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Arduino Nano Based Digital Password Lock for Door Security System Using 4x4 Matrix Membranes

Aparna Shirkande, Rupali Bairagi, Mayuri Gophane
Department of E&TC Engineering, S.B.Patil College of Engineering, Pune, Maharashtra, India

ABSTRACT

Nowadays, every human has a place of their own where they store their belongings. To prevent others from gaining access to their private property or privacy, they use locks, but these locks have a lot of flaws, like easy penetration, inadequate security, and the inability to deal with the lock in any other way than with a traditional key. Conventional door lock systems consist of a lock and lock system, in which a key is required to open the door lock automatically. Entrants can easily duplicate the keys and access the doors. This method was just as risky as contemporary door locks, which are rarely made with features like entry detection, alarms, and cameras. Door lock systems are essential to the security of offices holding private information or documents, retail establishments holding substantial sums of money or internal storage, and even residences housing numerous pricey but essential objects kept indoors.The Arduino Nano is the circuit's primary component. A 4x4 Matrix Keypad is utilized in the present work to input the password. The entered password and the predetermined password are compared. The system rotates the door motor to open the door if the password is entered correctly, and an LCD shows the door's state. The door stays closed and shows "PWD is wrong on LCD" if the password is incorrect

Keywords: Arduino nano, matrix membrane,IDE, EDA, IoT

I. INTRODUCTION

Main concept behind this project is of a door-latch opening using a password entered through keypad. As well as turning on the Buzzer when password is entered wrong. Today people are facing more problems about security in all over world, nowadays security is the most essential issue everywhere in the world so security of everything gains higher and higher importance in recent years. The main component in the circuit is Arduino nano. Here, 4X4 keypad is used to enter the password. The entered password is compared with the predefined password.

The scope of studying a 4x4 matrix membrane-based door lock system involves examining its design, functionality, security features, and practical applications. This entails understanding the technology behind the membrane keypad, including its layout, material composition, and how it detects and registers user input. Additionally, research may delve into the integration of the keypad with the door locking mechanism, exploring aspects such as encryption algorithms, access control protocols, and potential vulnerabilities. Furthermore, the study may encompass user experience considerations, such as ease of use, reliability, and

durability, as well as potential challenges like weather resistance and maintenance requirements. Overall, investigating a 4x4 matrix membrane-based door lock system offers insights into both the technical and practical aspects of modern security solutions for residential and commercial applications.

II. LITERATURE SURVEY

Mei-Chuan Tseng et al. proposed how the door opening function can be monitored by a single wrist-worn sensor. It can track the movement of a person's upper limb during daily activities. It can track the movement of a person's upper limb during daily activities. It had three subtitles for the complete motion of opening the door, which includes holding, turning and opening the door. The proposed system can detect and recognize these signals. The data collection phase includes the collection of data from a 3-axis accelerometer and a wrist-worn gyroscope.

Steven Zeiss et al. proposed a door locking security system with sensory sensors that detect human presence at a distance and without physical contact between the door and the person needed to lock/unlock the door. This helps prevent the spread of sanitary problems, such as infectious diseases, because fewer people touch the slide with their hands as in public toilets. Their project can be used in hospitals for leg replacements and for people with physical disabilities. When swiping, only the vertical and horizontal touch sensors are activated. The four touch sensors are numbered in a way that contradicts the movement of the clock. Active touch can be detected by digital numbers 1-4 (as there are 4 touch sensors). If the pattern is 12341, it indicates a circular touch, and the pattern 111444 represents a straight swing. There are different taps to lock, unlock, open and close the door, which can be done in different ways circularly, horizontally or vertically.

Yuan-Chih Yu [8] suggested in his article that the traditional door lock system involves carrying keys to open the door, Door lock systems also run on electrical equipment, making them dependent on electricity and ineffective during power outages. The author invented a digital door lock system that included a smart card reader and a touch panel. For example, in the event of a power failure, the system was connected to a USB port where a power bank could be connected to power the system.

III.HARDWARE DESCRIPTION

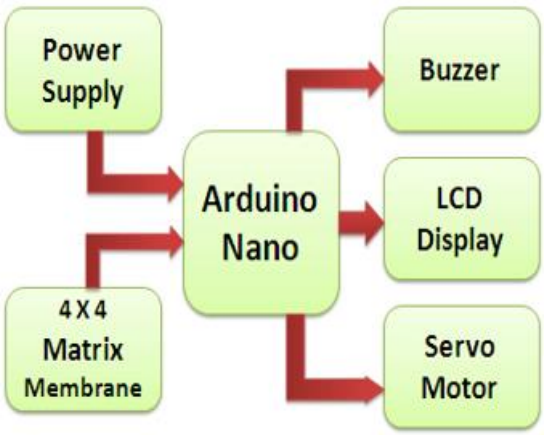

Figure1:Block diagram

The block diagram of 4X4 matrix membrane keypad door lock system contains the components like Arduino Nano, LCD, Servo motor, Keypad and Buzzer. For this purpose, we used a random password like “4574” by using the keypad.

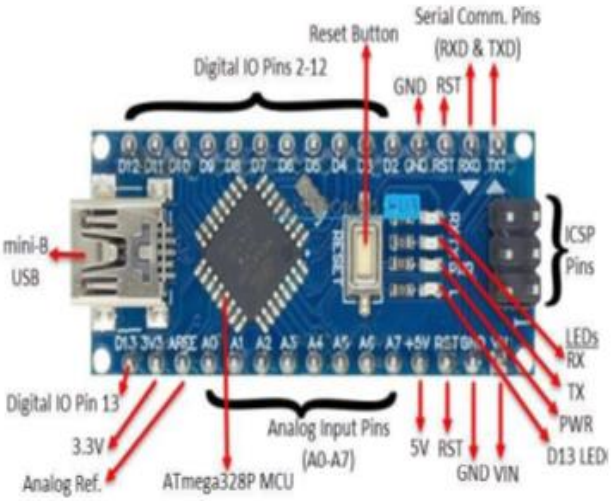

Figure2:Pin diagram of the Arduino Nano

The Arduino platform has become well acquainted with people into electronics. Unlike most previous programable circuit boards, the Arduino does not have a separate piece of hardware in order to load new code onto the board, you can simply use a USB cable to upload, and the software of the Arduino uses a simplified version of C++ , making it easier to learn to program, and it provides you with an easier environment that bypass the functions of the micro-controller into a more accessible package.

IV. MATRIX MEMBRANE

A 4x4 matrix membrane keypad is a type of input device commonly used in electronic systems for user interface purposes. It consists of 16 keys arranged in a 4x4 grid, typically labeled with numbers, letters, or symbols. Each key is connected to a matrix of conductive traces, and when a key is pressed, it makes electrical contact with the corresponding traces, allowing the system to detect which key has been pressed. These keypads are often used in applications such as security systems, industrial control panels, and electronic appliances for data entry and menu navigation. A 4x4 matrix membrane keypad is a type of input device commonly used in electronic systems for user interface purposes. Here's some more detailed information about it:

The keypad utilizes a matrix arrangement of conductive traces. Each row and column of keys is connected to a set of conductive traces on the membrane. This the number of required connections to the controller.

When a key is pressed, it makes contact between a specific row and column, creating a unique electrical connection. The microcontroller or dedicated keypad controller detects this connection by scanning through each row and column sequentially, determining which key has been pressed based on the activated row and column.

The keypad is usually connected to a microcontroller or other electronic device using simple digital I/O pins. The controller reads the keypad inputs and processes them according to the application's requirements, such as menu navigation, data entry, or system control.

4x4 matrix membrane keypads are commonly used in various electronic devices and systems, including security systems, industrial control panels, medical equipment, consumer electronics, and appliances. They provide a simple and reliable means of user input in a compact form factor.

A. Integrated Development Environment (IDE)

Arduino Integrated Development Environment, or Arduino software(IDE)- includes a text editor for writing code, a message area, a text console,a toolbar with common function buttons and a set of menus. It connects to Arduino hardware to download and interact with programs.

Programs written using Arduino Software (IDE) are called sketches. These sketches are written in the text editor and are saved with the file extension. ino. The editor has features for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and also displays errors. The console displays text output by the Arduino Software (IDE), including complete error messages and other information. The bottom righthand corner of the window displays the configured board and serial port. The toolbar buttons allow you to verify and upload programs, create, open, and save sketches, and open the serial monitor.

B. Easy EDA

An Easier and Powerful Online PCB Design Tool Featuring Parts and PCB Services Powered by LCSC. Easy EDA is an easier and powerful online PCB design tool that allows electronics engineers, educators, students, makers, and enthusiasts to design and share their projects. This is a design tool integrated LCSC components CatLog and JLCPCB PCB service that helps users to save time to make their ideas into real products.

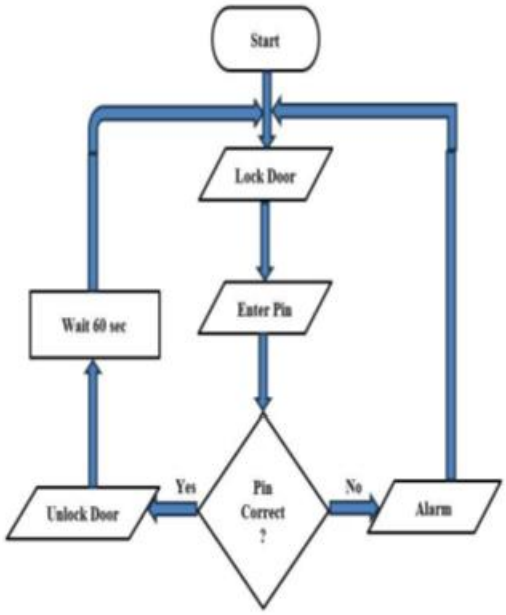

Figure3:Flowchart

Figure4:Flowchart

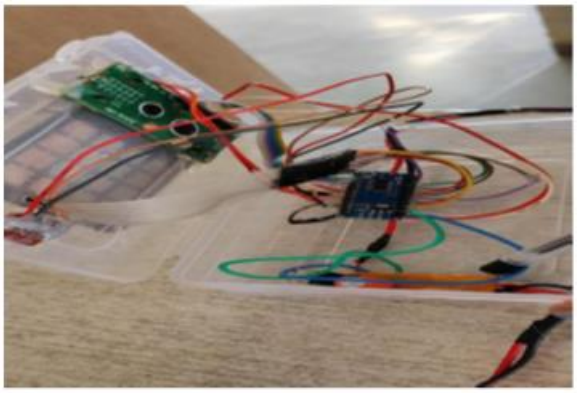

Figure5:Flowchart

The working principle is so simple. You just need to enter the password through the keypad provided. If the password is matched with the Arduino, it sends a signal to the servo and the servo rotate 180 degrees and then the door will open. Also, the LCD display shows a message “Access Granted”.
But if the password does not match. The Arduino does not send any signal to the motor and the door remains closed. This time the LCD display shows “Password Incorrect, Dismiss”. The alarm is beep when any of the keys are pressed. You can change all these messages anytime from the code.

V. CONCLUSION

The goal of our system was to create a safe door lock system using a 4x4 matrix membrane keypad. We were able to successfully integrate the keypad with an Arduino Nano by means of careful design and implementation, which established a strong code verification algorithm. The system proved to be very accurate and dependable during testing, however there were a few minor issues with interface optimization. User comments emphasized how practical and efficient the approach is. Future improvements might include connectivity with smart home systems and biometric authentication integration. Even with its success, it still needs to be improved upon in order to overcome some constraints. This study offers prospects for further developments in the industry and is a major step toward secure and effective door access control systems.

Future Scope

A 4x4 matrix membrane-based door lock system in the future might include machine learning algorithms for predictive maintenance and user behaviour analysis, IoT connectivity for remote monitoring and control, and

sophisticated biometric authentication techniques for increased security. It may also be easily integrated into ecosystems for smart homes, allowing for smooth automation and device interaction.

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