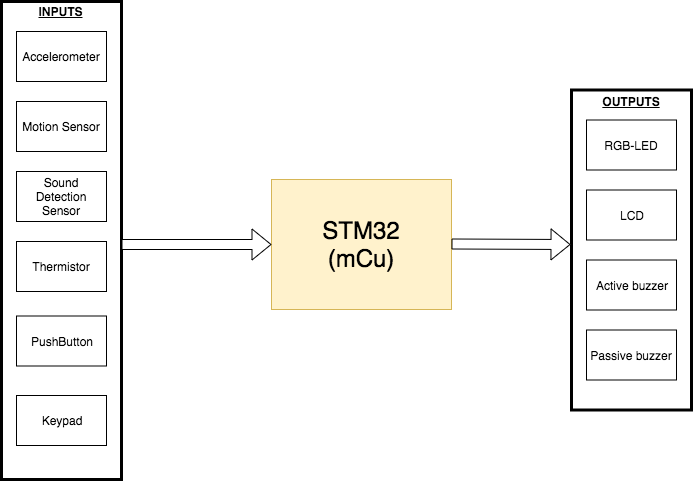
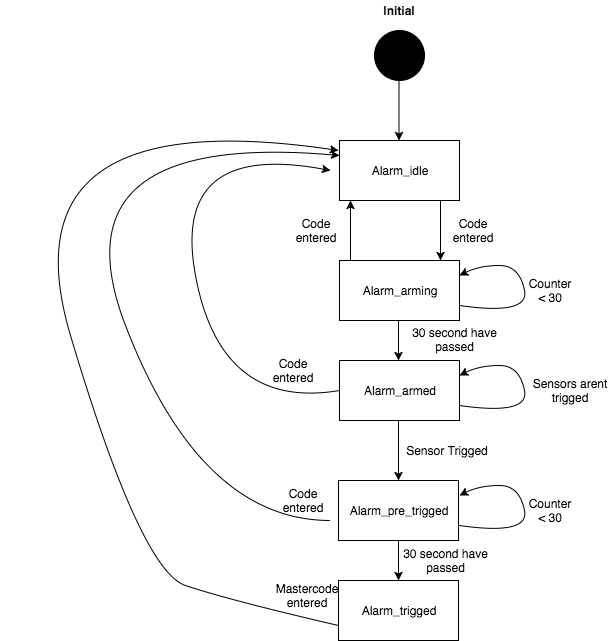
**OVERVIEW**

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**COMPONENTS**

* STM32F401RE NUCLEO-64
* LCD 20X4
* Keypad 4X4
* PIR motion sensor
* RGB LED
* ADXL345
* Sound detection sensor
* Pushbutton
* 2x breadboards
* YWROBOT POWER MB
* 6.5-12v PSU/ BATTERY
* 2x Buzzers
* Wires
* Thermistor
* Resistors

**STATE MACHINE**



**FULFILLED REQUIREMENTS**

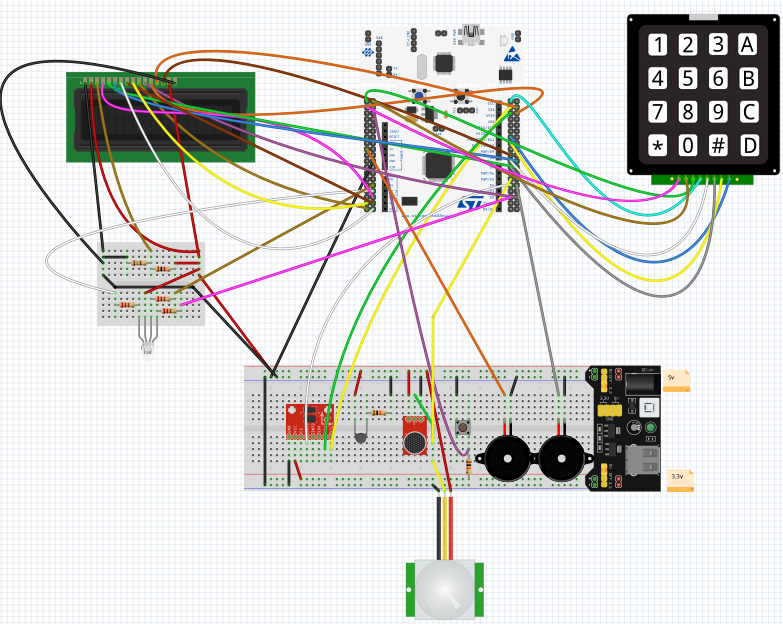
* An alarm system with an access panel consisting of a display and a keypad. A user interface is shown on the display presenting the status of the alarm and the possibility to deactivate/active the alarm with a 4 digits long code.
* LEDS indicating the current state.
* A PIR motion sensor to detect any thermal activities.
* A mechanical switch integrated beneath the diamond.
* Two buzzers
* Temperature sensor is added to measure any temperature changes and will then compare it to the set temperature.
* The set temperature is programmable via the keypad in the idle state by pressing the ‘A’ key on the keypad.
* An accelerometer is added and used in the activity interrupt mode. The accelerometer will generate an interrupt indicating that an intruder is detected.
* The threshold level for the accelerometer can be programmed by pressing the ‘B’ key on the keypad.

**ADDITIONAL FEATURES**

* Sound detection sensor
* The ‘D’ key works as a delete button when entering the code.
* The user code can be changed in idle state.
* A single RGB-LED instead of three LEDS.
* A bigger LCD-screen
* A cross-platform Application displaying the actual state of the alarm and the temperature.

**PINOUT & SCHEMATICS**

|  |  |  |  |
| --- | --- | --- | --- |
| PIN LABEL | PIN NUMBER | PIN DESCRIPTION | GPIO MODE |
| LCD\_D0 | PC0 | LCD DATA PIN 0 | OUTPUT |
| LCD\_D1 | PC1 | LCD DATA PIN 1 | OUTPUT |
| LCD\_D2 | PC2 | LCD DATA PIN 2 | OUTPUT |
| LCD\_D3 | PC3 | LCD DATA PIN 3 | OUTPUT |
| LCD\_D4 | PC4 | LCD DATA PIN 4 | OUTPUT |
| LCD\_D5 | PC5 | LCD DATA PIN 5 | OUTPUT |
| LCD\_D6 | PC6 | LCD DATA PIN 6 | OUTPUT |
| LCD\_D7 | PC7 | LCD DATA PIN7 | OUTPUT |
| LCD\_RS | PB0 | LCD RS PIN | OUTPUT |
| LCD\_RW | PB1 | LCD RW PIN | OUTPUT |
| LCD\_E | PB2 | LCD ENABLE PIN | OUTPUT |
| PAD\_COLUMN\_1 | PA6 | KEYPAD COLUMN 1 | OUTPUT |
| PAD\_COLUMN\_2 | PA7 | KEYPAD COLUMN 2 | OUTPUT |
| PAD\_COLUMN\_3 | PA8 | KEYPAD COLUMN 3 | OUTPUT |
| PAD\_COLUMN\_4 | PA9 | KEYPAD COLUMN 4 | OUTPUT |
| PAD\_ROW\_1 | PC9 | KEYPAD ROW 1 | INPUT |
| PAD\_ROW\_2 | PC10 | KEYPAD ROW 2 | INPUT |
| PAD\_ROW\_3 | PC11 | KEYPAD ROW 3 | INPUT |
| PAD\_ROW\_4 | PC12 | KEYPAD ROW 4 | INPUT |
| ADC1\_IN0 | PA0 | THERMISTOR | INPUT |
| LED\_BLUE | PA10 | RGB-LED BLUE PIN | OUTPUT |
| LED\_RED | PA4 | RGB-LED RED PIN | OUTPUT |
| LED\_GREEN | PA1 | RGB-LED GREEN PIN | OUTPUT |
| I2C1\_SCL | PB8 | SCL TO ADXL345 | I2C |
| I2C\_SDA | PB9 | SDA TO ADXL345 | I2C |
| GPIO\_EXTI2 | PD2 | EXTERNAL INTERRUPT ADXL345 | EXTI |
| GPIO\_EXTI4 | PB4 | EXTERNAL INTERRUPT PIR/SOUND | EXTI |
| GPIO\_EXTI5 | PB5 | EXTERNAL INTERRUPT BUTTON | EXTI |
| TIM2\_CH1 | PA15 | BUZZER | PWM |
| ACTIVE\_BUZZER | PB13 | ACTIVE BUZZER | OUTPUT |



**CODE IMPLEMENTATION**

The code is divided into a couple of header/source files. The main part of the program is implemented in the alarm source file.

**Enums defined in the alarm header file**

|  |  |  |
| --- | --- | --- |
| Name | Values | Description |
| Alarm\_state | Alarm\_init, Alarm\_idle, Alarm\_arming, Alarm\_armed, Alarm\_PRE\_Trigged, Alarm\_Trigged, Alarm\_SetTemp, Alarm\_SetGyro, Alarm\_setCode | Contains all the states for the  state machine. |
| Key\_Code | Key\_No\_Pressed, Key\_Pressed,  Key\_OK,Key\_Wrong, Key\_A, Key\_B, Key\_C, Key\_D | This enum is used for the  function that returns the current state of the keypad. The function does also check if the right code is entered. |
| Sensor\_status | NONE, Motion\_Trigged,  Sound\_Trigged, Diamond\_Trigged | This enum is used to indicate  the states of the sensors. A variable of this type is declared and used together with the external interrupts to indicate the states of the sensors. |
| LED\_COLOR | L\_OFF, L\_RED, L\_YELLOW,  L\_GREEN | Contains all the different states  the led can have in this program. |
| LCD\_Status | LCD\_NONE, LCD\_Unlocked,  LCD\_Locked, LCD\_Arming, LCD\_PRI\_Trigged, LCD\_Trigged, LCD\_SetTemp, LCD\_SetGyro, LCD\_SetCode | This enum is like the alarm enum and is used to control the printed text on the LCD. |

**Functions defined in alarm header file**

|  |  |  |  |
| --- | --- | --- | --- |
| Function type | Function name | Function paramter list | Function description |
| void | Alarm\_status | void | The alarm state machine is implemented in this function and every state calls a function. |
| Alarm\_state | A\_idle | TextLCDType lcd, uint8\_t setTemp,  uint8\_t code | This function is specifically for the idle state and relies on the function that checks the keypad status. |
| Alarm\_state | A\_arming | TextLCDType lcd, uint8\_t code | This function is specifically for the arming  state and returns a different state either if the code is entered or 30 seconds have passed |
| Alarm\_state | A\_armed | TextLCDType lcd, uint8\_t setTemp,  uint8\_t code | This function is specifically for the armed state and returns a different state if a sensor is trigged or the code is entered |
| Alarm\_state | A\_Pre\_Trigged | TextLCDType lcd, uint8\_t code | This function is for the pre\_trigged state and contains a counter |
| Alarm\_state | A\_Trigged | TextLCDType lcd | If the user doesn’t enter code when the alarm is set of will this function  run and handle the Trigged state |
| Alarm\_state | A\_setTemp | TextLCDType lcd, uint8\_t setTemp, | This function will run when the user enters the setTemp state and handles all the setups when the user want to change Temperature |
| Alarm\_state | A\_setGyro | TextLCDType lcd | Works like A\_setTemp but changes the threshold of the gyro instead |
| Alarm\_state | A\_setCode | TextLCDType lcd, uint8\_t code | Works like A\_setTemp and A\_setGyro but changes the code instead |
| Key\_code | Alarm\_code\_status | uint8\_t code | Handles the code input |
| void | update\_lcd | TextLCDType lcd, LCD\_status tmpS | Used to update the text print out on the LCD |
| void | lcd\_clearRow | TextLCDType lcd, uint8\_t row | Clears a row on the LCD |
| uint8\_t | check\_sensors | uint8\_t setTemp | Checks the status of the sensors and temperature |
| int16\_t | Read\_analog\_Temp | void | Reads the Analog value of the thermistor and converts it to a temperature in Celsius |
| void | Toggle\_Buzzer | void | Handles thee passive buzzer |
| void | set\_Led | Led\_Color ld | Used to set the color of the RGB led |

**Functions defined in the keypad**