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Password Based Door Locking System Using GSM

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ABSTRACT

This project presents a prototype security door that can be remotely controlled via a GSM mobile phone set, acting as the transmitter, and another GSM mobile phone set, connected to the door motor through a DTMF (Dual Tone Multi-Frequency) decoder interfaced with a microcontroller unit and a stepper motor. The design consists of four main functional modules: the GSM module, the decoding module, the controlling module, and the switching module. The GSM module serves as both the transmitting and receiving unit, utilizing a mobile phone set to facilitate communication between the user at one end and the object of access (i.e., the door) at the other end. The decoding and controlling modules are made possible using modern integrated circuit chips, which ensure the proper conversion of signals into binary codes, allowing the microcontroller to communicate effectively with the switching device responsible for opening and closing the door. The code for this project was written in assembly language using Visual Basic software, compiled with M-IDE Studio for the MC-51 compiler, and designed to function within a Windows XP environment. The program ran without error before being uploaded to the microcontroller using a device called the programmer, where the microcontroller is placed in the corresponding socket.

Keywords: Door Lock, GSM., DTMF, GSM

I. INTRODUCTION

Security refers to the protection of life and property, and it has evolved significantly over time. While traditional methods like key locks and chains were common, today, doors are made from stronger materials like metal, and high-profile individuals use bulletproof doors for added protection. The security sector is constantly evolving, pushing for smarter and more reliable systems.

The microcontroller-based digital lock is a modern access control system that only allows authorized individuals to access restricted areas. It is well-suited for corporate offices, ATMs, and home security, offering improved security with automation and advanced control.

II. OVERVIEW

A. ***Existing System***

The existing system primarily relies on physical locks and keys, which pose security risks, especially in the case of burglaries. A burglar could potentially steal or replicate the key, leading to significant damage or theft of valuable property. Additionally, physical locks are vulnerable to lock-picking, making them less secure compared to modern electronic alternatives.

B. ***Proposed System***

The microcontroller-based digital locking system aims to offer advanced security features compared to traditional mechanical locks. It consists of an electronic

unit installed at the entry door, controlling a solenoid-operated lock via a stepper motor. When an authorized person enters the predetermined password using a GSM keypad, the stepper motor operates for a set time to unlatch the lock, allowing the door to open. After the preset delay, the motor reverses to lock the door again. If the password is entered incorrectly three times consecutively, the system enters block mode, preventing rapid code-guessing attempts. Additionally, if the user forgets their password, access can be granted using a unique 8-digit administrator password, and the master code can be changed after entering the current code.

This project involves interfacing a microcontroller with a GSM modem to remotely control an engine motor by sending predefined messages from a mobile phone to the controlling unit. The system utilizes GSM and embedded technology to receive commands and act accordingly. The microcontroller reads the incoming messages and adjusts the motor's status based on the requirements. Efficiency is measured by how quickly the microcontroller detects and responds to these messages.

The central processing unit for this project is the 8051 microcontrollers, specifically the AT89s52, with programs written in assembly language. The assembly code is compiled using M-IDE Studio for the MC51 compiler, designed for a Windows XP environment. The system controls the motor's operation by sending and receiving messages through the GSM modem. Although the system works well with Windows XP, it may face compatibility issues with higher versions of the operating system.

In residential applications, the system is integrated with reinforced doors, such as solid wood, panel doors, or metal-skinned wood-edged doors. These doors are further secured with deadbolts, frame reinforcements, and hinge screws. However, despite these reinforcements, the door security is still vulnerable. The project utilizes an electronic lock (magnetic lock or "mag lock") that operates with electricity. This lock uses a large electromagnet mounted on the door frame, and a corresponding armature is secured to the magnet. A key feature of mag locks is that they fail in the unlocked state when the power is removed, ensuring easy access during power failure situations

III. WORKING PROCEDURE OF THE PROJECT

The operation of the GSM-based security door lock system is summarized as follows:

1. Call Placement and Password Entry: A call is placed to the phone connected to the system, similar to calling a friend or colleague. The call is automatically answered at the door end, and the caller is prompted to press a six-digit password.
2. Tone Amplification and Decoding: The signal quality of the tones is first increased by passing them through a step-up transformer. The output of this transformer is fed into the DTMF (Dual Tone Multi-Frequency) decoder, where the tones are received and decoded into a binary code equivalent.
3. Microcontroller Processing: The microcontroller receives the decoded signals from the DTMF decoder. The microcontroller processes these signals, identifying the keys pressed on the phone keypad.
4. Outputs to Various Units:
   - Liquid Crystal Display (LCD): Displays the digits that the user presses for feedback.
   - ULN2003 Driver: Converts the logic level from the microcontroller's TTL to the signal that controls the switching sequence of the relay.
   - Buzzer Alarm: Alerts the user with a sound when a digit is pressed and sounds continuously if the wrong digits are entered by an intruder.
5. Code Confirmation: After entering the six-digit password, the user presses the “#” button on the keypad to confirm the code. If the code entered is correct (and if a mistake is made, the user can backspace by pressing the "0" key), the microcontroller activates the door opening sequence. This includes displaying "Access Granted" on the LCD and sending a signal to a transistor driving a relay, which switches the relay and completes the motor circuit, causing the door to open.
6. Door Closing Sequence: The door closes automatically after 8 seconds. However, the user can also close the door manually by pressing the “#” key on the keypad. The microcontroller recognizes this input and triggers another relay to close the door.

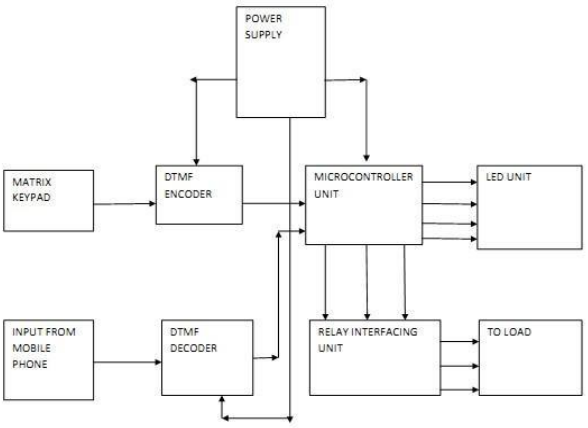
PURPOSE OF THE PROJECT:

- The primary aim of this project is to create an innovative system using mobile technology to manage various devices in homes and industries, as well as to enhance security measures.
- GSM technology allows users to control different appliances remotely, providing the convenience of operating devices from a distance.
- The system allows users to turn appliances on or off simply by pressing a button on a remote telephone keypad.
- The door can be unlocked using a predefined password entered via the keypad.
- The security level of the system is designed to prevent unauthorized unlocking of the door.
- The system ensures that only authorized individuals can open the door, preventing unauthorized access.
- Users have the flexibility to change or reset their password as needed for added security
- The system offers a more secure and cost-effective solution for door locking and unlocking.
- The system includes a matrix keypad, a door control unit, and a GSM modem connected to the microcontroller for secure communication.
- The keypad serves as the interface for password entry, and once the correct password is entered, the door lock is activated and opens.

IV. THE PROPOSED SYSYTEM

A. Block diagram

The block diagram of proposed system is as shown below



B. Description of Blocks

The major blocks used in the said system are as follows:

• MICROCONTROLLER

The AT89S52 is an energy-efficient and high-speed 8-bit CMOS microcontroller featuring 8KB of in-system programmable Flash memory. Developed using Atmel's advanced nonvolatile memory technology, it supports the industry-standard 80C51 instruction set and maintains a compatible pin configuration. The integrated Flash memory allows for easy reprogramming either directly in-system or through traditional memory programming methods.

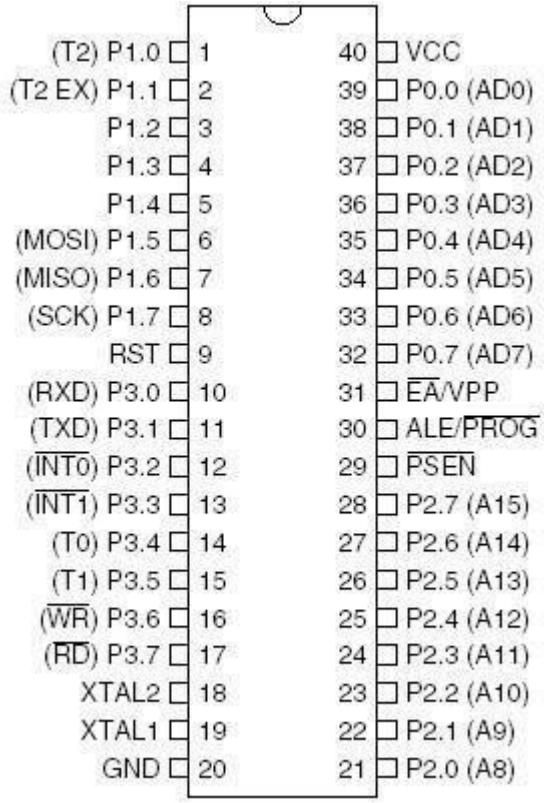
This microcontroller integrates a robust 8-bit CPU with programmable Flash memory in a single chip, offering a flexible and cost-efficient solution for a wide range of embedded control tasks.

Key features of the AT89S52 include 8KB of Flash memory, 256 bytes of RAM, 32 general-purpose input/output (I/O) pins, three 16-bit timers/counters, a watchdog timer, dual data pointers, a six-source two-level interrupt system, a full-duplex serial communication port, and built-in oscillator and clock circuits.

The device supports static logic operation for low-frequency or zero-frequency use and includes two selectable power-saving modes. In Idle Mode, the CPU halts while allowing peripherals like RAM, timers, serial port, and interrupts to function. In Power-down Mode, the device preserves RAM contents while

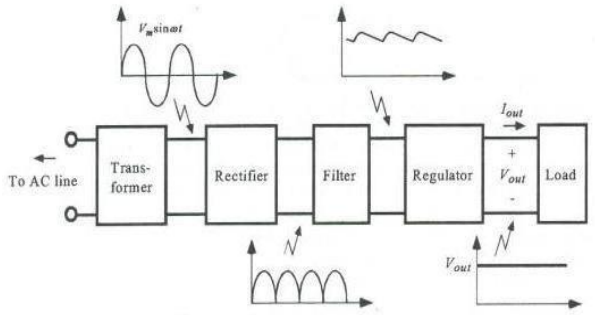
shutting down the oscillator and disabling all functions until a reset or interrupt event occurs.

PIN DIAGRAM



• POWER SUPPLY

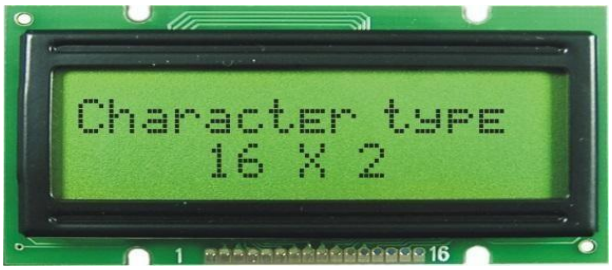
The circuit receives its input from a regulated power source. Initially, the 230V AC from the mains is stepped down to 12V using a transformer. This reduced AC voltage is then passed through a rectifier, which converts it into a pulsating DC voltage. To eliminate the remaining AC ripples, the rectified output is filtered, producing a smoother DC signal. Finally, this filtered voltage is supplied to a voltage regulator, which ensures a stable and constant DC output for the circuit.



Components of a regulated power supply

• LCD

The project utilizes a 16x2 alphanumeric Liquid Crystal Display (LCD), capable of displaying both letters and numbers across two lines, each with 16 character spaces. It is primarily used to show the entered password and indicate whether the password is correct or incorrect. Additionally, it can display various system options and data retrieved from the EEPROM.



• Mobile handset

The system includes an Android smartphone equipped with Bluetooth capability. This device must have a specific application installed to function properly. The Android phone is used to transmit commands via GSM technology for system operation.

• GSM MODEM

A GSM/GPRS modem is a wireless communication device used to connect a computer or microcontroller to the GSM and GPRS networks. It functions similarly to a mobile phone, requiring a SIM card to establish a network connection and possessing a unique IMEI number for identification. These modems can handle various tasks, including sending, receiving, and deleting

SMS messages, accessing and modifying SIM phonebook entries, and making or rejecting voice calls. Communication between the modem and a processor or controller is achieved using AT commands over a serial interface. When a command is issued by the processor, the modem responds accordingly, enabling interaction with the mobile network.

• Relay

A relay functions as an electrically operated switch that can control high-voltage AC loads, such as a 230V power supply. In this system, the relay is programmed to switch off when no individual is detected in the room. It can be used to automatically power down electrical devices like fans, lights, or other appliances, thereby improving energy efficiency and safety.

• EEPROM Memory IC

EEPROM, which stands for Electrically Erasable Programmable Read-Only Memory, is a type of non-volatile storage that retains data even when power is removed. Unlike traditional read-only memory, EEPROM can be both erased and reprogrammed electrically. In this project, it is utilized to securely store the system password, ensuring that the data remains intact across power cycles.

V. SOFTWARE AND PROGRAMMING LANGUAGES

The following software were used for development of the proposed system

- EAGLE software for PCB designing
- KEIL compiler

VI. STEPS IN PROJECT DEVELOPMENT

The following steps were taken during the development of the proposed system:

- The development of the proposed system began with clearly identifying the core problem to be addressed.
- This was followed by conducting an in-depth study of existing solutions and related technologies.
- A block diagram was created to outline the system functionality, and individual circuit modules were designed and tested.
- The printed circuit board (PCB) layout was developed using EAGLE software, after which the PCB etching process was carried out.
- All electronic components were mounted and soldered onto the PCB.
- The PCB was then verified through rigorous testing and troubleshooting.
- Embedded software was written and refined, followed by thorough debugging to ensure reliability.
- The microcontroller was programmed with the finalized code. Comprehensive system testing was conducted to validate performance.
- A fully operational prototype was constructed, and detailed documentation of the entire development cycle was compiled.

VII. APPLICATIONS

The proposed system as a wide range of applications, some of them are as follows:

- Home security
- Can be used in offices
- Can be used to secure industrial plants against intruders
- Can be installed at any place where remote access is required.

VIII. CONCLUSION

The project was successfully implemented, demonstrating that mobile phones, when integrated with appropriate electronic circuitry, can effectively operate a security system. In today's world, mobile phones are widely accessible and more cost-effective compared to custom-made keys or smart cards. The capability of the system to remotely grant access to secure locations—such as homes, offices, or ATMs—from virtually anywhere around the globe is a significant advantage, aligning with the modern era where technology continues to shrink geographical boundaries.

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