Electronic Door Lock Using Arduino

JOY MUKHERJI

Presented here is an electronic locking system in which Arduino Nano plays the role of the processing unit. This circuit allows activation of an electronic door lock only on entering the correct password. It uses Arduino Nano to provide a keypad interface door lock for the front door.

It is a keyless system where you can use your own personal code to enter your home with just a few simple pushes of some buttons. The keypad lock functions by entering a secret code, which is user-programmable. Prototype of the electronic door lock is shown in Fig. 1.

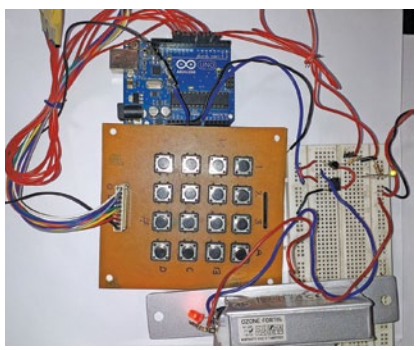

Fig. 1: Prototype of the electronic door lock using Arduino

Circuit and working

Using a microcontroller (MCU) cuts down on external components. The circuit comprises Arduino Nano board, transistors PN2222A (T1) and BD139 (T2), a 4x4 matrix keypad (S1-S16), solenoid lock and a few other components. The 4x4 matrix keypad is connected to Arduino digital pins D5 through D12. The keypad is simply an arrangement of 16 push-button switches in a 4x4 matrix form.

Typically, a hex keypad will have keys for numbers 0, 1, 2, 3, 4, 5, 6, 7, 8 and 9, letters A, B, C and D, and symbols * and #. The hex keypad will have eight connection wires, through resistors R1, R2, R3, R4 and capacitors C1, C2, C3, C4, representing the rows and columns, respectively.

The matrix-encoding scheme requires fewer output pins and, thus, fewer connections that have to be made for the keypad to work. The schematic diagram of the electronic door lock system is shown in Fig. 2.

Arduino receives parallel data from the keypad. Arduino software constantly scans the keypad to see if a button is pressed. Upon receiving a valid code input, digital pin D4 goes high and fires up the solenoid lock for five seconds. Transistor T2 is capable of supplying up to 1.5 ampere current to the solenoid. LED1 indicates that the lock has been opened. Entering an invalid code causes it to blink a few times. Diode D5 protects the circuit from any back EMF that might be created when the lock is turned off.

Test Points

Test point	Details
TP0	0V (GND)
TP1	5V
TP2	12V

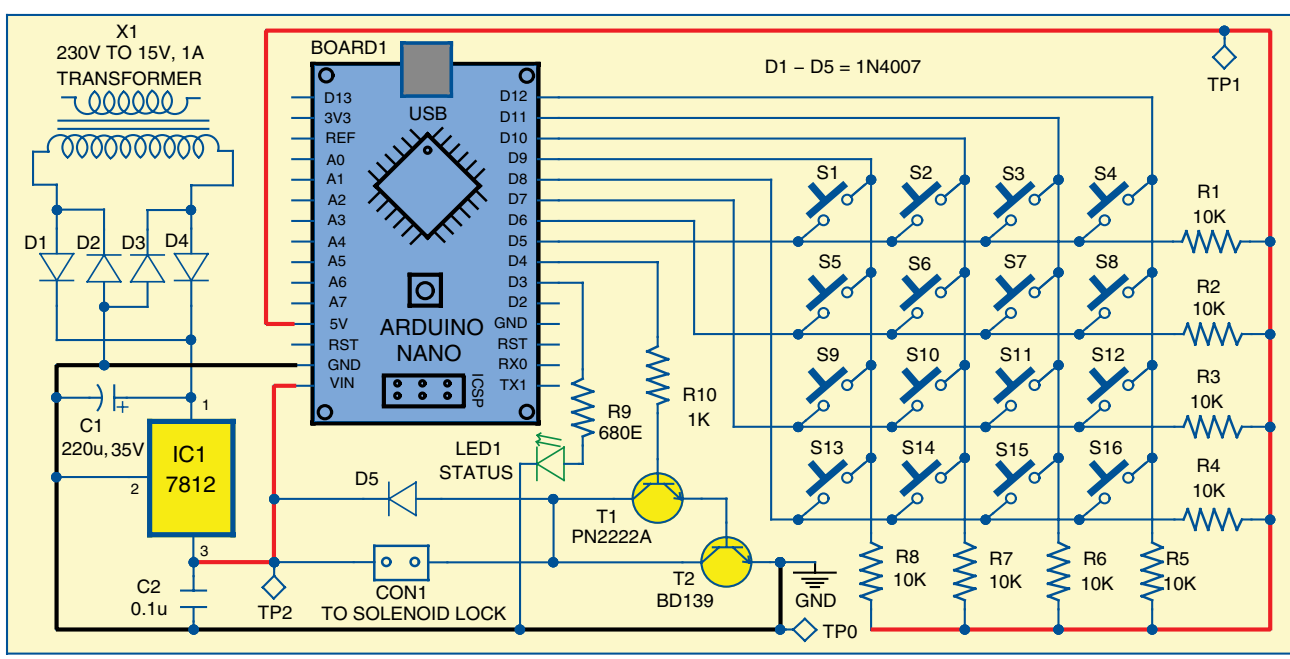

Fig. 2: Schematic diagram of the electronic door lock system

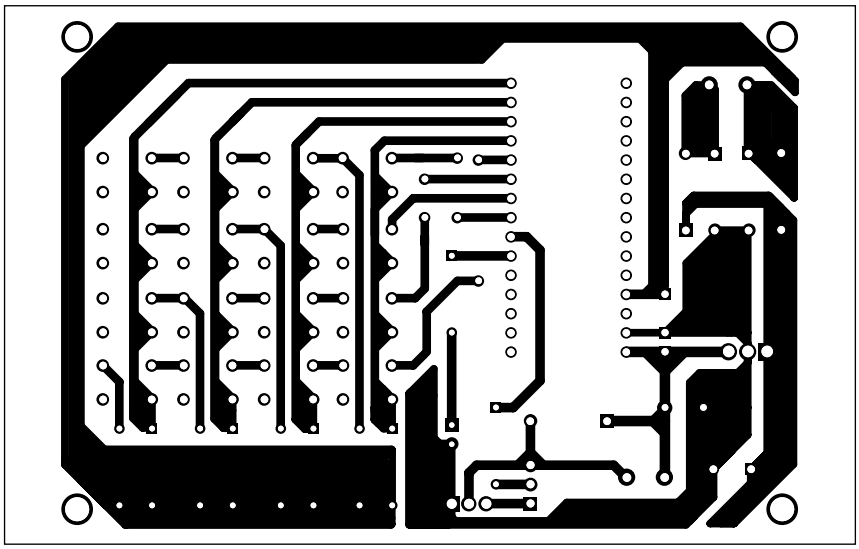

Fig. 3: Actual-size PCB layout of the electronic door lock system

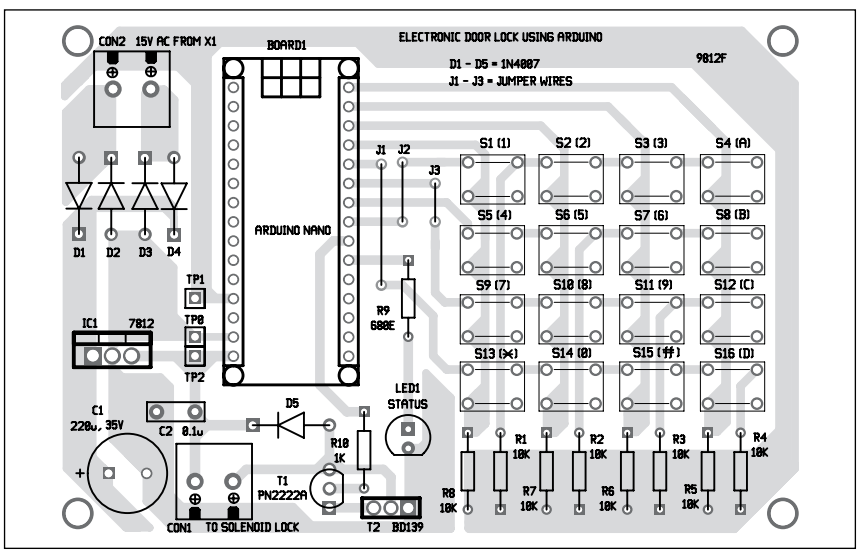

Fig. 4: Component layout of the PCB

Software

The software code (door lock.ino) for Arduino Nano is written in Arduino programming language and compiled using Arduino IDE.

keypad.h header file is added to the library for the functioning of the keypad. This library can be downloaded from *http://playground.arduino.cc/code/Keypad#Download*

After downloading, import this library to Arduino IDE from Sketch- > Import Library...- > Add Library option.

The default password is *1234# that can be modified by making changes to the code in the following line:

char PIN[4] = {'1','2','3','4'}

Construction and testing

Any Arduino-Nano- or UNO-compatible board can be used for this project. However, Arduino Nano is recommended as it is small and compact. It accepts 6V DC to 20V DC external power supply. Use of a 230V AC primary to 15V, 1A secondary transformer (X1) is recommended. Here we have used a regulated supply circuitry using 12V regulator IC 7812 to drive the circuit and solenoid lock.

An actual-size, single-side PCB layout of the electronic door lock system is shown in Fig. 3 and its component layout in Fig. 4. You can also use a readymade keypad module in place of the switches S1 through S16 given in this PCB. Readymade keypad interfacing with Arduino is shown in Fig. 5.

PARTS LIST

Semiconductors:

BOARD1	- Arduino Nano board
IC1	- 7812, 12V regulator
LED1	- 5mm LED
T1	- PN2222A npn transistor
T2	- BD139 npn transistor
D1-D5	- 1N4007 rectifier diode

Resistors (all 1/4-watt, ±5% carbon):

R1-R8	- 10-kilo-ohm
R9	- 680-ohm
R10	- 1-kilo-ohm

Capacitors:

C1	- 220µF, 35V electrolytic
C2	- 0.1µF ceramic disk

Miscellaneous:

X1	- 230V AC primary to 15V, 1A secondary transformer
S1-S16	- 4×4 matrix keypad using tactile switches
CON1, CON2	- 2-pin connector terminal
	- 12V solenoid lock

EFY Note

The source code of this project is included in this month's EFY DVD and is also available for free download at *source.efymag.com*

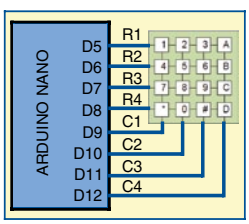

Fig. 5: 4x4 matrix keypad

Connect transformer X1 to the PCB at CON2 (Fig. 4). Initially, the solenoid lock (connected on CON1) will be locked and the status LED (LED1) connected on digital pin D3 of Arduino will be off.

When the user enters the right password, the solenoid lock gets unlocked for five seconds and LED1 glows. After five seconds, both LED1 and solenoid lock will be in the initial off state.

If the password is incorrect, LED1 will blink a few times, indicating that a wrong password has been entered.

The different voltage levels of 12V (TP2) and 5V (TP1) can be measured with respect to 0V (TP0), as listed in the table.

Joy Mukherji is an electronics hobbyist and a small-business owner in Albany, New York, the USA. His interests include designing radio frequency (RF) circuits