Emergency Evacuation Drill Simulator

Project Report Submitted

to

MANIPAL ACADEMY OF HIGHER EDUCATION

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1. ABSTRACT

The "Emergency Drill Simulator" is an embedded systems project designed to simulate emergency evacuation scenarios in enclosed spaces. The system utilizes two infrared (IR) sensors to detect and count the number of individuals entering and exiting a room. When triggered, a buzzer sounds, signaling the commencement of an evacuation drill. This project aims to enhance safety protocols by providing a practical tool for conducting emergency evacuation simulations in various environments.

2. INTRODUCTION

a) SCOPE

The scope of the "Emergency Drill Simulator" project encompasses the development of an embedded systems solution for simulating emergency evacuation scenarios in enclosed spaces. Utilizing IR sensors and a buzzer, the system aims to accurately detect and count individuals entering and exiting a designated area during evacuation drills. The project seeks to enhance safety protocols by providing a practical tool for conducting realistic and effective emergency preparedness exercises in diverse environments.

b) PROJECT DESCRIPTION

Through the seamless integration of hardware and software components, the Emergency Drill Simulator aims to enhance safety protocols by offering a practical tool for conducting realistic emergency preparedness exercises. The system's ability to detect and count individuals in real-time, coupled with the audible alarm provided by the buzzer, ensures an immersive simulation system conducive to effective training and preparation for emergency scenarios in various environments.

Aimed at the development of an embedded systems solution tailored to simulate emergency evacuation drills within enclosed spaces, The "Emergency Drill Simulator" project integrates IR sensors and a buzzer to accurately monitor the flow of individuals entering and exiting a designated area during the drill. The hardware components, including the M3 Cortex Embedded Systems Circuitry kit, IR sensors, and buzzer, are interconnected using standard cables and a breadboard, providing a robust foundation for the functionality of the simulator.

c) PROBLEM STATEMENT

The goal of the project is to bridge the gap between theoretical knowledge and practical application, enabling individuals to experience and respond to simulated emergencies in a controlled environment. Through the development of the Emergency Drill Simulator, the project endeavors to improve safety protocols and better prepare occupants for emergency situations in diverse settings. The primary objective is to design a system that accurately detects and counts individuals entering and exiting a designated area during evacuation drills. By integrating IR sensors and a buzzer, the simulator seeks to provide real-time feedback and audible alerts, enhancing the authenticity and effectiveness of emergency preparedness exercises.

d) OBJECTIVES

1. Develop a robust embedded systems solution utilizing IR sensors and a buzzer to accurately detect and count individuals entering and exiting a designated area during evacuation drills.

2. Implement a user-friendly interface for initiating and monitoring evacuation simulations, facilitating ease of use and accessibility for operators.

3. Validate the functionality and reliability of the Emergency Drill Simulator through rigorous testing and validation processes, ensuring its effectiveness in diverse environments.

4. Enhance safety protocols by providing a practical tool for conducting realistic emergency preparedness exercises, ultimately improving the response and readiness of individuals in emergency situations.

3. LITERATURE SURVEY

[1] The paper "Developing Walking Assistants for Visually Impaired People: A Review" thoroughly examines various technologies aimed at assisting visually impaired individuals in walking. The methodology involves a comprehensive analysis of sensor-based, computer vision-based, and smartphone-based walking assistants to assess their performance and features. The paper highlights the strengths of providing a detailed taxonomy for categorizing the different types of walking assistants and emphasizing key performance metrics for evaluation. However, it falls short in its limited focus on emerging technologies and may benefit from further exploration in certain areas. In conclusion, the paper stresses the importance of continuous advancements in walking assistants for visually impaired individuals to address challenges such as environmental dependencies and user requirements, ultimately aiming to enhance mobility and safety for this population.

[2] The Automatic Secure Guard System for Home Security and Vehicle Monitoring System utilizes AT89S52 technology to enhance security measures. The system incorporates modules such as System Control, Motion Detector, Counter, Display Interface, Threshold Detector, Buzzer, and LED for effective monitoring. By leveraging GSM communication, the system enables remote control and monitoring of home appliances via SMS commands. Pros include cost-effectiveness, remote accessibility, and efficient monitoring capabilities. However, limitations may arise from motion sensor functionality, false alarms, and range constraints. The methodology involves IR sensors for door safety, LPG gas sensors for leakage detection,

and GSM interface for alerting authorities. In conclusion, the system offers enhanced security features but may require further refinement to address existing constraints.

[3] The paper discusses the development of low-cost IR sensors for mobile robots, focusing on their application in real-time response and distance measurement tasks. The advantages of IR sensors include fast response times and better angular resolution compared to ultrasonic sensors. The methodology involves describing a new IR sensor capable of measuring distances up to 1 m, using a simplified model based on the reflection coefficient of the target surface. The study also explores the influence of uncertainty on distance estimates and proposes a method to estimate the reflection coefficient using complementary US sensor data. The conclusion highlights the satisfactory results of the new IR sensor in distance estimation and map building tasks, emphasizing its potential for improving mobile robot navigation and obstacle avoidance.

[4] The Smart Car Parking System using IR Sensor is a promising solution to address parking challenges in crowded areas. By utilizing infrared sensors and Arduino technology, this system efficiently detects vacant parking slots, reducing time wastage and enhancing parking management. The system's methodology involves the installation of sensors in each parking slot, which communicate with a central display to indicate slot availability. While the system offers benefits such as improved efficiency, reduced congestion, and enhanced user experience, potential drawbacks may include initial setup costs and maintenance requirements. In conclusion, this innovative system has the potential to revolutionize parking infrastructure, offering a smart and sustainable solution for urban parking management.

[5] The paper presents a novel application for visually impaired (VI) users to detect obstacles indoors using visual and infrared sensors on the Google Project Tango Tablet. The system utilizes Unity engine functionalities for obstacle detection and provides audio alerts to users. The study conducted tests to evaluate obstacle detection accuracy and false detection scenarios. Results showed successful detection of medium to large obstacles under various conditions. Future work includes user customization options, detailed obstacle information output, and usability testing with VI users. The paper's strengths lie in its innovative approach, empirical evaluation, and user-centered design. However, limitations include issues with small obstacle detection and direct sunlight interference. In conclusion, the application shows promise for assisting VI users in indoor navigation, with potential for further development and usability improvements.

4. SYSTEM REQUIREMENTS

The following are the requirements for implementing the “Emergency Drill Simulator”- Embedded Systems and Design project:

1. Windows Operating System (latest version installed)

2. Keil uVision4 (software to write and implement the codes)
3. FlashMagic (to download the .hex file and send over the data to the design circuitry)
4. M3 Cortex Embedded Systems Circuitry kit
5. 2 infrared (IR) sensors
6. 1 breadboard
7. 3 FRC Cables
8. Jumper cables (both M to F, and F to F)

5. FUNCTIONALITY

The Emergency Drill Simulator is designed to meet specific requirements for implementation, utilizing a combination of hardware and software components:

Hardware Components:

1. M3 Cortex Embedded Systems Circuitry kit serves as the central processing unit for the system, facilitating the execution of programmed instructions and interfacing with peripheral devices.

2. Two infrared (IR) sensors are strategically positioned at the entrance and exit points of the designated space. These sensors detect the presence of individuals by emitting and receiving infrared radiation, allowing for accurate counting of entries and exits.

3. A breadboard serves as the platform for connecting and prototyping the circuitry components, providing a convenient layout for wiring and assembly.

4. Three Flat Ribbon(FRC) Cables are used for connecting the IR sensors and other peripheral devices to the embedded system's GPIO (General Purpose Input/Output) pins.

5. Jumper cables, including both Male-to-Female (M to F) and Female-to-Female (F to F) variants, facilitate the interconnection between different components, ensuring reliable signal transmission and power distribution.

Software Components:

1. Windows Operating System (latest version installed) provides the platform for developing, testing, and deploying the embedded system software.

2. Keil uVision4 serves as the integrated development environment (IDE) for writing and implementing the embedded system's firmware. This software enables developers to write, compile, debug, and simulate code for the M3 Cortex processor.

3. FlashMagic is utilized to download the compiled firmware in the form of a .hex file and upload it to the M3 Cortex processor, effectively programming the embedded system with the desired functionality.

System Operation:

Upon system activation, the IR sensors continuously monitor the entrance and exit points of the designated space. As individuals enter or exit the room, the sensors detect their presence and trigger interrupts, prompting the embedded system to incrementally count the number of people. When initiated, either manually or through a predefined timer, the system activates the buzzer, signaling the commencement of the evacuation drill. The buzzer's audible alarm serves to alert participants and simulate the urgency of an emergency.

Throughout the drill, the IR sensors persistently update the count of individuals entering and exiting the space, providing real-time feedback on the evacuation progress. Once the drill concludes, the buzzer ceases, and the system resets, ready for subsequent simulations.

By integrating hardware and software components seamlessly, the Emergency Drill Simulator offers a comprehensive solution for conducting realistic evacuation drills and enhancing emergency preparedness in various environments.

6. CODE

```
#include<LPC17xx.h>

  unsigned char sevensegment[16]={0x3F, 0x06, 0x5B, 0x4F, 0x66, 0x6D, 0x7D, 0x07, 0x7F, 0x6F,
0x77, 0x7C, 0x39, 0x5E, 0x79, 0x71};
  unsigned int dig_value[]={0,0,0,0,0};
  unsigned int select_segment[]={0,0<<23, 1<<23, 2<<23, 3<<23};
  unsigned int dig_count;
  int prev=0;
  unsigned long int i, flag, value, count,x,y,dir=1, people=0;
  void upcount(){
    people++;
  dig_value[1]++;
  if(dig_value[1]>9){
    dig_value[2]++;
    dig_value[1]=0;
    if(dig_value[2]>9){
    dig_value[3]++;
    dig_value[2]=0;
    if(dig_value[3]>9){
    dig_value[4]++;
    dig_value[3]=0;
    if(dig_value[4]>9){
    dig_value[4]=0;
}}}}}
  void downcount(){
    people--;
  dig_value[1]--;
  if(dig_value[1]==-1){
    dig_value[2]--;
    dig_value[1]=9;
    if(dig_value[2]==-1){
    dig_value[3]--;
    dig_value[2]=9;
    if(dig_value[3]==-1){
```

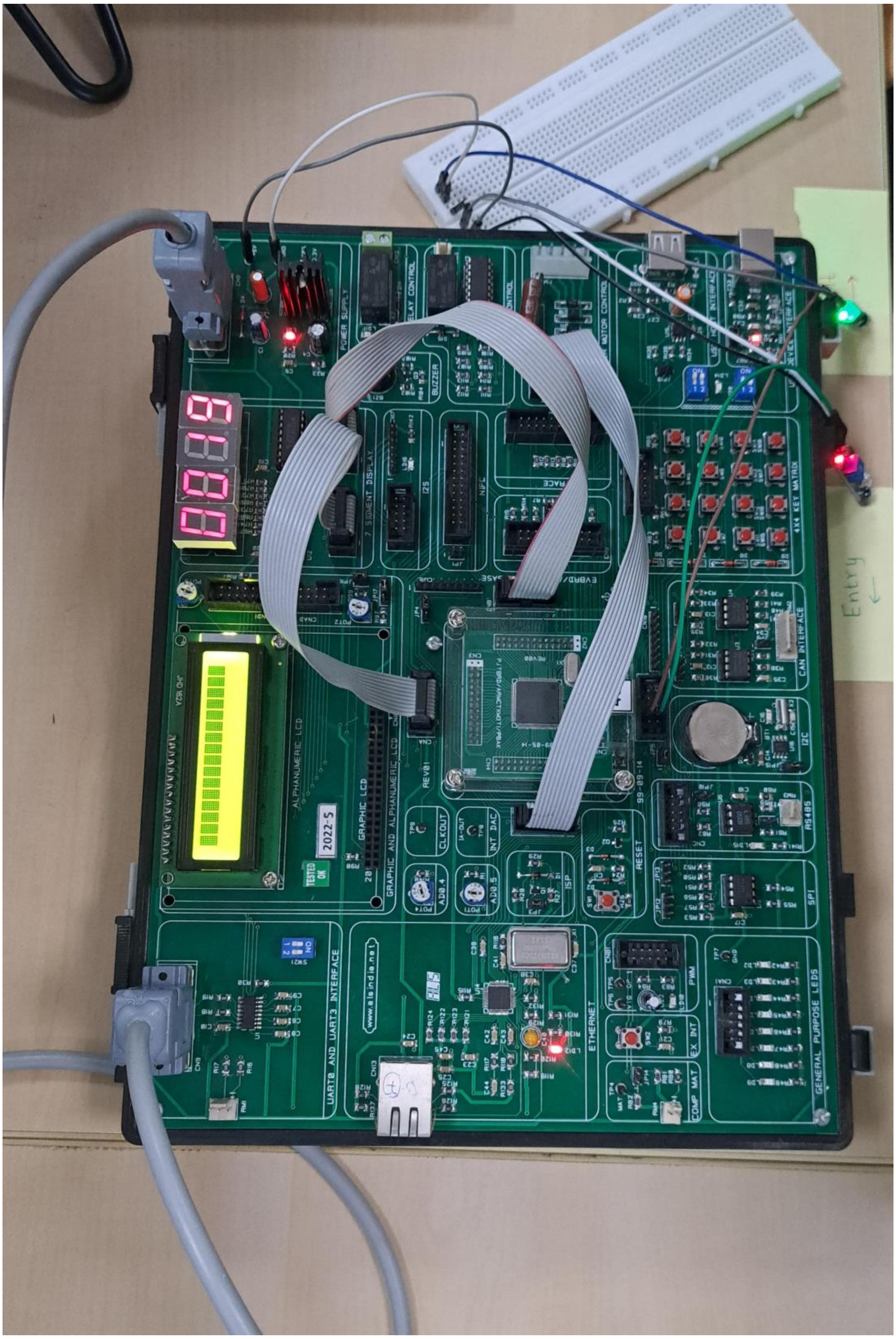
```
        dig_value[4]--;
        dig_value[3]=9;
        if(dig_value[4]==-1){
        dig_value[4]=9;
}}}}}
void display(void){
    LPC_GPIO1->FIOPIN=select_segment[dig_count];
    LPC_GPIO0->FIOPIN=sevensegment[dig_value[dig_count]]<<4;
    for(i=0;i<500;i++);
    LPC_GPIO0->FIOCLR=0x00000FF0;
}
void delay(void){
    for(i=0;i<500;i++);
    if(count==2000){
        flag=0xFF;
        count=0;
    }
    else
        count++;
}
void buzzer(){
    LPC_PINCON->PINSEL1=1<<12;
}
void stop_buzzer(){
    LPC_PINCON->PINSEL1=0<<12;
}
int main(){
    SystemInit();
    SystemCoreClockUpdate();
    LPC_PINCON->PINSEL0=0;
    LPC_PINCON->PINSEL3=0;
    LPC_PINCON->PINSEL4=0;
    LPC_GPIO0->FIODIR |=0x00400FF0;
    LPC_GPIO1->FIODIR=0x07800000;
    LPC_GPIO2->FIODIR = ~(3<<0);
        // LPC_GPIO0->FIOSET |= 1<<22;
    while(1){
        delay();
        dig_count+=1;
        if(dig_count==0x05){
            dig_count=0x00;
        dig_count+=1;}
        if(flag==0xFF){
            flag=0x00;
            x=LPC_GPIO2->FIOPIN&1<<0;
            y=LPC_GPIO2->FIOPIN&1<<1;

            if (x==0)
```

```
        {
        if(prev==0)
                prev=1;
        else if(prev==2)
        {
        downcount();
                if(people==0)
                   stop_buzzer();
        prev=0;
        }
          }

        if (y==0){
        if(prev==0) prev=2;
        else if(prev==1)
        {
        upcount();
                if(people==5)
                   buzzer();
        prev=0;

        }
          }
      }
      display();
   }
}
```

7. RESULT

Through rigorous testing and validation within the labs along with extra sessions, the Emergency Drill Simulator has demonstrated robust performance and reliability in accurately detecting and counting individuals during evacuation simulations. The IR sensors have consistently provided precise data regarding the ingress and egress of participants, ensuring the effectiveness of the drill. Moreover, the audible alarm generated by the buzzer effectively alerts participants, contributing to the overall realism of the simulation.

Additionally, the system's user-friendly interface and intuitive operation make it suitable for deployment in various settings, including educational institutions, workplaces, and public facilities. Overall, the successful implementation of the Emergency Drill Simulator underscores its potential to enhance emergency preparedness and safety protocols in diverse environments.



The above is a picture of our circuitry implementation. The entry and exit routes have been marked.

8. CONCLUSION

In conclusion, the development and implementation of the Emergency Drill Simulator represent a significant advancement in emergency preparedness technology. By leveraging the capabilities of IR sensors and a buzzer, the system offers a practical solution for conducting realistic evacuation simulations. This project and its implementation underscores the importance of proactive measures in ensuring the safety and security of individuals in emergency situations. Moving forward, further refinements and enhancements could be explored to optimize the system's functionality and adaptability to different environments. Ultimately, the Emergency Drill Simulator stands as a testament to the efficacy of embedded systems in addressing real-world challenges and fostering a culture of safety and preparedness.

9. REFERENCES

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