House Monitoring System

Team members
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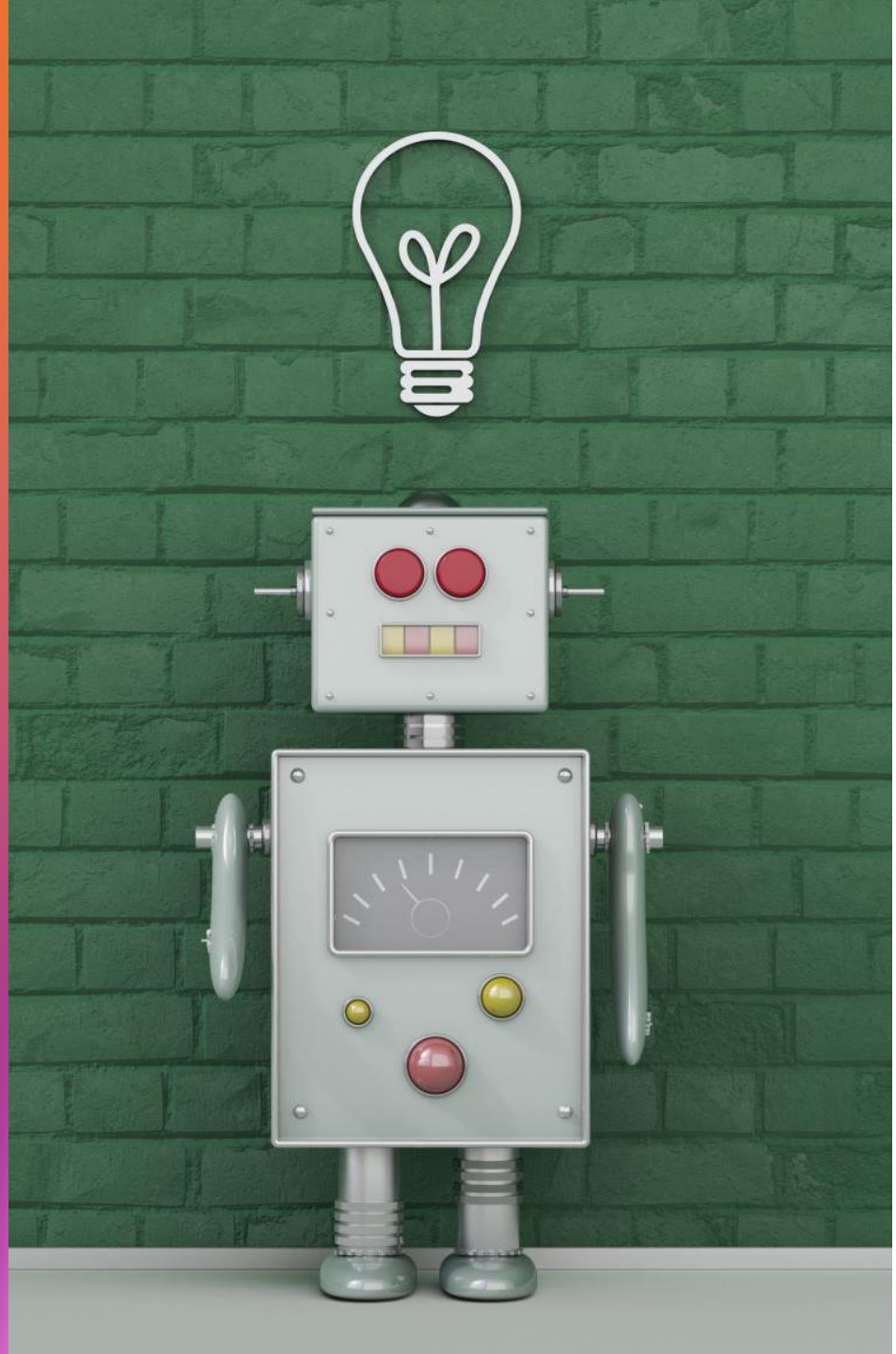


Background

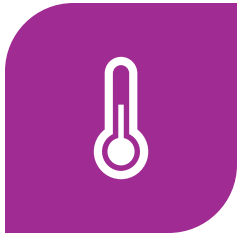
- First Ideas
  - House security system
  - AC control through temperature sensor
  - 3D robot
  - Robotic arm
- Combine first two to get a basic house monitoring system

Motivation

HOUSE MONITORING SERVICES ARE EVERYWHERE (ADT, SIMPLISAFE, ETC.)

BASIC SERVICES INCLUDE HOME SECURITY

OTHER SERVICES INCLUDE ENVIRONMENTAL MONITORING



WE WILL IMPLEMENT SECURITY SYSTEM AND TEMPERATURE MONITORING

Project Definition

Using a STM32 Nucleo-L476RG board to incorporate a keypad to enable security system, a magnetic door switch, to activate the buzzer for alerting when sensors are tripped, and a temperature sensor to monitor room temperature.

Project Goals / Objectives

- Successfully use the capabilities of the STM32-Nucleo Evaluation board to Design and implement a house monitoring system
- Implement the sensors using the Nucleo board functionalities

Workload Assignment

JULIAN B.

KEYPAD AND PROGRAM FLOW

EDWIN O.

TEMPERATURE SENSOR AND FAN

SAI VIVEK K

MAGNETIC DOOR SWITCH AND SLIDES

Detailed Design & Implementation

Sensors Used for the Application

- 4x4 Keypad Matrix / Basic program flow
- Temperature sensor
- Magnetic door switch

Detailed Design and Implementation
GPIO Pin Assigning

- Keypad
  - GPIO Input
    - PA10
    - PA11
    - PA12
    - PA15
  - GPIO Output
    - PB11
    - PB12
    - PB14
    - PB15

Temperature Sensor

PC1 – ADC

Fan

PB0 – GPIO Output

Magnetic Switch

PA4 – GPIO Input

Other

PA6 – GPIO Output for green LED

PA7 – GPIO Output for red LED

PA9 – GPIO Output for the buzzer

Detailed Design and Implementation Timers and ADC

- Tim 2 set for 1 second
- Tim 3 set for 100ms
- ADC set for polling

Detailed Design and Implementation

4x4 Matrix Keypad / Program flow

- Ports 1-4 (columns) are set as GPIO input
- Ports 5-8 (rows) are set as GPIO output
- Set individual output ports to HIGH while checking for HIGH on input ports.

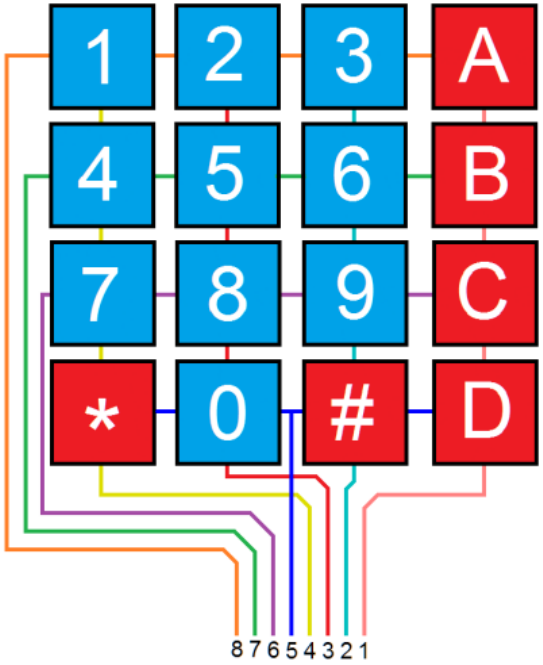
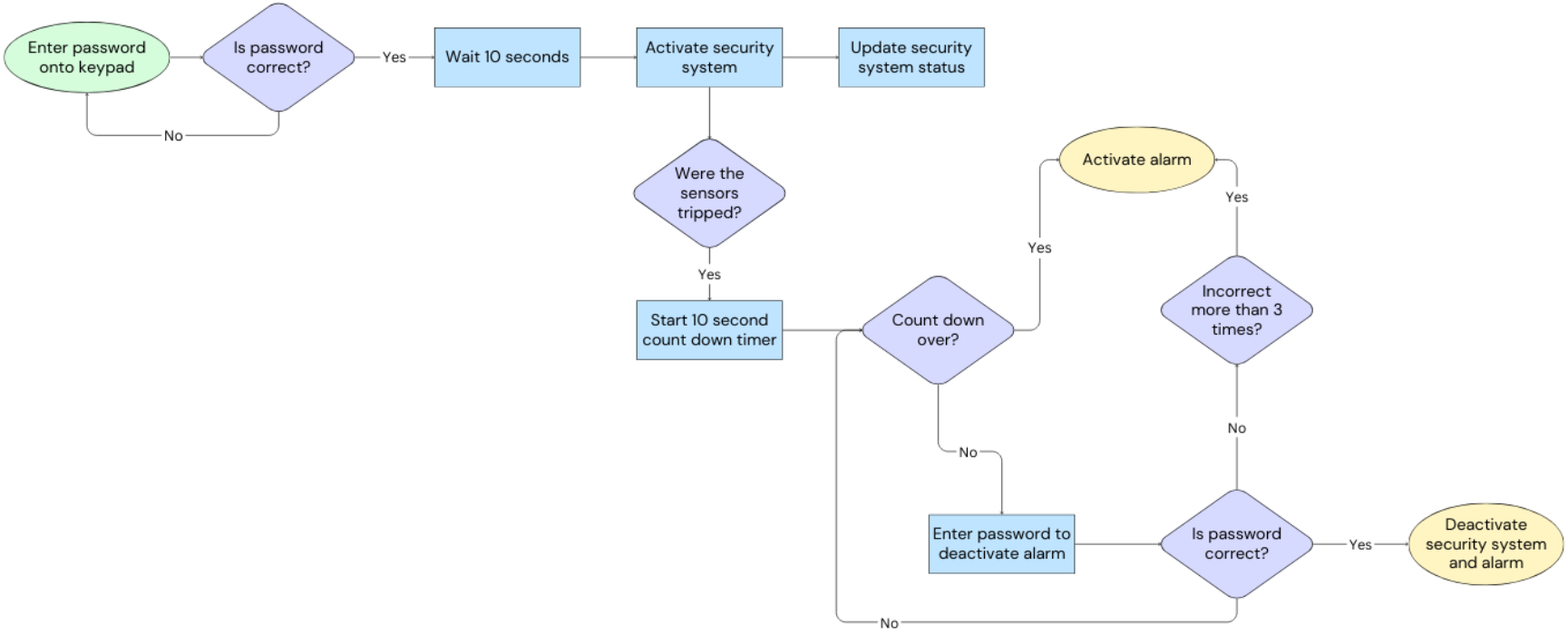


Figure 1: Matrix Keypad Connections

4x4 Matrix Keypad / Program flow



Temperature Sensor – LM35 With STM32 ADC

- The LM35 series are precision integrated-circuit temperature sensors with output voltages that are proportional to Celsius temperature. It has a linear +10 mV/°C scale factor. To acquire the temperature reading in degrees Celsius, we first measure the output voltage and divide it by 0.01.
- Formula to convert ADC to Volts to C°.

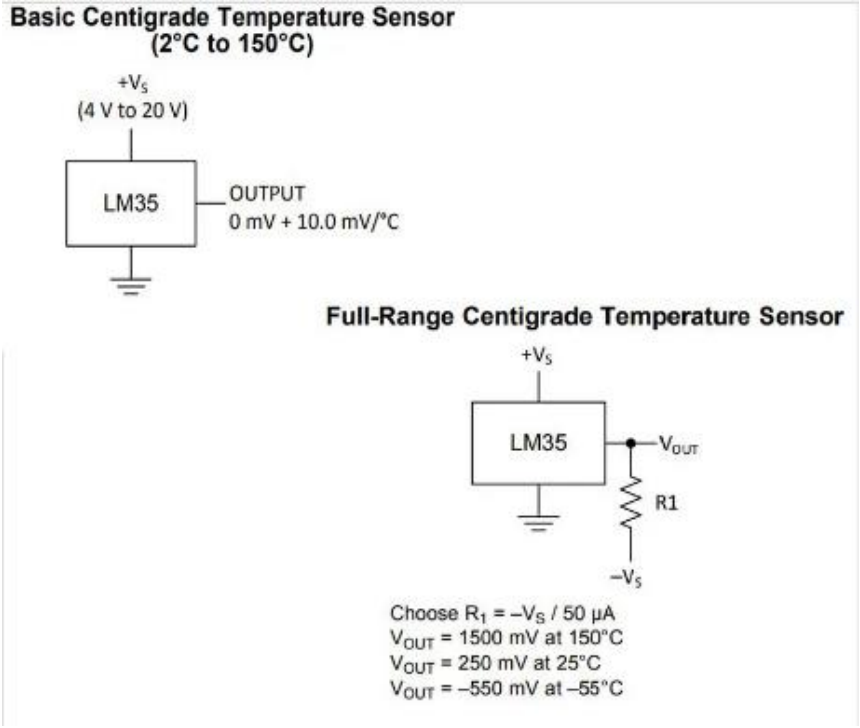
Vout =ADC Reading×Vref/ADC Resolution

- Convert Voltage to Temperature:

Tc=Vout/.01

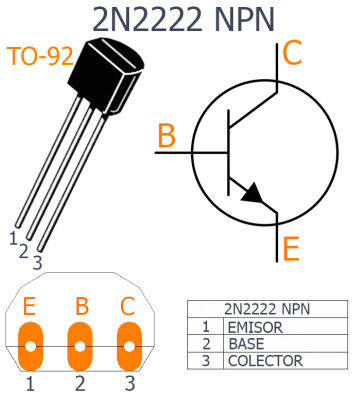
```
volts = ((float)TEMP * 3.3f) / 4095.0f;   // A

temp = volts * 100.0f; // LM35: 10mV/°C (Conv
```

- The LM35 temperature sensor can be used in several combinations. The fundamental one is the entire positive temperature range (from 2°C to +150°C). And the complete temperature range below zero degrees (-55°C to +150°C). The basic design requires no other components other than the LM35 itself, however the full range configuration requires an additional resistor, which may be calculated using the formula below. For this experiment we used the basic configuration.



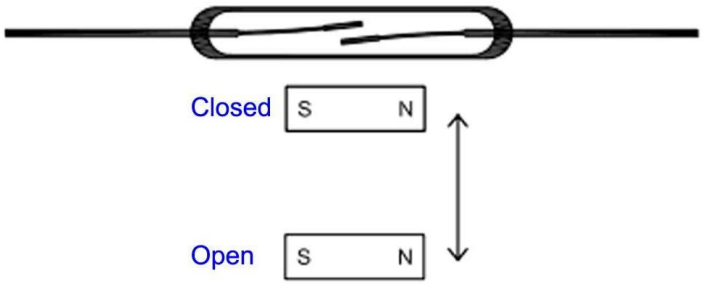
How does the temperature sensor work?

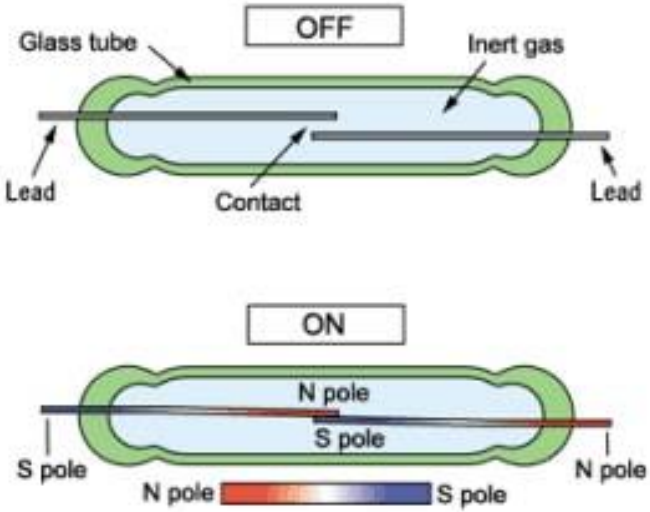
- The sensor is set to a specific temperature. When that temperature is exceeded, a signal is sent for the fan to activate and turn on or off. Once the fan is on, the temperature remains above a set limit.
- The system is configured with a high-temperature threshold of 24°C and a low-temperature threshold of 22°C. When the temperature reaches 24°C, the fan automatically turns on to cool the sensor. The fan continues operating until the temperature drops to 22°C, at which point it turns off. The cycle repeats to maintain the temperature within the desired range.
- The fan is turned by a 2N2222 NPN transistor where a small current on the transistor's base controls a larger current flowing from the collector to the emitter, thereby powering the fan. When PA0 is HIGH, the transistor allows current to flow, and the fan turns on. When PA0 is LOW, the transistor stops the current, and the fan turns off.



Magnetic Sensor

Reed switch with 1pc magnet can be used as normally open switch



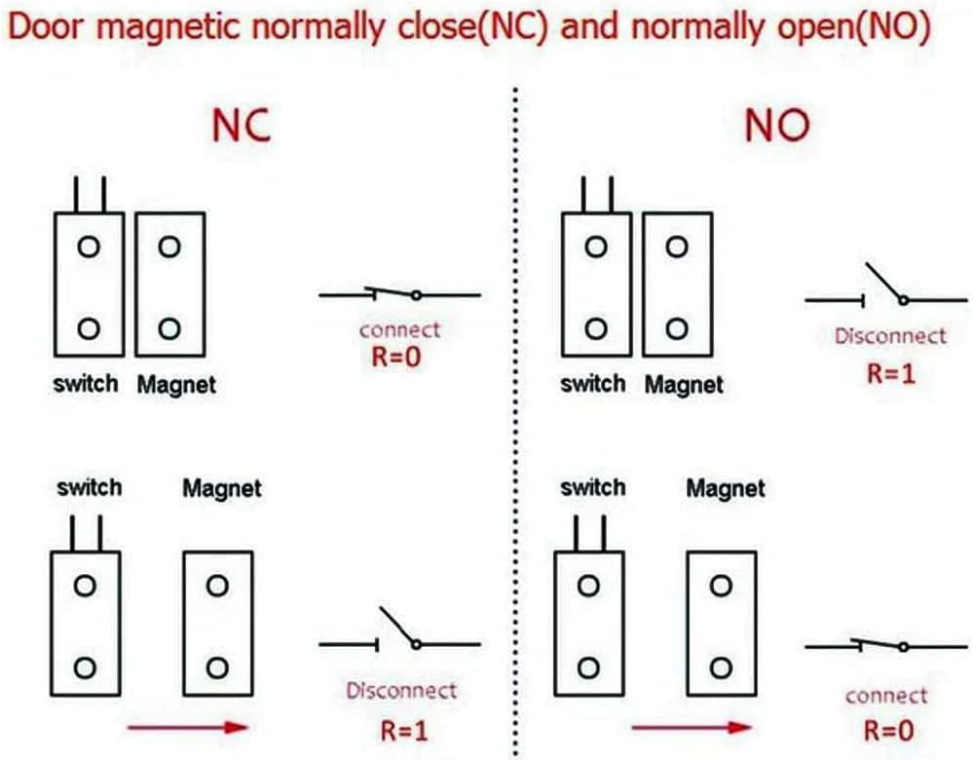


Magnetic switch is a reed Switch, encased in an ABS Shell

Magnetic Sensor Configurations

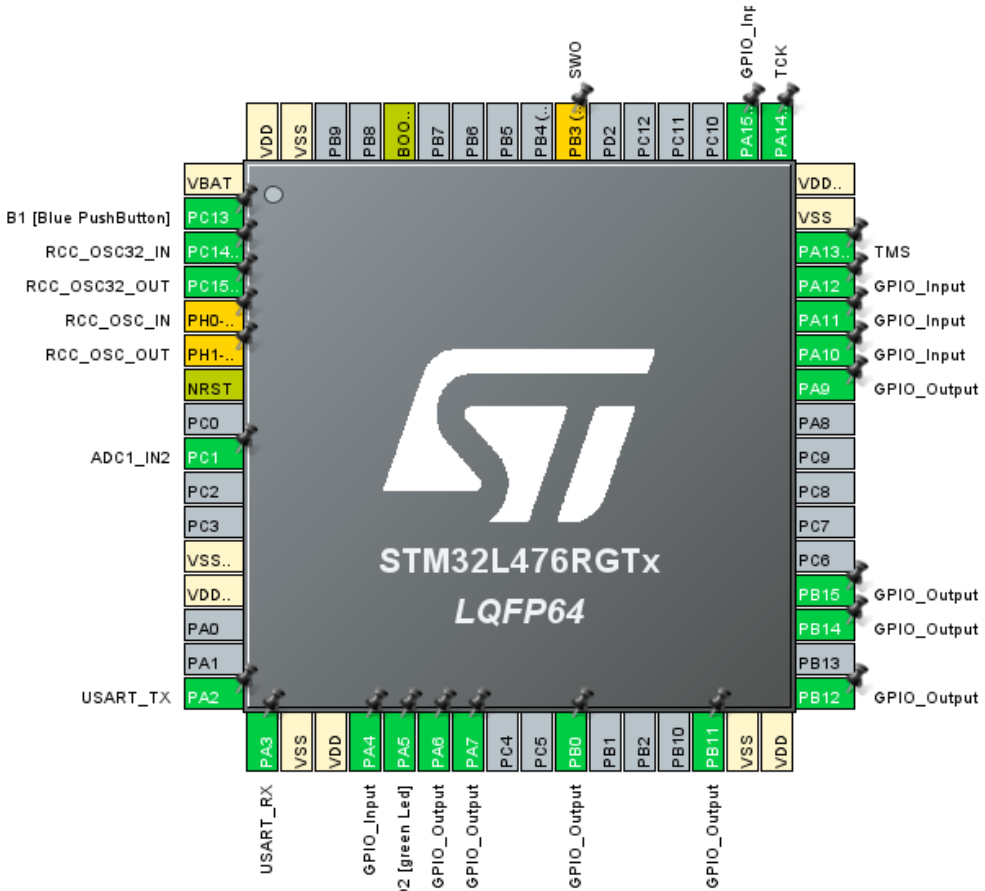
The magnetic switch has 3 configurations for each lead wire

- NC – Normally Closed
- NO – Normally Opened
- C – Combined

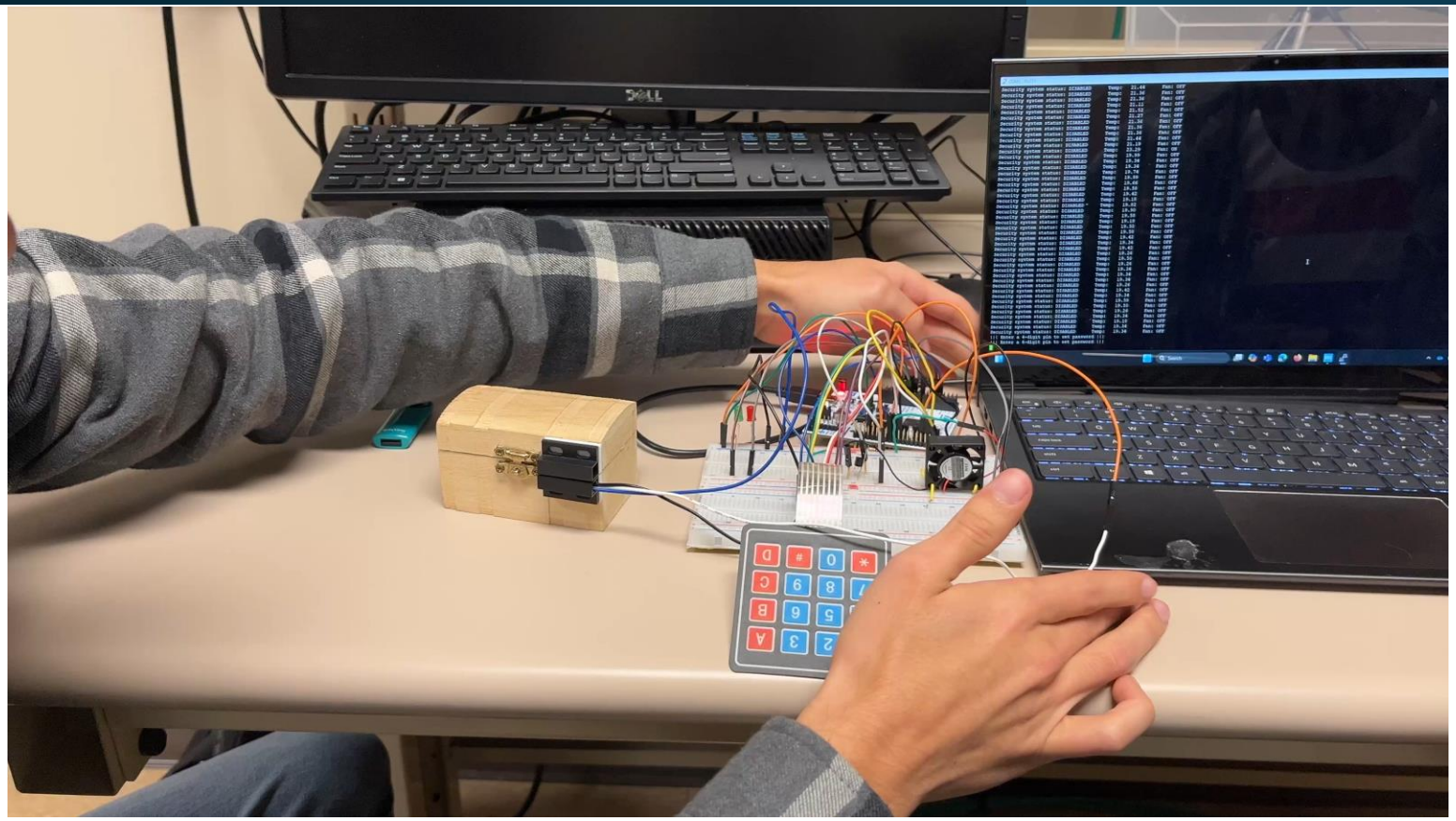


Here we used the Normally opened configuration so that when the switch is not in contact the Alarm is activated, and the buzzers go off until the system correct system password is entered

Implementation



Device Testing



IMG_8102.MOV

Results

```
Security system status: DISABLED      Temp:   21.11      Fan: OFF
Security system status: DISABLED      Temp:   21.19      Fan: OFF
||| Enter a 4-digit pin to set password |||
||| Enter a 4-digit pin to set password |||
```

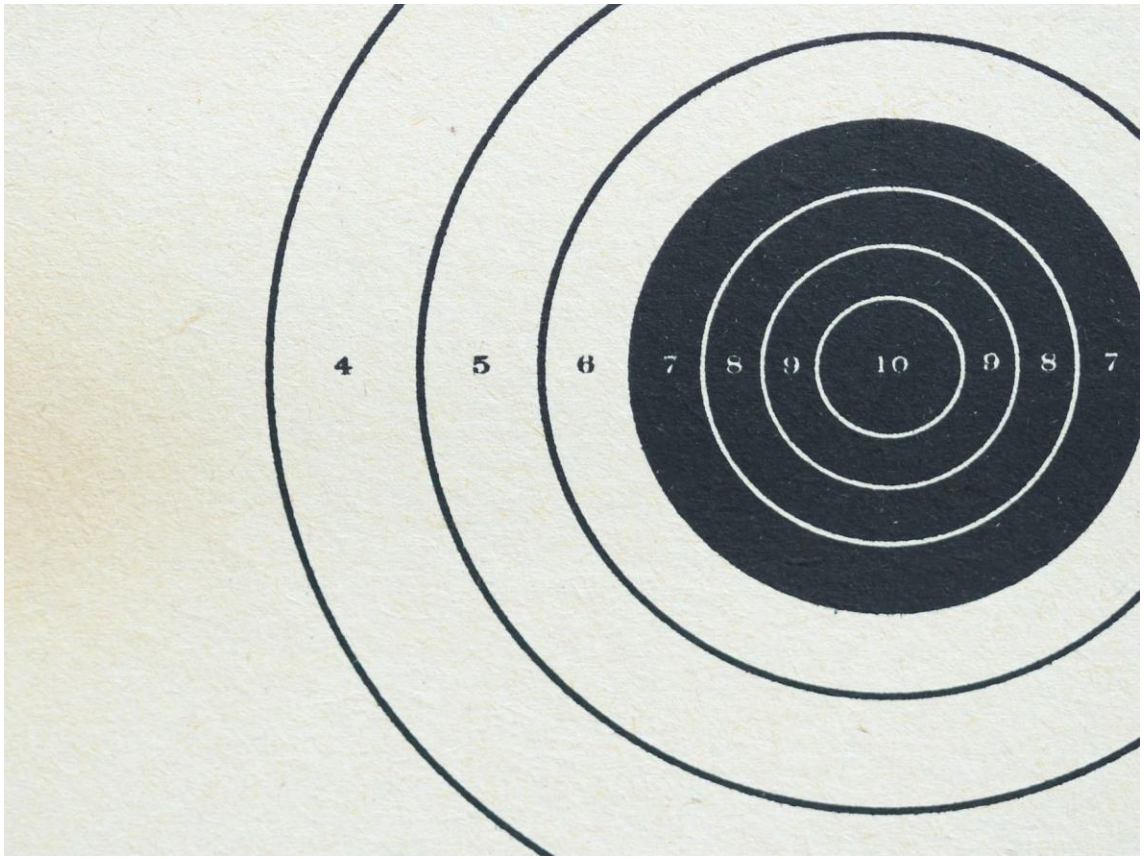
```
System On

Security system status: ENABLED      Temp:   19.82      Fan: OFF
Security system status: ENABLED      Temp:   19.66      Fan: OFF
Security system status: ENABLED      Temp:   19.74      Fan: OFF
Security system status: ENABLED      Temp:   19.82      Fan: OFF
Security system status: ENABLED      Temp:   19.58      Fan: OFF
Security system status: ENABLED      Temp:   20.07      Fan: OFF
```

```
Security system status: DISABLED      Temp:   19.58      Fan: OFF
Security system status: DISABLED      Temp:   19.58      Fan: OFF
Security system status: DISABLED      Temp:   19.58      Fan: OFF
Security system status: DISABLED      Temp:   19.66      Fan: OFF
Security system status: DISABLED      Temp:   19.66      Fan: OFF
Security system status: DISABLED      Temp:   19.90      Fan: OFF
Security system status: DISABLED      Temp:   19.58      Fan: OFF
```

```
1111
System will activate in 11 seconds.
Security system status: DISABLED      Temp:   19.58      Fan: OFF
Security system status: DISABLED      Temp:   19.82      Fan: OFF
Security system status: DISABLED      Temp:   19.66      Fan: OFF
Security system status: DISABLED      Temp:   19.74      Fan: OFF
```

```
Security system status: ENABLED      Temp:   21.84      Fan: OFF
Security system status: ENABLED      Temp:   23.13      Fan: OFF
Security system status: ENABLED      Temp:   23.85      Fan: ON
Security system status: ENABLED      Temp:   24.66      Fan: ON
Security system status: ENABLED      Temp:   25.79      Fan: ON
Security system status: ENABLED      Temp:   26.84      Fan: ON
Security system status: ENABLED      Temp:   27.48      Fan: ON
```

Demo



Summary and Analysis

- Learned more about Configurations of GPIO Pins
- Using Analog to Digital Conversion for Voltage to Temperature conversion.

Challenges:

- Difficulties setting up the magnetic switch sensor
- LCD screen

Future Ideas:

- Cameras
- Weather alerts- Notification system
- Smoke detectors, Carbon Monoxide sensors.
- Replace small fan with ceiling fan

GitHub Repo & References

GitHub Repo: https://github.com/ksvivek25/House-Monitoring-System/tree/main

- Magnetic Switch Implementation Reference: https://www.engineersgarage.com/stm32-microcontroller-door-sensor-project/
- Sensor Link https://www.sparkfun.com/products/13247
- Keypad reference: 27899-4x4-Matrix-Membrane-Keypad-v1.2.pdf
- Magdy, K. (2024, January 20). *STM32 LM35 temperature sensor example - LM35 with STM32 ADC*. Deep Blue. https://deepbluembedded.com/stm32-lm35-temperature-sensor-example-lm35-with-stm32-adc/