Graphical user interface, text

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**Title:** Constructing an Alarm System using an Arduino Mega 2560

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with Network Infrastructure

**Module:** Project 2

Table of Contents

[Acknowledgements 3](#_Toc132205805)

[Abstract/Summary 3](#_Toc132205806)

[Introduction 3](#_Toc132205807)

[Background Research 3](#_Toc132205808)

[Hardware Design 3](#_Toc132205809)

[Software Design 3](#_Toc132205810)

[Implementation 3](#_Toc132205811)

[Testing & Evaluation 3](#_Toc132205812)

[Future Development 3](#_Toc132205813)

[Conclusion 3](#_Toc132205814)

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# Abstract

Demand for affordable and effective security systems has increased in recent years. This has led to the development of a range of home security solutions, from simple home alarms to more sophisticated systems using sensors and cameras.

This report discusses the design and implementation of an alarm system using an Arduino Mega 2560 microcontroller. The system consists of several sensors and modules that are connected to the Arduino, and it is programmed to detect and respond to intrusions or any other suspicious activity that will trigger the alarm systems.

The report describes the hardware components and their connections, as well as the software design and implementation. Finally, the report evaluates the system's performance and discusses its potential for further development and improvement.

# Introduction

Home security has become an important aspect of modern life and the development of do-it-yourself (DIY) alarm systems is becoming increasingly popular. The use of microcontrollers and Integrated Development Environments (IDE) has opened new possibilities in the development of such systems. This report explores the design and implementation of an alarm system using the Arduino Mega 2560 microcontroller and Processing IDE.

The report seeks to demonstrate the feasibility of building an effective alarm system using readily available and affordable hardware components. The main goal of this project is to develop a functional alarm system that can detect and respond to potential security breaches while providing users with a high level of flexibility and control. Specific goals of this project include designing and implementing various sensors and actuators, integrating the Arduino Mega 2560 with the sensors and processing, and developing a user-friendly interface that allows users to monitor the behaviour of the system. Another goal of this project is to program the system and evaluate the performance of the alarm system and identify future improvements.

The system consists of various components such as sensors, actuators,

and microcontrollers. The sensors detect any unusual activity, while the actuators trigger the alarm. Microcontrollers control the sensors and actuators and process the data received.

Below is an overview of the various components required for the system to function:

**Arduino Mega 2560 Microcontroller:**

The Arduino Mega 2560 microcontroller is a widely used open-source platform for controlling various devices and sensors. It is based on the ATmega2560 microprocessor and features 54 digital input/output pins, 16 analog inputs, and 4 hardware UART (serial communication) channels. Additionally, it has 256 KB of flash memory, 8 KB of SRAM and 4 KB of EEPROM. [1]

**Processing IDE:**

The Processing Integrated Development Environment (IDE) is a software tool that simplifies the process of writing code for the Arduino Mega 2560 microcontroller. The IDE is based on a simplified version of the C++ language and provides an easy-to-use interface for writing and editing code. Compiles code into machine-readable instructions that can be used to control a microcontroller. [2]

**Alarm System Components:**

The alarm system is equipped with various sensors such as Passive Infrared (PIR), vibration sensor, temperature sensor, RFID, and keypad for detecting and responding to potential security breaches. These sensors are connected to an Arduino Mega 2560 microcontroller that acts as the system's control centre. The microcontroller receives input signals from the sensors, processes the data, and triggers appropriate responses using actuators.

Actuators such as buzzers and lights are used to signal alarms when a security breach is detected. A combination of sensors and actuators allows the system to detect and respond to various security threats. The Arduino Mega 2560 provides a reliable and robust platform for the alarm system, allowing for real-time processing of data and accurate responses to potential security breaches.

# 

# Background Research

This section of the report contains the background research completed on the various components required to build an alarm system using an Arduino Mega 2560 microcontroller. The report will cover the fundamental aspects of alarm zones, Processing IDE, temperature sensors, LEDs, vibration sensors, buzzers, PIR sensors, RFID, and keypads. The purpose of this study is to fully understand the functions and capabilities of these components and how they can be integrated to create a robust and reliable alarm system.

**Alarm Zones:**

Alarm zones are defined areas within a building or property that are monitored by an alarm system. These zones are typically set up to detect any suspicious activity or unauthorized entry and trigger an alarm. The number of alarm zones required for a system depends on the size and complexity of the area being monitored. [3]

The system should have the capability to detect and alert any potential threat in each zone separately. The design and configuration of alarm zones are important to ensure that the system is effective in detecting any threats and protecting the premises.

Different components such as PIR sensors, vibration sensors, temperature sensors, and RFID and keypads can be used to create separate alarm zones within a single system, as is demonstrated in the model used for this project.

**Processing IDE:**

Processing IDE is a versatile software tool that can be used to create graphical user interfaces (GUIs), which can be especially useful for monitoring and controlling systems such as an alarm system. Processing IDE is based on the Java programming language and includes a variety of libraries for creating interactive elements such as buttons, sliders, and maps.

It is also capable of reading data from the serial port, which allows it to receive information from sensors connected to the Arduino Mega 2560 microcontroller. By using Processing IDE to display this sensor data in a graphical format, users can easily monitor the status of the alarm system and detect any issues that arise.

Additionally, Processing IDE can be used to create custom visualizations and data analyses of the alarm system's operation, providing valuable insights for further improvements. Overall, the use of Processing IDE in conjunction with the Arduino Mega 2560 microcontroller provides a powerful toolset for developing an effective alarm system, as is demonstrated in the model for the project. [4]

**Temperature Sensor**

Temperature sensors are an integral part of alarm systems, and they work by detecting changes in temperature within a designated area. When connected to an Arduino Mega 2560, these sensors can provide real-time temperature readings and trigger alarms in case of abnormal temperature fluctuations. [5]

The Arduino Mega 2560 has analog-to-digital converter (ADC) pins that can be used to interface with temperature sensors that output analog signals. A temperature sensor is connected to an analog input pin on the Arduino board, and the Arduino firmware is programmed to read the analog signal from the sensor and convert it to a temperature reading.

These temperature values can then be used to trigger an alarm when they exceed predetermined thresholds. The alarm can be in the form of a loud buzzer or a flashing LED, depending on the design of the system. In summary, temperature sensors within an alarm system run by an Arduino Mega 2560 work by detecting temperature changes and triggering alarms to notify users of any abnormal temperature fluctuations.

**Vibration Sensor**

Vibration sensors are commonly used in alarm systems to detect any unusual movements or vibrations in a designated area. When integrated with an Arduino Mega 2560, these sensors can provide real-time vibration data and trigger alarms in case of abnormal readings.

The Arduino Mega 2560 has several digital input pins that can be used to interface with vibration sensors that output digital signals. The sensor is connected to one of the Arduino board's digital input pins and the firmware is programmed to read the digital signal from the sensor and analyze the vibration data. When vibration levels exceed certain thresholds, the firmware triggers alerts in the form of LEDs or buzzers to warn users of potential threats.

When the vibration readings exceed a certain threshold, the firmware triggers an alarm, which can be in the form of an LED or a buzzer, to alert the user of the potential threat. In summary, vibration sensors work with the Arduino Mega 2560 in an alarm system by detecting movements and vibrations, which are converted into digital signals and analysed by the microcontroller to trigger alarms when necessary.

**Buzzer/Alarm**

In an alarm system utilizing an Arduino Mega 2560 microcontroller, a buzzer can be an essential component that produces an audible alert to signal potential dangers or emergencies.

By connecting the buzzer to a microcontroller's digital output pin, the system can control when the buzzer goes off and what it sounds like. The buzzer can be programmed to trigger in response to various events or conditions, including sensor inputs, keypad inputs, or time-based triggers.

For example, a motion sensor detects movement within a protected area and sends a signal to the microcontroller. A microcontroller activates a buzzer to make a loud, attention-grabbing sound. Similarly, a keypad input could signal the activation or deactivation of the alarm system, with the buzzer producing a confirming beep to indicate successful input.

The Arduino Mega 2560 microcontroller's flexibility and programmability allow for customization of the buzzer's sound, including the frequency and tone, to suit different alert or emergency situations.

**PIR Sensor**

A Passive Infrared (PIR) sensor is another critical component in an alarm system that utilizes an Arduino Mega 2560 microcontroller. PIR sensors detect changes in infrared radiation levels within their field of view, allowing them to detect the movement of people or objects. When the PIR sensor detects changes in infrared radiation, it sends a signal to the microcontroller to activate an event buzzer. [6]

A PIR sensor consists of a lens that focuses infrared radiation onto a detection element, typically a pyroelectric sensor. The detection element converts the incoming infrared radiation into an electrical signal, which is then amplified and processed by the sensor's electronics. The sensor is designed to detect changes in the amount of infrared light received and is therefore sensitive to the presence of moving objects and to passers-by.

In an alarm system, a PIR sensor can be positioned in strategic locations to detect movement and trigger an alert or alarm. For example, a PIR sensor placed in a hallway could detect a person entering a protected area and send a signal to the microcontroller to activate the buzzer, signalling an intrusion alert. The sensitivity of the PIR sensor can be adjusted to prevent false alarms, such as from pets or environmental factors.

Overall, a PIR sensor can be a reliable and effective means of detecting movement in an alarm system. Its integration with an Arduino Mega 2560 microcontroller allows for precise control over how the sensor is used, improving the overall security of a space.

**RFID**

In an alarm system that is run from the Arduino Mega 2560, Radio Frequency Identification (RFID) technology is commonly used for access control. An RFID reader is connected to the Arduino Mega 2560 using an appropriate interface, such as SPI or I2C, to read unique identification tags attached to authorized users.

These tags are compared to a pre-configured list of authorized users stored in the microcontroller board's memory. If the tag is recognized, the system sends a signal to disable the alarm and allow access.

If the tag is not recognized, the alarm is triggered, and an alert is sent to the designated recipient. The integration of RFID technology into an alarm system using the Arduino Mega 2560 provides an efficient and secure access control mechanism, making it a popular choice in various applications such as home security systems, office buildings, and restricted access areas. [7]

**Keypad**

In an alarm system, a keypad is commonly used for user input, configuration, and access control. The keypad typically consists of a set of buttons, each of which corresponds to a specific numerical value or function.

When a user inputs a code on the keypad, the system processes the code and performs the appropriate action. For example, the user may input a code to arm or disarm the alarm, or to access a restricted area. To ensure security, the system may be programmed to limit the number of attempts to input a code, and to trigger an alarm or alert if an incorrect code is entered too many times.

The integration of a keypad into an alarm system provides an easy and convenient method for users to interact with the system and ensures secure access control. [8]

**Arduino Mega 2560**

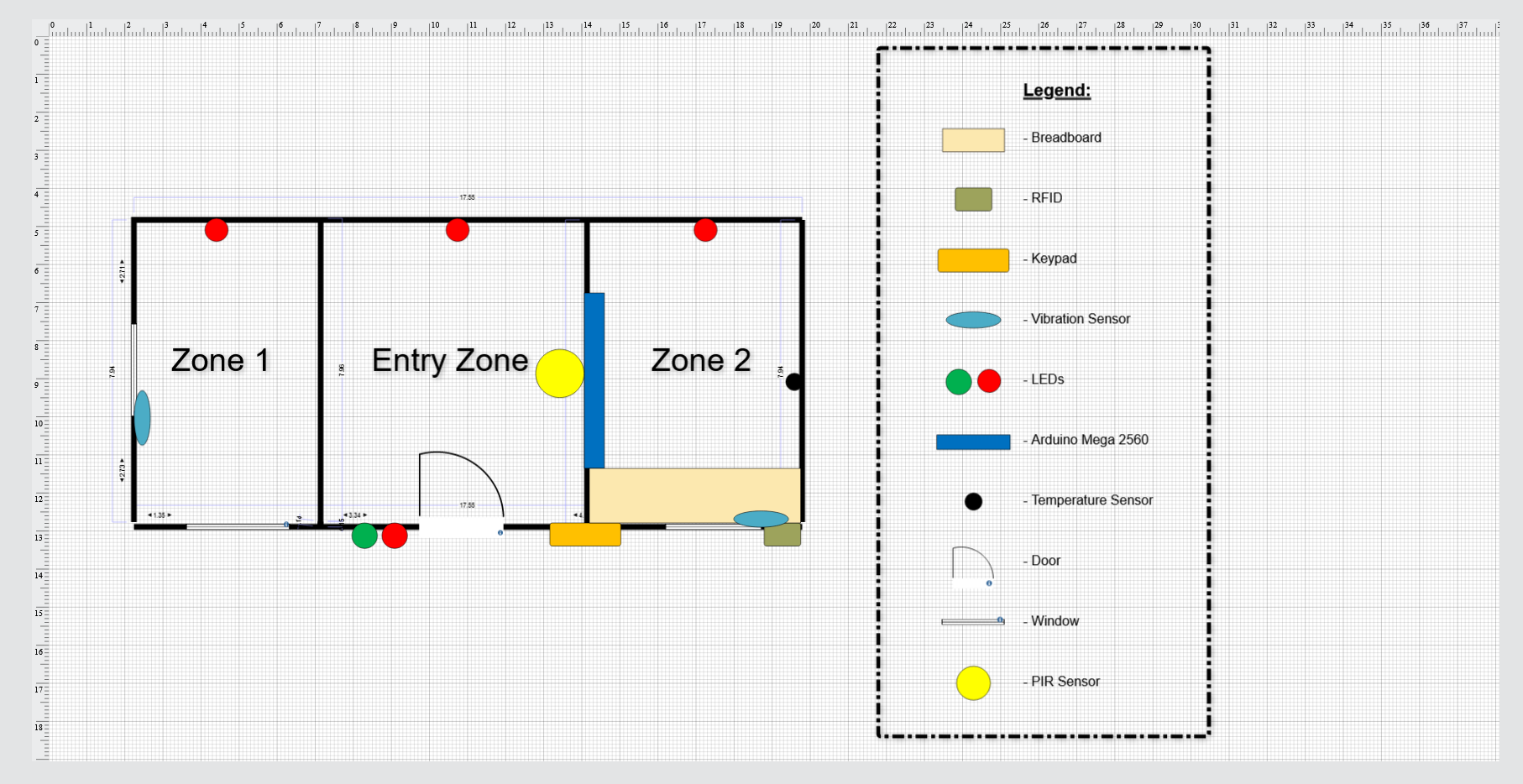
The Arduino Mega 2560 is a microcontroller board that can be programmed to control various electronic devices, including alarm systems. An alarm system can be designed using a combination of various sensors, such as PIR motion sensors, door and window contacts, and other types of sensors that can detect unusual activity.

With its various digital and analog input/output pins, the Arduino Mega 2560 can interface with sensors and control various output devices, such as sirens, buzzers, and strobe lights. The programmer can use the Arduino IDE (Integrated Development Environment) to write code to read the input from sensors and activate the output devices when an alarm condition is detected.

For instance, a PIR motion sensor can be connected to one of the digital input pins of the Arduino Mega 2560. The programmer can write code to read the input from the sensor and activate a siren or a strobe light when motion is detected. Similarly, door and window contacts can be connected to other input pins, and the programmer can write code to activate the alarm when a door or window is opened.

Overall, the Arduino Mega 2560 provides a flexible and customizable platform for building alarm systems. Its ability to interface with various sensors and output devices makes it an ideal choice for such applications. [9]

# Hardware Design



The hardware design for the alarm system project is centred around an Arduino Mega 2560 microcontroller board, which serves as the brain of the system. The board is responsible for interfacing with the various sensors and output devices used in the system and executing the code that controls their behaviour. The board is in zone 2 of the model, along with a breadboard that provides a platform for prototyping and connecting the various components.

There are three distinct zones in the model, each with its own set of sensors and output devices. Zone 1 is the entry zone and contains a front door and a PIR (Passive Infrared) motion sensor that overlooks the zone. The PIR sensor is connected to the Arduino Mega 2560's digital input pins, which allow the board to detect when the door is opened or when motion is detected in the zone.

In addition, there are two windows in zones 1 and 2, respectively, each equipped with a vibration [10]Zone 2 is an emergency zone that works independently of the alarm state. It contains a temperature sensor and a vibration sensor that are connected to the board's analog input pins.

The temperature sensor is used to detect sudden changes in temperature, which can indicate the presence of a fire, while the vibration sensor can detect any physical disturbances in the zone. When either of these sensors detects a disturbance, the board's code activates the buzzer, which is also located in zone 2, to generate an audible alarm.

The RFID (Radio Frequency Identification) reader and keypad, which are used to arm and disarm the alarm system, are located on the front of the model/house. The RFID reader is connected to the board's digital input pins, while the keypad is connected to both the board's digital input and output pins. When the correct RFID tag is presented or the correct code is entered on the keypad, the board's code sets the appropriate output pins to arm or disarm the alarm system.

Each zone contains LEDs that are connected to the board's digital output pins and serve as indicators of the alarm system's status. When the system is armed, the green LED on the front of the model lights up, and if any of the sensors in that zone are triggered, the LED for that zone lights up red to indicate the alarm's activation.

Overall, the hardware design of the alarm system project uses a combination of sensors, output devices, and a microcontroller to create a customizable and flexible platform for detecting and responding to disturbances in the designated zones. The Arduino Mega 2560's digital and analog input/output pins provide the necessary interface for connecting the various sensors and output devices used in the system, and the board's code serves as the control centre that activates the output devices when an alarm condition is detected. [10]

# Software Design

\*All code mentioned in the following section is available through the following link: <https://github.com/Cathal-Mc/TUS-Project-2>

**Arduino**

The following section of the report outlines the design of a security system that can detect and responding to various security threats such as motion, knock, and temperature. The system utilizes a combination of sensors, including a PIR motion sensor, a knock sensor, a temperature sensor, and an RFID reader, to detect these threats. The system is also equipped with a keypad for password entry and control, as well as LEDs and an alarm buzzer for signalling alarm status. This report will provide an overview of the software design of this security system, including the functions and methods used to handle various events and inputs.

The code starts by including the necessary libraries for using the keypad, password, RFID, and SPI communication. It then defines the pins for various components such as the PIR sensor, RFID reset pin, RFID SS pin, alarm buzzer, LEDs, and various sensor pins.

The RFID object is created and a boolean variable is initialized to change modes. The knock sensor pin and threshold value are defined, and temperature sensor variables are initialized. The alarm state is initialized as false, and the delay period for My\_Delay is set to 5000ms.

The keypad layout is defined, and a Keypad object is created. The maximum and current password length are defined, and a default password of "1616" is set using the Password library.

The setup function initializes the serial communication at 9600 baud rates, sets the PIR pin as an input, initializes the SPI bus and the MFRC522 RFID reader, and sets the LED and Beeper pins as an output.

The loop function calls various functions, including my\_key() to handle keypad inputs, Entry\_Exit() to check the entry/exit zone for motion, Zone\_1() to check zone 1 for knock detection, emergency() to check for overheating, and RFID() to check for an RFID card present. [11]

The Entry\_Exit() function checks if the alarm is activated and motion is detected. If motion is detected, it prints a message to the serial monitor and activates LED E, starts the countdown to disarm the alarm, and checks for an RFID card present. If the alarm is disarmed, it returns. Otherwise, it activates the alarm using the TurnOnAlarm() function.

The Zone\_1() function checks if the alarm is activated and the knock sensor threshold is exceeded. If the threshold is exceeded, it prints a message to the serial monitor and activates LED Z1. It then activates the alarm using the TurnOnAlarm() function.

The emergency() function reads the thermistor sensor value and calculates the temperature. If the temperature is above 50 degrees Celsius, it prints the temperature value to the serial monitor

The function emergency() reads the temperature using the thermistor sensor and calculates the temperature in Celsius. If the temperature is above 100 degrees Celsius or a knock is detected, the alarm is activated, and the RFID and My\_Delay functions are called. My\_Delay waits for some time before returning, while RFID checks for an RFID card and sets the alarm state based on whether the card is present.

The countdown() function counts down from 5 and waits for 1 second between each count. The TurnOnAlarm() function activates the alarm and turns on the LED and the beep sound, while the TurnOffAlarm() function turns off the alarm and all LEDs. The my\_key() function reads a key from the keypad and calls the appropriate function based on the key pressed. The processNumberKey() function is called if a number key is pressed and increases the length of the current password.

The processNumberKey function processes the number keys entered by the user. It prints the key to the serial monitor and appends the key to the password. It also increases the length of the current password. When the length of the current password reaches the maximum password length, the checkPassword function is called.

The checkPassword function checks the entered password against the stored password. If the entered password matches the stored password, the alarm is turned off, and the system is armed. If the entered password does not match the stored password, an error message is printed to the serial monitor.

The resetPassword function is called after the checkPassword function is executed, regardless of whether the entered password matches or not. It resets the password and the length of the current password.

**Processing**

The code begins by importing the Serial library and declaring the Serial object myPort, which is used to communicate with the serial port. A string variable val is declared to store the data received from the serial port. The code also declares a PrintWriter object output to log events to a file and a string variable dateTime to store the current date and time.

In the setup() function, the Serial object is initialized with the appropriate port and baud rate. A new file named "log.txt" is created to log events to. The current date and time are obtained and formatted. A message indicating when the program started is printed to the console and logged to the file. The output is flushed to ensure that the message is written to the file. The size of the window is set to 1000 x 800 pixels, and the background colour is set to white. Rectangles are drawn to represent three zones of the alarm system, and text is added to label each zone.

In the draw() function, the code checks if data is available from the serial port. If data is available, the data is read from the serial port and stored in the val variable. Any leading or trailing whitespace is removed from the val variable. The code then checks if val is not null. If val is not null, the code checks if the value of val equals "Main Door: Motion detected." or "Emergency Zone 2" or "Zone 1 Detection" or "Alarm Disarmed". If the value of val equals any of these, the code changes the colour of the appropriate zone rectangle to red, adds text to the rectangle, and logs the event with a message.

# Implementation

The hardware and software design of the alarm system project have been described in detail in the previous sections. This section will discuss the implementation of the system and how the design was translated into a functioning prototype.

**Hardware Implementation:**

The hardware implementation of the alarm system project was carried out using the Arduino Mega 2560 microcontroller board as the principal component. The board was connected to various sensors and output devices, including a PIR motion sensor, vibration sensors, temperature sensor, RFID reader, keypad, buzzer, and LEDs. The connections were made using jumper wires and a breadboard.

The front door, windows, and other components were designed using a cardboard box. The components were assembled to create a model/house that served as the physical platform for the alarm system. The model/house was designed to be modular so that the sensors and output devices could be easily added or removed.

**Software Implementation:**

The software implementation of the alarm system project was carried out using the Arduino Integrated Development Environment (IDE). The code was written in C++ and uploaded to the Arduino Mega 2560 microcontroller board using a USB cable.

The code started by including the necessary libraries for using the keypad, password, RFID, and SPI communication. It then defined the pins for various components such as the PIR sensor, RFID reset pin, RFID SS pin, alarm buzzer, LEDs, and various sensor pins.

The RFID object was created, and a boolean variable was initialized to change modes. The knock sensor pin and threshold value were defined, and temperature sensor variables were initialized. The alarm state was initialized as false, and the delay period for My\_Delay was set to 5000ms.

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The Zone\_1() function checked if the alarm was activated, and the knock sensor threshold was exceeded. If the threshold was exceeded, it printed a message to the serial monitor and activated LED Z1. It then activated the alarm using the TurnOnAlarm() function.

The emergency() function read the thermistor sensor value and calculated the temperature. If the temperature was above 50 degrees Celsius, it printed the temperature value to the serial monitor. If the temperature was above 100 degrees Celsius or a knock was detected, the alarm was activated, and the RFID and My\_Delay functions were called. My\_Delay waited for some time before returning, while RFID checked for an RFID card and set the alarm state accordingly.

# Testing & Evaluation

**Temperature Sensor:**

To ensure that the temperature and vibration sensors were functioning properly, and the alarm system was responding appropriately, testing and evaluation was carried out on the model. The testing process involved exposing the temperature sensors to a range of temperatures to check if the sensors were accurately measuring the temperature and triggering the alarm system when necessary.

**Vibration Sensor:**

Like the temperature sensors, vibration sensors were also tested for their accuracy and sensitivity. They were subjected to distinct levels of vibration to check if they were detecting and measuring vibration correctly. The sensitivity of the sensors was also evaluated to ensure that they could detect even the slightest movements. Any discrepancies or issues were addressed and corrected to ensure that the sensors were functioning accurately.

**RFID and Keypad:**

Testing was performed on both the RFID and keypad components to verify their accuracy and effectiveness in arming and disarming the alarm system. The RFID system was tested to ensure that it was reading the RFID tags correctly and only allowing authorized users to disarm the alarm. The keypad was also tested to ensure that the system could be armed and disarmed with a secure PIN code.

**PIR Sensor:**

The PIR sensor was tested to ensure that it was detecting motion accurately and that the firmware was responding appropriately to the sensor's readings. The system was evaluated for its ability to differentiate between normal movements and suspicious activities and trigger the alarm system accordingly.

**Arduino Code:**

The firmware running on the Arduino Mega 2560 was critical to the overall performance of the alarm system. Testing was carried out on the code to ensure that it was accurately reading and processing the sensor data. The code was analysed to ensure that it was triggering the alarm system when necessary and disarming it when appropriate. The code was also evaluated for its response time and accuracy in detecting and responding to potential threats. Any issues or bugs in the code were identified and corrected to ensure that the system was operating as intended.

**Processing Code:**

The processing code running on the computer was responsible for analysing the data collected from the sensors and displaying it in a meaningful way to the user. Testing was performed on the processing code to ensure that it was correctly receiving and processing the data from the Arduino Mega 2560. The code was evaluated for its ability to display the sensor data in real-time and trigger alarms when necessary.

The processing code was also tested to ensure that it was responsive and accurate in identifying potential threats. Any issues or bugs in the processing code were identified and corrected to ensure that the system was operating reliably and accurately.

**LCD Screen:**

Despite efforts to integrate the LCD screen into the alarm system, it was unable to print text, despite the backlight working correctly. Multiple configurations were attempted, including using normal resistors and a potentiometer to adjust the contrast, but none proved effective. As the LCD screen was not critical to the overall functionality of the alarm system, a decision was made to remove it from the model. Through testing and the evaluation process, the issue with the LCD screen was identified and the necessary adjustments were made to ensure that the alarm system's performance was not impacted.

# Future Development

After completing the project and model, while the alarm system operated as desired and served the purpose of a complex alarm system, there are some improvements that could be made in future developments to enhance the alarm system. They are as follows:

**LCD Screen:**

As mentioned above, the initial design of the model included an LCD in its design. However, after thorough testing and evaluation, the decision was made to remove the LCD screen form the model entirely.

In regarding to future developments of the model, the addition of an LCD screen could provide valuable information to the user without the need of connecting the model to a PC. With an LCD screen, the user could easily see the status of the alarm system, such as whether it is armed or disarmed, and any detected threats. Additionally, an LCD screen could display the status of individual sensors in the system, allowing the user to quickly identify any malfunctions or issues.

While the LCD screen may not be essential to the overall functionality of the alarm system, it could enhance the user experience by providing more detailed and specific information about the system's status.

**Wireless Capabilities:**

In future developments of the alarm system, the addition of wireless capabilities could enhance the system's remote-control capabilities. By integrating wireless connectivity, the user could remotely control the alarm system and receive notifications about detected threats or malfunctions.

Additionally, wireless connectivity could enable the user to use the processing code without having to physically connect the alarm system to a PC. This would provide a more convenient way for the user to monitor and control the system.

**Processing:**

Improve the graphical user interface: The interface currently includes a menu bar, several text entry fields, and a button to trigger the system's functionality. In future developments, the GUI can be improved by adding more features such as a file browser, drag-and-drop functionality, and real-time visual feedback to enhance the user experience.

Integrate with a database: The system could be integrated with a database to store events and generate reports. In the model’s current condition, the system generates a new log every time the program is run. Ideally, each log file that is generated should be saved in a database to improve the overall security of the system.

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# Conclusion

In conclusion, the development of an alarm system using an Arduino Mega 2560 has been a successful project, made possible by thorough research, careful hardware and software design, implementation, and testing.

The background research that was conducted for the project provided a comprehensive understanding of the components and technologies required to build a functional alarm system.

Hardware design included the integration of temperature sensors, vibration sensors, LEDs, RFID, keypad, PIR sensors, and an LCD screen (although the latter was removed).

As seen in the software design section of the report, it included the creation of reliable and flexible control systems through Arduino and processing code. The implementation phase involved the careful assembly and integration of all the hardware components and code.

Aa mentioned in the testing and evaluation section of the report, it was imperative that the alarm system met project objectives and provided reliable threat detection and user interaction. Which, after thorough testing and modifications the alarm system met all project objectives.

Finally, future developments of the alarm system could include the addition of wireless capabilities for remote control and the inclusion of an LCD screen for enhanced user experience.

Overall, the development of an alarm system using an Arduino Mega 2560 has been a successful project, achieving its objectives of providing comprehensive threat detection and reliable user interaction. Despite some issues with the LCD screen, the integration of temperature sensors, vibration sensors, LEDs, RFID, keypad, PIR sensors, and reliable control systems through Arduino and processing code demonstrated the potential of microcontrollers for DIY home security solutions. This project highlights the importance of thorough planning, careful design, and testing in the successful implementation of such projects.

\*All code mentioned in the software design section is available through the following link: <https://github.com/Cathal-Mc/TUS-Project-2>

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