EMERGENCY ALERT SYSTEM FOR PATIENTS

GROUPS 11&12

GROUP MEMBERS

Richel Naa Odarkor Wellington (1808122)

Jerry Enyan Kumi (1805322)

Kevin Papa K. Bekoe (1802822)

Asare Ida Akua Adobea (1802122)

Justice A. A. Adugdaa (1800022)

Steven Kwaw Donkor (1803822)

Joyce Yetsa Amable (1800822)

Afia Ampomah Fosu-Gyeabour (1804422)

Umeh Joy O.(1808022)

Egyir Maxwell Kofi (1804022)

PROBLEM STATEMENT

In all medical facilities and hospitals, timely communication and response during emergencies are crucial to saving lives. Current methods of alerting hospital staff, such as paging systems and manual notifications, can not only be inefficient, but life costly. There is the need for an automated and swift emergency alert system that can instantly notify the relevant medical staff and departments when a patient is in need of urgent attention.

The goal of this project is to design and simulate an emerging alert system for hospitals which meets the criteria previously.

METHODOLOGY

Introduction

This project entails the development of an emergency alert system catered to patients, enabling them to trigger a number of emergency alerts via the push of a button, alerting their respective caregivers. This system was simulated using an ESP32 via Wokwi, with the implementation of the code in C++. This simulation is based on the assumption that, in a real-world application, the buttons would be placed near the patient's bedside, while the alert screens would be located at the nursing stations.

System Overview

This overview will include an explanation of both the workings of the system simulated and how it is envisioned to work in a hospital setting. Four different push buttons are integrated to form this emergency alert system. Each of these buttons have respective functions and are colour coded in way to promote easy distinction by the patients.

When the 'Emergency Fire Button,' indicated by a bright red colour, is pressed, a high-frequency buzzer immediately sounds. Apart from this buzzer, a red LED lights up, serving as a visual indicator of the activation of the button. A bold message including the words “Fire Emergency” and the specific department encountering this hazard is then displayed on the OLED screen; however, in a hospital setting, this message or alert is expected to display on the screens situated at the different nursing stations.

When the ‘Medical Button’, indicated by a blue colour, is pressed, a buzzer sound with an appropriate frequency is heard. In addition to this buzzer sound is a blue LED which lights up following the activation of the button. A prominent message containing “Medical Emergency”, the

patient's name, the room number, and the specific department the patient resides is displayed on the screen.

Finally, when the 'Security Button', depicted in green, is pushed, a loud buzzer sounds, and a green LED turns on. The words "Security Alert" and the location of this incident are clearly displayed on the screen.

The buzzer sound, the LED, and the displayed alert are deactivated by the push of the black stop button. In the hospital setting, this push button is expected to be pressed by the healthcare practitioner once the alert has been successfully conveyed. The reason for a one-time activation of the buttons is to cater to variety of patients in the hospitals, especially those with severe hand disorders and patients who may fall unconscious as they are seeking assistance.

Hardware Implementation

The components used for this simulation are LEDs, resistors, pushbuttons, ESP32 microcontroller, OLED display, breadboard, buzzer, and jumpier wires.

- Pushbuttons - The system includes three 6mm pushbuttons and one larger pushbutton. The three 6mm pushbuttons are used to trigger different emergency alerts when activated by the patient.
    - Red push button - Displays Fire Emergency Alert along with the department of the fire outbreak.
    - Blue push button – Displays Medical Emergency Alert along with the name of the patient, the room number, and the department.
    - Green push button – Displays Security Alert along with the department facing the issue.
    - The larger black push button deactivates these above-stated pushbuttons when activated.

- LEDs – Three LEDs are integrated in this emergency alert system, colour coded in a way to match the three 6mm pushbuttons. Once the coloured push button matching with the LED is activated, the LED lights up. This serves as a visual indicator or confirmation of the activation of the pushbutton.

- Resistors – Three different resistors each having resistance of 220 ohms are connected in series with each of the LEDs. These resistors limit the current flowing through the LED, preventing current overflow and a possible damage to the LED.

- Buzzer – The buzzer produces a high frequency sound when activated. This is

to ensure that the activation of the button is noticed by the healthcare practitioners when they are not near the display screen.

- OLED Display -The OLED display used was the SSD1306 OLED display. It is on this OLED that the respective emergency alerts are displayed along with the necessary information accompanied with the alerts.

- Breadboard – A half breadboard was used to implement the connections of the components which could not fit the microcontroller due to the number of components used.

- ESP32-S3—This serves as the central processing unit, handling input from the button and triggering responses. The main reason for choosing the ESP32-S3 for this project is its built-in Wi-Fi and Bluetooth capabilities, which enables real-time communication and dashboard hosting to nurses and doctors who happen to not be around central stations but are needed during an emergency.

  Additionally, the ESP32-S3 offers low power consumption, making it suitable for continuous usage for a long period of time. Its multiple GPIO (general purpose input/output) pins allow for the easy connection of the buttons, buzzer, OLED and LEDs, while its high processing power ensures smooth handling of input signals and web interface updates.

  The ESP32 is advantageous because of its Wi-Fi integration feature, enabling internet connection for a variety of applications.

- Jumper-wires— These color-coded wires were used to connect the components to the breadboard, the microcontroller, and in some cases to other components.
- Local Web Dashboard — Hosted on the ESP32-S3, allowing caregivers to monitor alerts in real time from the central station and anywhere else within the facility as long as they are connected to the local network. The dashboard displays information such as patient name, room number and the department they can be found in and the kind of emergency being faced.

Software Implementation

This section has to do with the design and setup of the hardware and software parts of the project. The simulation was programmed using C++ programming language coupled with Arduino syntax. Some detailed explanations of important parts of the code are provided below;

- Setup function (void setup()):
  - Debugging begins by initializing serial communication.

    - Button pins are defined as input_pullup instead of input to eliminate the need for resistors, setting their default states to high.
    - The LED and buzzer pins are defined as outputs.
    - The OLED parameters are set, including the text size and text colour.

- Loop Functions (void loop()):
    - An if statement is used to ensure that if any of the emergency buttons (fire button, medical button, and security button) are pressed(states low due to the input_pullup), the function for the activation of the appropriate LED, buzzer and the alert is called. These are deactivated when the stop button is activated.

- Emergency Alert Functions
    - void activateFireAlert(Emergency Location location) - This function turns on the fire LED, activates the buzzer and displays an emergency alert.
    - void activateMedicalAlert(Patient patient)- This function turns on the medical LED, activates the buzzer, and displays a medical emergency alert.
    - void activateSecurityAlert(EmergencyLocation location)- This function turns on the security LED, activates the buzzer, and displays a security alert.
    - void deactivateAlert() – This function turns off the LEDs and buzzer pins and displays “System Normal”.

Testing

To test the functionality of the simulation, each button was pressed to confirm that it produced the expected response. The fire emergency button successfully turned on the fire LED and the buzzer, and it displayed the expected emergency alert on the OLED display screen. The alerts only stopped when the stop pushbutton was pressed, which also deactivated the LED and the buzzer, as required. The same results were seen when the security button and the medical button were pushed.

CONCLUSION

This project successfully develops an emergency alert system designed to improve patient safety and communication in hospitals. By simply pressing a button, patients can instantly alert medical staff to emergencies, whether it's a fire, a medical crisis, or a security problem. The combination of visual (LEDs and an OLED display) and sound alerts ensures that caregivers are promptly notified. Additionally, the integration of a local web dashboard allows real-time monitoring, making it easier for nurses and doctors to respond quickly, even if they’re away from the central station. Through testing, the system proved to be reliable and responsive, demonstrating its

potential to enhance hospital emergency response and ultimately improve emergency response routines.

REFERENCES

1. https://projecthub.arduino.cc/jobitjoseph/oled-display-interfacing-with-arduino-263cef

2. https://docs.arduino.cc/tutorials/generic/digital-input-pullup/

3. https://projecthub.arduino.cc/jeffreythecoder/cura-a-health-emergency-alert-for-seniors-we-care-3bb2c9