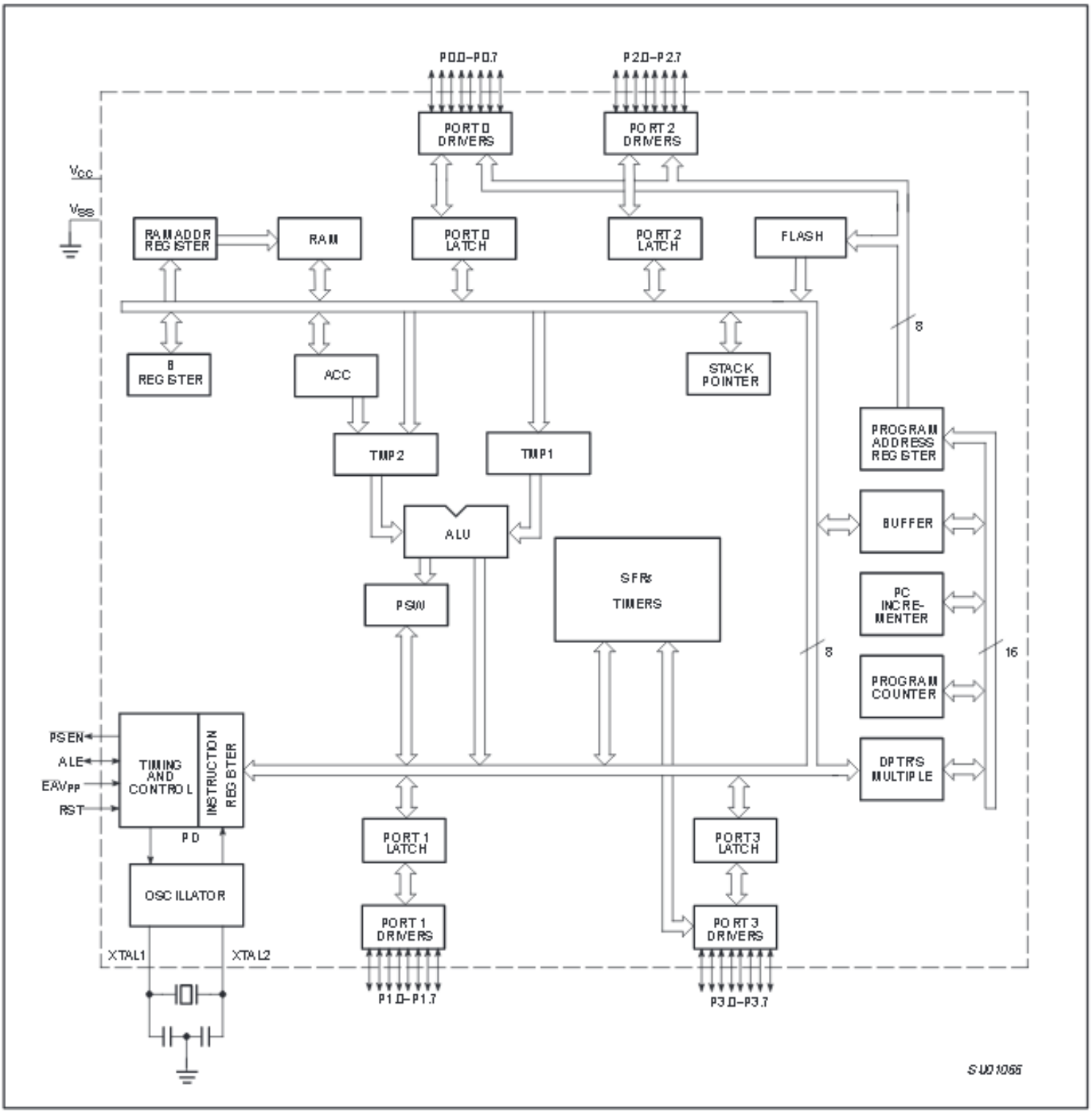
	MEMORY SIZE 4 k · 8	MEMORY SIZE 8 k · 8	MEMORY SIZE 16 k · 8	MEMORY SIZE 32 k · 8	TEMPERATURE RANGE °C AND PACKAGE	VOLTAGE RANGE	FREQ. (MHz)	DWG. #
FLASH	P89C51UBA A	P89C52UBA A	P89C54UBA A	P89C58UBA A	0 to +70, Plastic Leaded Chip Carrier	5 V	0 to 33	SOT187-2
FLASH	P89C51UBP N	P89C52UBP N	P89C54UBP N	P89C58UBP N	0 to +70, Plastic Dual In-line Package	5 V	0 to 33	SOT129-1
FLASH	P89C51UBB B	P89C52UBB B	P89C54UBB B	P89C58UBB B	0 to +70, Plastic Quad Flat Pack	5 V	0 to 33	QFP44[2]
FLASH	P89C51UFA A	P89C52UFA A	P89C54UFA A	P89C58UFA A[1]	–40 to +85, Plastic Leaded Chip Carrier	5 V	0 to 33	SOT187-2
FLASH	P89C51UFP N	P89C52UFP N	P89C54UFP N	P89C58UFP N[1]	–40 to +85, Plastic Dual In-line Package	5 V	0 to 33	SOT129-1
FLASH	P89C51UFB B	P89C52UFB B	P89C54UFB B	P89C58UFB B[1]	–40 to +85, Plastic Quad Flat Pack	5 V	0 to 33	QFP44[2]

NOTES:
1. Contact Philips Sales for availability.
2. SOT not assigned for this package outline.

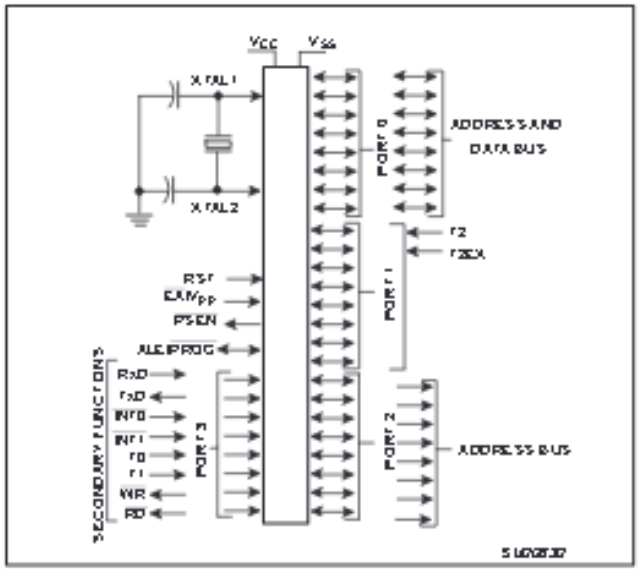
PART NUMBER DERIVATION

DEVICE NUMBER (P89CXX)	OPERATING FREQUENCY, MAX (V)	TEMPERATURE RANGE (B)	PACKAGE (AA, BB, PN)
P89C51 FLASH P89C52 FLASH P89C54 FLASH P89C58 FLASH	U = 33 MHz	B = 0°C to 70°C F = –40°C to 85°C	AA = PLCC BB = PQFP PN = PDIP

BLOCK DIAGRAM

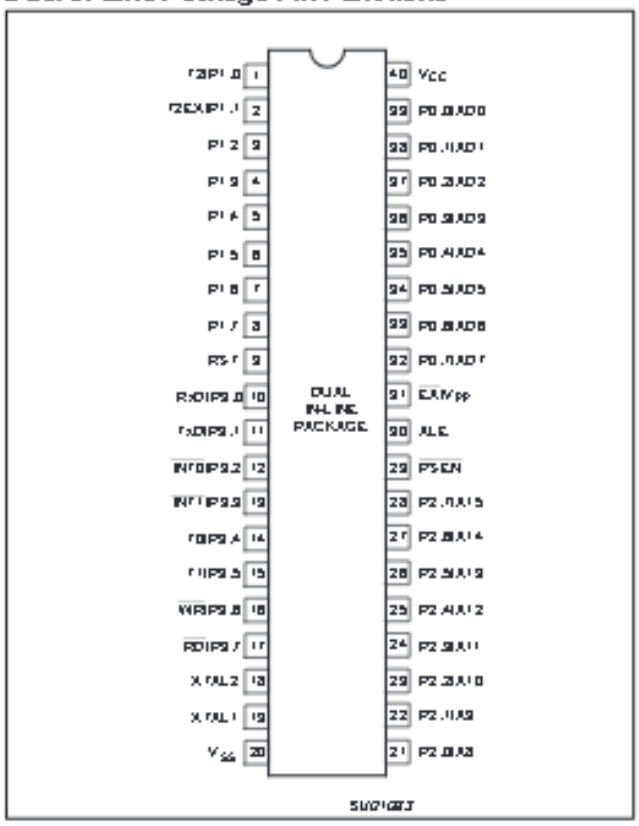


LOGIC SYMBOL

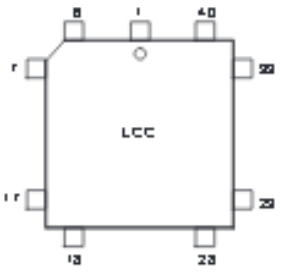


PIN CONFIGURATIONS

Dual In-Line Package Pin Functions



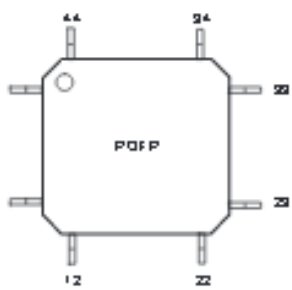
Ceramic and Plastic Leaded Chip Carrier Pin Functions



Pin	Function	Pin	Function	Pin	Function
1	NIC*	18	P3.4/T0	61	P2.7/A15
2	P1.0/T2	17	P3.5/T1	62	PSEN
3	P1.1/T2EX	16	P3.6/WR	63	ALE
4	P1.2	15	P3.7/RD	64	NIC*
5	P1.3	20	XTAL2	65	EA/V_PP
6	P1.4	21	XTAL1	66	P0.0/AD7
7	P1.5	22	V_SS	67	P0.1/AD6
8	P1.6	23	NIC*	68	P0.2/AD5
9	P1.7	24	P2.0/A8	69	P0.3/AD4
10	RST	25	P2.1/A9	60	P0.4/AD3
11	P3.0/RxD	26	P2.2/A10	61	P0.5/AD2
12	NIC*	27	P2.3/A11	62	P0.6/AD1
13	P3.1/TxD	28	P2.4/A12	63	P0.7/AD0
14	P3.2/INT0	29	P2.5/A13	64	V_CC
15	P3.3/INT1	30	P2.6/A14		

* NO INTERNAL CONNECTION

Plastic Quad Flat Pack Pin Functions



Pin	Function	Pin	Function	Pin	Function
1	P1.5	18	V_SS	61	P0.7/AD6
2	P1.6	17	NIC*	62	P0.6/AD5
3	P1.7	16	P2.0/A8	63	P0.5/AD4
4	RST	15	P2.1/A9	64	P0.4/AD3
5	P3.0/RxD	20	P2.2/A10	65	P0.3/AD2
6	NIC*	21	P2.3/A11	66	P0.2/AD1
7	P3.1/TxD	22	P2.4/A12	67	P0.1/AD0
8	P3.2/INT0	23	P2.5/A13	68	V_CC
9	P3.3/INT1	24	P2.6/A14	69	NIC*
10	P3.4/T0	25	P2.7/A15	60	P1.0/T2
11	P3.5/T1	26	PSEN	61	P1.1/T2EX
12	P3.6/WR	27	ALE	62	P1.2
13	P3.7/RD	28	NIC*	63	P1.3
14	XTAL2	29	EA/V_PP	64	P1.4
15	XTAL1	30	P0.0/AD7		

* NO INTERNAL CONNECTION

PIN DESCRIPTIONS

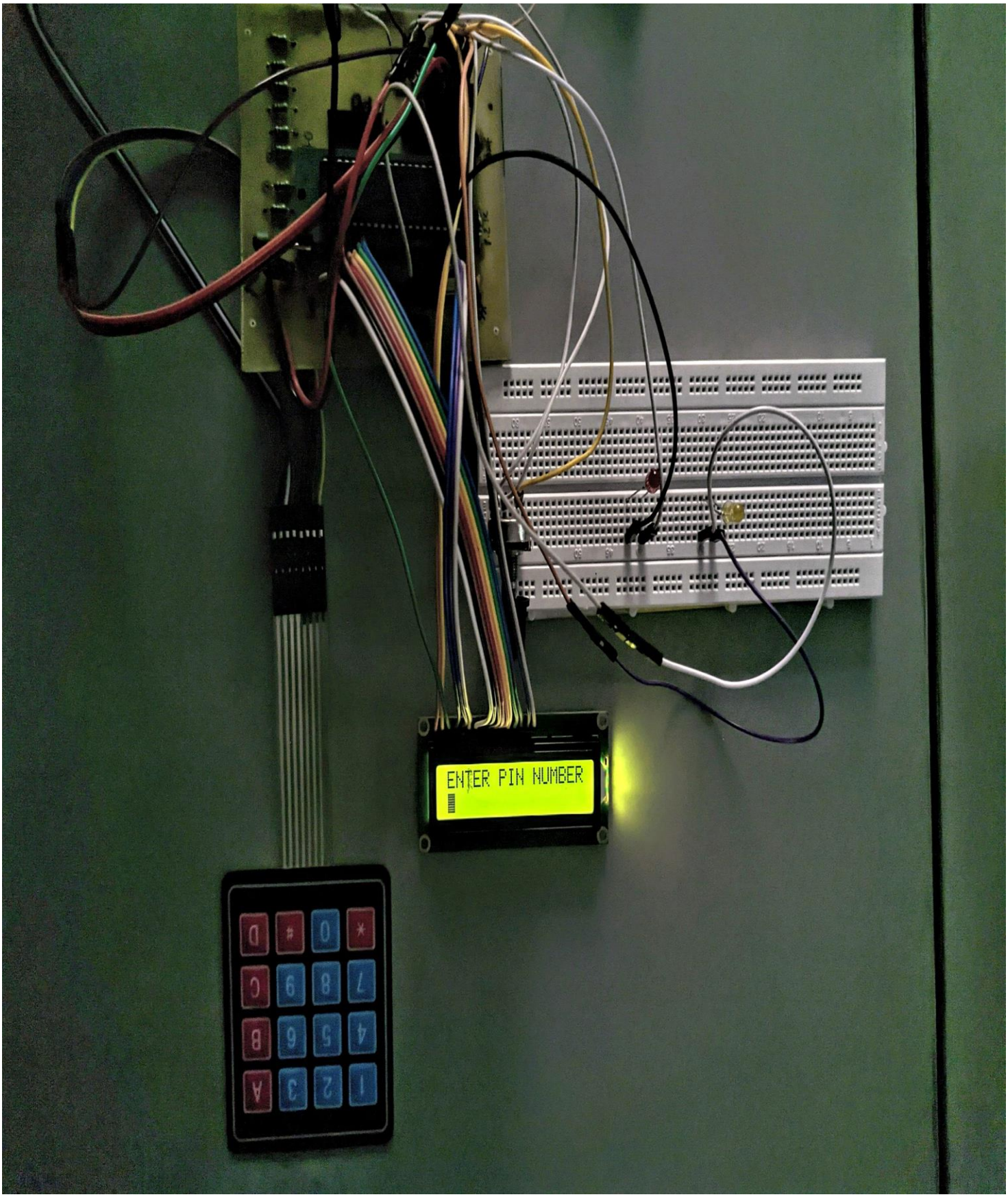
MNEMONIC	PIN NUMBER DIP	PIN NUMBER LCC	PIN NUMBER QFP	TYPE	NAME AND FUNCTION
V_{SS}	20	22	16	I	Ground: 0 V reference.
V_{CC}	40	44	38	I	Power Supply: This is the power supply voltage for normal, idle, and power-down operation.
P0.0–0.7	39–32	43–36	37–30	I/O	Port 0: Port 0 is an open-drain, bidirectional I/O port. Port 0 pins that have 1s written to them float and can be used as high-impedance inputs. Port 0 is also the multiplexed low-order address and data bus during accesses to external program and data memory. In this application, it uses strong internal pull-ups when emitting 1s.
P1.0–P1.7	1–8	2–9	40–44, 1–3	I/O	Port 1: Port 1 is an 8-bit bidirectional I/O port with internal pull-ups. Port 1 pins that have 1s written to them are pulled high by the internal pull-ups and can be used as inputs. As inputs, port 1 pins that are externally pulled low will source current because of the internal pull-ups. (See DC Electrical Characteristics: I_{IL}). Alternate function for Port 1:
	1	2	40	I/O	T2 (P1.0): Timer/Counter2 external count input/clockout (see Programmable Clock-Out).
	2	3	41	I	T2EX (P1.1): Timer/Counter2 reload/capture/direction control.
P2.0–P2.7	21–28	24–31	18–25	I/O	Port 2: Port 2 is an 8-bit bidirectional I/O port with internal pull-ups. Port 2 pins that have 1s written to them are pulled high by the internal pull-ups and can be used as inputs. As inputs, port 2 pins that are externally being pulled low will source current because of the internal pull-ups. (See DC Electrical Characteristics: I_{IL}). Port 2 emits the high-order address byte during fetches from external program memory and during accesses to external data memory that use 16-bit addresses (MOVX @DPTR). In this application, it uses strong internal pull-ups when emitting 1s. During accesses to external data memory that use 8-bit addresses (MOV @Ri), port 2 emits the contents of the P2 special function register.
P3.0–P3.7	10–17	11, 13–19	5, 7–13	I/O	Port 3: Port 3 is an 8-bit bidirectional I/O port with internal pull-ups. Port 3 pins that have 1s written to them are pulled high by the internal pull-ups and can be used as inputs. As inputs, port 3 pins that are externally being pulled low will source current because of the pull-ups. (See DC Electrical Characteristics: I_{IL}). Port 3 also serves the special features of the 89C51/89C52/89C54/89C58, as listed below:
	10	11	5	I	RxD (P3.0): Serial input port
	11	13	7	O	TxD (P3.1): Serial output port
	12	14	8	I	INT0 (P3.2): External interrupt
	13	15	9	I	$\overline{INT1}$ (P3.3): External interrupt
	14	16	10	I	T0 (P3.4): Timer 0 external input
	15	17	11	I	T1 (P3.5): Timer 1 external input
	16	18	12	O	$\overline{WR}$ (P3.6): External data memory write strobe
	17	19	13	O	$\overline{RD}$ (P3.7): External data memory read strobe
RST	9	10	4	I	Reset: A high on this pin for two machine cycles while the oscillator is running, resets the device. An internal diffused resistor to V_{SS} permits a power-on reset using only an external capacitor to V_{CC}.
ALE	30	33	27	O	Address Latch Enable: Output pulse for latching the low byte of the address during an access to external memory. In normal operation, ALE is emitted at a constant rate of 1/6 the oscillator frequency, and can be used for external timing or clocking. Note that one ALE pulse is skipped during each access to external data memory. ALE can be disabled by setting SFR auxiliary.0. With this bit set, ALE will be active only during a MOVX instruction.
PSEN	29	32	26	O	Program Store Enable: The read strobe to external program memory. When executing code from the external program memory, PSEN is activated twice each machine cycle, except that two PSEN activations are skipped during each access to external data memory. PSEN is not activated during fetches from internal program memory.
$\overline{EA}$/V_{PP}	31	35	29	I	External Access Enable/Programming Supply Voltage: $\overline{EA}$ must be externally held low to enable the device to fetch code from external program memory locations 0000H to the maximum internal memory boundary. If $\overline{EA}$ is held high, the device executes from internal program memory unless the program counter contains an address greater than 0FFFH for 4 k devices, 1FFFH for 8 k devices, 3FFFH for 16 k devices, and 7FFFH for 32 k devices. The value on the $\overline{EA}$ pin is latched when RST is released and any subsequent changes have no effect. This pin also receives the 12.00 V programming supply voltage (V_{PP}) during FLASH programming.
XTAL1	19	21	15	I	Crystal 1: Input to the inverting oscillator amplifier and input to the internal clock generator circuits.
XTAL2	18	20	14	O	Crystal 2: Output from the inverting oscillator amplifier.

NOTE: To avoid "latch-up" effect at power-on, the voltage on any pin (other than V_{PP}) at any time must not be higher than V_{CC} + 0.5 V or V_{SS} – 0.5 V, respectively.

Table 1. 89C51/89C52/89C54/89C58 Special Function Registers

SYMBOL	DESCRIPTION	DIRECT ADDRESS	BIT ADDRESS, SYMBOL, OR ALTERNATIVE PORT FUNCTION MSB							LSB	RESET VALUE
ACC*	Accumulator	E0H	E7	E6	E5	E4	E3	E2	E1	E0	00H
AUXR#	Auxiliary	8EH	–	–	–	–	–	–	–	A0	xxxxxxx0B
AUXR1#	Auxiliary 1	A2H	–	–	–	–	GF2	0	–	DPS	xxxx00x0B
B*	B register	F0H	F7	F6	F5	F4	F3	F2	F1	F0	00H
DPTR:	Data Pointer (2 bytes)										
DPH	Data Pointer High	83H									00H
DPL	Data Pointer Low	82H									00H
			AF	AE	AD	AC	AB	AA	A9	A8	
IE*	Interrupt Enable	A8H	EA	–	ET2	ES	ET1	EX1	ET0	EX0	0x000000B
			BF	BE	BD	BC	BB	BA	B9	B8	
IP*	Interrupt Priority	B8H	–	–	PT2	PS	PT1	PX1	PT0	PX0	xx000000B
			B7	B6	B5	B4	B3	B2	B1	B0	
IPH#	Interrupt Priority High	B7H	–	–	PT2H	PSH	PT1H	PX1H	PT0H	PX0H	xx000000B
			87	86	85	84	83	82	81	80	
P0*	Port 0	80H	AD7	AD6	AD5	AD4	AD3	AD2	AD1	AD0	FFH
			97	96	95	94	93	92	91	90	
P1*	Port 1	90H	–	–	–	–	–	–	T2EX	T2	FFH
			A7	A6	A5	A4	A3	A2	A1	A0	
P2*	Port 2	A0H	AD15	AD14	AD13	AD12	AD11	AD10	AD9	AD8	FFH
			B7	B6	B5	B4	B3	B2	B1	B0	
P3*	Port 3	B0H	RD	WR	T1	T0	INT1	INT0	TxD	RxD	FFH
PCON#[1]	Power Control	87H	SMOD1	SMOD0	–	POF[2]	GF1	GF0	PD	IDL	00xx0000B
			D7	D6	D5	D4	D3	D2	D1	D0	
PSW*	Program Status Word	D0H	CY	AC	F0	RS1	RS0	OV	–	P	000000x0B
RACAP2H#	Timer 2 Capture High	CBH									00H
RACAP2L#	Timer 2 Capture Low	CAH									00H
SADDR#	Slave Address	A9H									00H
SADEN#	Slave Address Mask	B9H									00H
SBUF	Serial Data Buffer	99H									xxxxxxxxB
			9F	9E	9D	9C	9B	9A	99	98	
SCON*	Serial Control	98H	SM0/FE	SM1	SM2	REN	TB8	RB8	TI	RI	00H
SP	Stack Pointer	81H									07H
			8F	8E	8D	8C	8B	8A	89	88	
TCON*	Timer Control	88H	TF1	TR1	TF0	TR0	IE1	IT1	IE0	IT0	00H
			CF	CE	CD	CC	CB	CA	C9	C8	
T2CON*	Timer 2 Control	C8H	TF2	EXF2	RCLK	TCLK	EXEN2	TR2	C/T2	CP/RL2	00H
T2MOD#	Timer 2 Mode Control	C9H	–	–	–	–	–	–	T2OE	DCEN	xxxxxx00B
TH0	Timer High 0	8CH									00H
TH1	Timer High 1	8DH									00H
TH2#	Timer High 2	CDH									00H
TL0	Timer Low 0	8AH									00H
TL1	Timer Low 1	8BH									00H
TL2#	Timer Low 2	CCH									00H
TMOD	Timer Mode	89H	GATE	C/T	M1	M0	GATE	C/T	M1	M0	00H

* SFRs are bit addressable.
\# SFRs are modified from or added to the 80C51 SFRs.
– Reserved bits.
1. Reset value depends on reset source.
2. Bit will not be affected by reset.


ENTER PIN NUMBER