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Safety Grill with Fire Alarm System for Building Emergency Evacuation

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Abstract Fire incidents pose a serious threat to both property and personal safety in society. Existing door and window grill systems often lack ease of use, hindering self-rescue and external assistance during emergencies. To address this issue, this work proposes a "safety grill with fire alarm system for building emergency action." This system integrates an automatic window grill with a fire alarm, utilizing the Durian UNO, DS18b20 Water Proof Temperature Sensor, and the Blynk application to detect temperature changes, unlock the grill, and activate alarms. Notably, the system accommodates various users, including adults, the elderly, children, and individuals with disabilities. The developed prototype successfully combines automatic window grill activation with a fire alarm system, ensuring timely response to temperature increases. Through the integration of the Durian UNO, DS18b20 Water Proof Temperature Sensor, and Blynk application, the system can swiftly detect temperature changes and unlock the grill, allowing occupants to escape. Furthermore, the system incorporates remote monitoring, enabling real-time alerts to be sent to designated personnel during emergencies, enhancing overall safety measures.

Keywords: Fire Incidents, Emergency Action, Fire Alarm System, Blynk Application

1. Introduction

This work delves into the vital topic of building safety, emphasizing its significance within the context of housing as a fundamental human need. Iron-grill windows, commonly used for security, underscore the importance of personal and property safety. However, the increasing frequency of fires in Malaysia necessitates a heightened public understanding of building safety [1]. The work centers on a literature review that highlights a tragic incident at the Darul Quran Ittifaqiyah religious school in Kuala Lumpur. This catastrophe claimed the lives of twenty-five individuals, primarily teenage boys, as a fire engulfed the school. Notably, the very safety features meant to protect hindered escape efforts – permanent grills obstructed the children from fleeing the blaze [2]. The paper calls for a shift in architectural thinking, urging a fusion of aesthetics and safety. It advocates for proactive measures,

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encompassing fire prevention, early detection systems, and effective fire control strategies, all aimed at creating resilient structures [3].

2. Materials and Methods

2.1 Materials

Figure 1 shows the block diagram depicts the major steps taken from sensor to output using the internet of things (IoT).

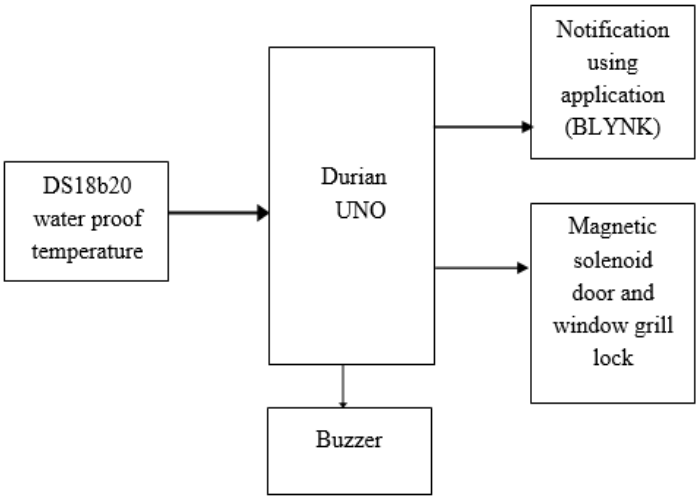

Figure 1: The Block diagram for proposed system

- Design and Implementation of a Comprehensive Building Safety System with IoT Integration
  This study aims to evaluate the performance of design monitoring systems using the software. The effectiveness of the implementation of this device was analyzed and proven using the Arduino IDE software and Blynk. The system receives the input and then transmits the data to the main processing unit. The obtained data is subsequently analyzed by the Durian Uno and displayed on the Blynk platform. The Arduino IDE software is widely used in IoT applications. The applications were generally user-friendly, comprehensive, and open-source software. The researchers then display the data using the Blynk program. Data may be monitored using mobile apps. Hence, the design approach for safety grill with fire alarm system for building emergency evacuation system includes components such as Durian Uno, DS18b20 water proof temperature sensor, magnetic solenoid lock, and buzzer. However, the process of developing measured factors were included in the design of this model to attain functionality and dependability. Therefore, it is essential for checking the continuity in the sensor for identifying defective components at an early stage. Although, it also assists in evaluating the soldering quality.

- Software Integration and Control in Building Safety System Design
  The software is a vital component of the programming created by to develop the system. In this study was utilizing an Arduino IDE and Blynk application to implementing the hardware. Furthermore, the Arduino IDE is widely used in IoT applications. In fact, it was a user-friendly and open-source software. Thus, it simpler to create and submit the code to the device. Besides, it is establishing a connection with hardware to upload and interact with programs. Next, a Blynk application is an IoT platform for iOS and Android devices that enables internet-based control [4]. The Blynk program can display all the device's input parameters. When a microcontroller is connected to a power source and Wi-Fi, it immediately links to the Blynk. Although it would display on the serial monitor of the Arduino IDE and the Blynk application.

2.2 Methods

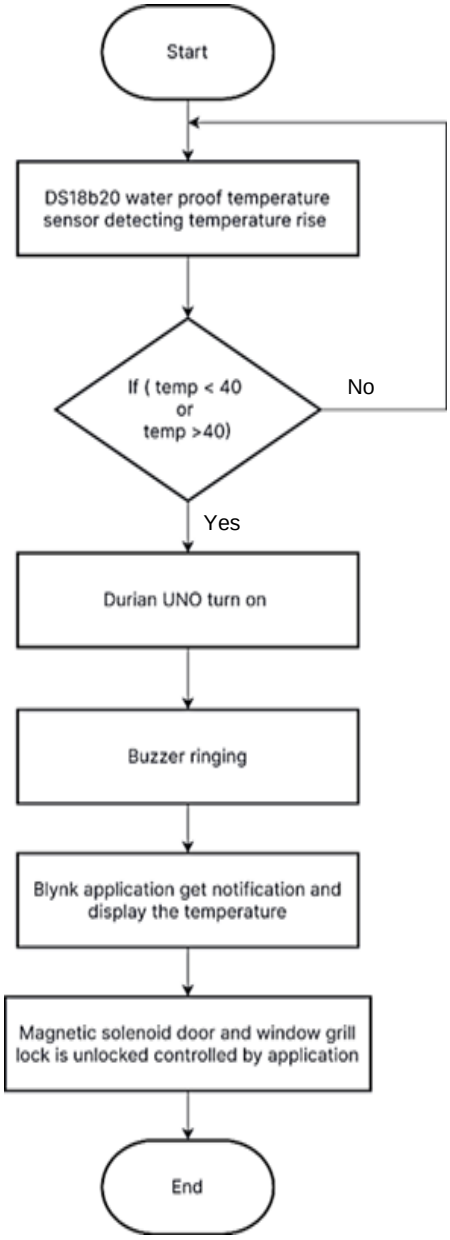

Figure 2: The operational of the proposed system

A safety grill would merge software and hardware into an effective device. Initially, need to design coding using Arduino IDE. Then, setup for detect the temperature and open close lock activity. Thus, the hardware part needs to check the functionality such as checking the continuity of each component. Furthermore, integrate the software and hardware. And then the process flow consists of many phases, including connecting to Wi-Fi on Blynk and the Durian Uno. Once the system connects to Wi-Fi following the activation of the device, the sensors begin working. Consequently, it would continue to read the value and show the data on the serial monitor in the Arduino IDE and the Blynk application on the web and smartphone.

In short, create a safety grill with a fire alarm system for building emergency evacuation based on desired criteria such as temperature, notification, and fire alarm. Figure 2 shows how the information is processed by a microcontroller (Durian Uno) and how the buzzer will sound as a fire alarm. The microcontroller (Durian Uno) will then transfer data to the application (Blynk) and notify it of the temperature rise. The application (Blynk) will then control the magnetic solenoid lock, which will either

unlock or lock. Furthermore, the temperature rise display contributes to the application (Blynk) while it is visible.

3. Results and Discussion

3.1 Results

The DS18b20 water resistant temperature sensor detects temperature rises caused by fire and transmits signals to the Durian Uno. An application will thus activate and control the buzzer, application (Blynk), and magnetic solenoid window grill lock. Following that, an application can lock the magnetic solenoid lock window grill while the buzzer turns off automatically. The level of security and technology will improve as the system is improved. Furthermore, this system will undoubtedly provide users with an option when they are trapped inside a burning building, allowing them to either escape or be rescued by firemen.

Figure 3 depicts the prototype involves the creation of an automatic window grill and fire alarm system using a microcontroller box, mobile phone displays, and physical door and window grilles. The prototype's design emphasizes functionality, user interaction, and realism. Mobile phones serve as display interfaces, while reused boxes are used for the prototype's body, reflecting a sustainable approach. The inclusion of physical grilles enhances the prototype's practicality. Overall, the prototype effectively demonstrates the system's features and design considerations, incorporating both electronic components and real-world elements.

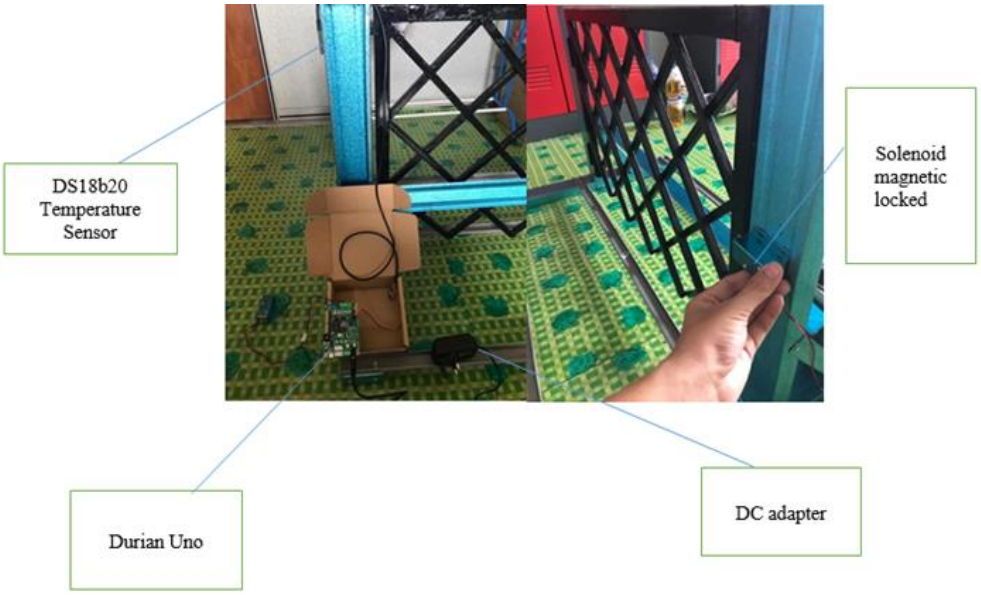

Figure 3: Prototype of proposed system

In Figure 4, the temperature rise can be seen, and the temperature sensor triggered when the temperature exceeded 40 degrees Celsius, and the data was sent via an application (Blynk). The prototype successfully incorporates a fire alarm system with temperature sensing, triggered when temperatures surpass 40 degrees Celsius. This threshold is strategically chosen due to its alignment with early signs of fire hazard and established safety standards. Materials tend to undergo thermal degradation and combustion around this temperature, making it a reliable indicator of fire initiation. The prototype's positive test results validate the effectiveness of this threshold in detecting potential fire-related incidents promptly, thus enhancing safety and demonstrating the system's alignment with industry standards.

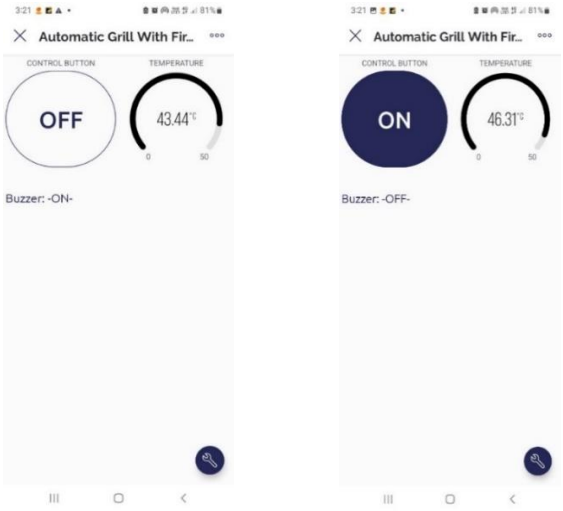

Figure 4: Serial monitor when temperature rise

3.2 Discussions

Circuit testing is performed to ensure that all components function properly. Figure 5 depicts breadboard view for window grill with fire alarm system created using Tinkercad software. These components form a circuit that detects the reed switch's status (open or closed) and sounds an alarm if the door or window is opened. Through the digital input pin, the Arduino reads the status of the reed switch and controls the motor and buzzer accordingly. By simulating this circuit in Tinkercad, its can observe the behavior of the components in response to the status of the reed switch, allowing you to test and refine the functionality of the door and window grill with the fire alarm system

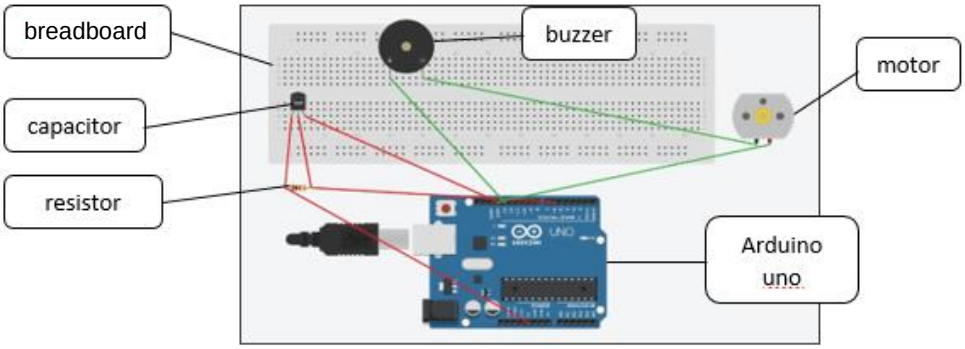

Figure 5: Breadboard view for window grill with fire alarm system

Table 1 provides an overview of the magnetic solenoid lock is controlled based on the temperature readings from the DS18b20 waterproof temperature sensor. When the temperature rises and is detected by the sensor, the lock is unlocked, the buzzer is turned on, and the application receives a signal. However, if the temperature does not rise or if the application control is set to 'ON', the lock remains locked, the buzzer is turned off, and no signal is received by the application.

Table 1: Result of sensor testing

Process	Magnetic solenoid lock	Application (Blynk)	Buzzer
Temperature rise.	Unlock	Turn on	Turn on
Temperature rise and an application receive signal from sensor.	Unlock	Turn on	Turn on
Not detecting a rise in temperature.	Lock	Turn off	Turn off
Application control is ‘ON’	Unlock	Turn on	Turn off

4. Conclusion

In conclusion, a lock system is constantly updated and practiced all over the world. Despite the introduction of this type of system, traditional lock systems are still in use today. Furthermore, most of us continue to priorities home security and personal property over our own safety. As evidence, permanent window grills, which are a traditional lock system, are still used today. This work aims to improve the system so that it is more effective for the user, especially in the event of a fire. As a result, the development of a safety grill equipped with a fire alarm system was a success. As a result of prototype testing, the first goal of this work is met. This work enables the combination and design of a safety grill lock system that includes a fire alarm system as well as the use of an application as a building safety system. The second goal is then accomplished. The proposed system can assist users in escaping a fire by unlocking the door and window grill using the application (Blynk) as the sensor DS18b20 water proof temperature detects the presence of combustible gas or a temperature rise. An application also can display the reading for temperature rise during emergency. Last but not least, the third goal is accomplished. When an emergency occurs, the system function can be analyzed with the goal of designing a safety system that ensures users' places are designed and provided with an appropriate level of safety such as prevention, early detection, and control, which means that if a fire occurs, an application (Blynk) and buzzer will be activated, while the magnetic solenoid lock will unlock automatically with other options namely manually by pressing a push button.

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