Microprocessor SKEE3223 / SEEE3223
ASSIGNMENT GROUP (15%)

C Programming + Hardware Built

PROJECT TITLE:
Eco-Smart Conveyor Systems with STM32 Microcontroller Processor

GROUP MEMBERS

NO	NAME	NO. MATRIC	SECTION
1.	**ARUN A/L G. MARAN**	**SX230229EEEHS04**	SPACE KL
2.	**MUHAMAD HAZLI BIN JAAFAR**	**SX230228EEEHS04**	SPACE KL
3.	**NORASYKIN BINTI ISA**	**SX221828EEEHF04**	SPACE KL
4.	**NUR ATHIRA SYAKIRA BINTI SHAIFUL AZLI**	**SX230242EEEHS04**	SPACE KL

YouTube Link:
https://youtu.be/hulyeBpiagY?si=zdcX2Dw2QQdVgJSH

GitHub Link:

1. EXPLAIN HOW YOU DISTRIBUTE TASKS

Problem and solution

Problem: Industries often face the issue of conveyor systems running continuously without stopping, leading to unnecessary energy consumption and wear on the motor.

Solution: My solution involves integrating the **STM32F411FCEUX** microcontroller to create a more cost-effective conveyor system. By programming the system to run only when an object is detected on the conveyor, it helps reduce electricity costs and extends the motor's lifespan. This approach provides a smarter alternative to traditional PLC-based systems, offering both efficiency and savings.

Task Distribution for the Project Team

1. **Arun -** ***(Project Leader and Concept Creator)***
   - Define the overall project goals and objectives.
   - Guide the team in understanding the system workflow and technical requirements.
   - Ensure proper documentation of the project (introduction, objectives, and conclusion).
   - Oversee testing and final system integration to ensure the system meets the desired functionality.

2. **Ekin -** ***(Hardware, Circuit Design and Report Writing)***
   - Design and assemble the circuit, including connections for the sensor, LEDs, relay, buzzer, and push button.
   - Ensure proper wiring and hardware compatibility with the STM32 microcontroller.
   - Perform initial hardware testing to confirm component functionality.
   - Troubleshoot hardware-related issues during the testing phase.
   - Compile the final report, including test data, results, and any future recommendations.

3. **Syakira -** ***(Software Development and Programming)***
   - Write the embedded C code for the STM32 microcontroller, focusing on: GPIO initialization.
   - Sensor and button debounce logic.
   - Timing and control mechanisms using SysTick.
   - Develop and implement the reset functionality.
   - Debug and optimize the program for reliable operation.

4. Hazli - (*Testing, Analysis, and Video Editing*)

- Conduct thorough testing of the hardware and software integration.
- Document test results and identify potential areas for improvement.
- Analyze system performance and ensure it meets the 10-cycle requirement.
- Make a video editing for submitted.

Collaboration and Team Effort

- Weekly team meetings to review progress and address challenges.
- Collaborative testing to ensure all components (hardware and software) function together.
- Joint presentation and demonstration of the final project.
- This task distribution ensures that each team member has clear responsibilities while fostering teamwork and knowledge sharing.

2. PROJECT ABSTRACT

Abstract

This project focuses on the design and development of an automated conveyor system controlled by a sensor and indicator lights. In the initial state, a green light will illuminate, signaling that the system is ready to accept objects. However, the conveyor motor will remain idle until an object is detected by the sensor. Upon detection, the motor will activate and run the conveyor for 5 seconds, allowing the object to move along the system. After this period, the motor stops, and the process resets for the next cycle.

The system operates for a total of 10 cycles. Once the cycle count exceeds 10, the green light turns off, and a red light, accompanied by a buzzer, activates to indicate that the system has reached its limit. In this state, the conveyor motor will remain deactivated, even if the sensor detects additional objects. To reset the system and return it to its initial state, a push button must be pressed, clearing the cycle count and reactivating the green light.

This project offers a practical solution for automated material handling systems, ensuring efficient and controlled operation with clear visual and auditory feedback. It is particularly suitable for industrial and manufacturing applications, providing safety, precision, and ease of use in repetitive operations.

Objective

- The objective of this project is to design and implement a microcontroller-based automated conveyor system using the **STM32F411FCEUX** microcontroller.
- The system will utilize sensors, LEDs, a relay, and a buzzer to detect and handle objects in a controlled manner. It aims to demonstrate an efficient material-handling process while providing clear visual and auditory feedback and ensuring safety.

3. LIST OF COMPONENTS (AND PICTURE) USED

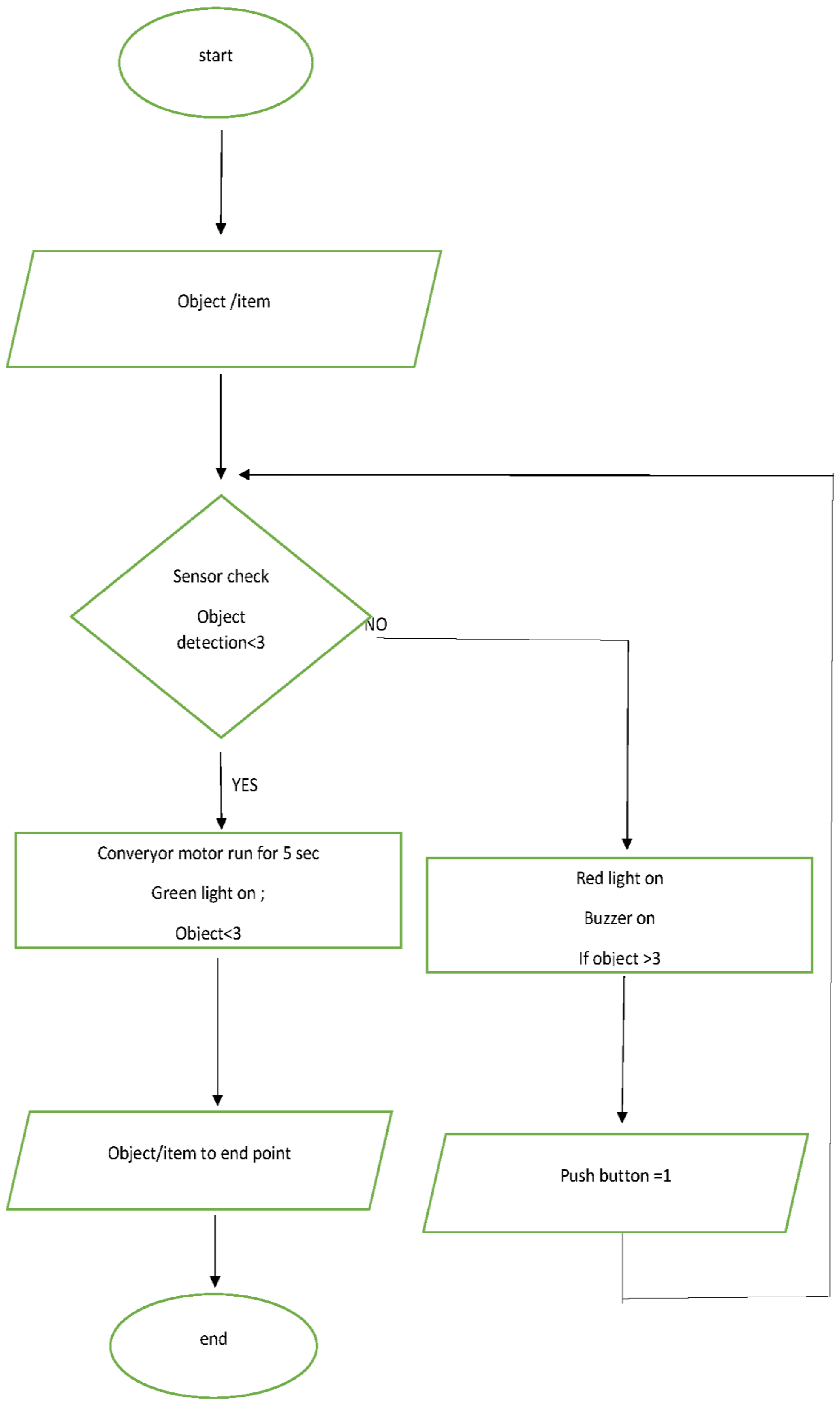
List Of Components

NO	PART IMAGE	PART MODEL & FUNCTION
1		**E18-D80NK IR Proximity Sensor** • Light Source: Infrared • Output Current DC/SCR Relay Control Output: 100mA/5V • Sensing Distance: 30mm to 80mm (adjustable) - Input Voltage: 5VDC • Current Consumption: <25mA DC • Type: NPN output - Response Time: < 2ms • Operating Temperature: - 25°C to +55°C
2		**MC27 3-24VDC BUZZER** • Alarm Height: 15mm Alarm Diameter: 29mm • Alarm Height: 15mm 2 Mounting Holes • distance: 40mm 2 Wires length: 105mm • Operating Voltage: 3-24V • Rated Current (MAX): 20mA Operating • Temperature: -20 to +80 (Degrees Celsius)
3		**LED-607R 5MM** • Voltage: 2.1V • Temperature range: - 40°C to 85°C

4		**LED-607G 5MM** • Voltage: 2.1V • Temperature range: - 40°C to 85°C
5		**4.5VDC MOTOR** • Operating Voltage: 4.5V DC • No-Load Speed: 1000-3000 RPM (varies by model) • No-Load Current: 50-100mA (varies by model) • Stall Torque: 1.5-3.0 kg-cm (varies by model) • Stall Current: 200-500mA (varies by model)
6		**5V 2 Channel Level Trigger Optocoupler Relay Module** • Maximum load: AC 250V/10A, DC 30V/10A • Trigger current: 5Ma • Working voltage: 5V • Module size: 50 x 26 x 18.5mm (L x W x H) • Four mounting bolts holes, diameter 3.1mm
7		**ZS-X4B 3V~35V 5A Motor PWM Speed Controller** • Operating voltage: DC3V-35V • Output current: 0-5A Output power: 90W (max) • Quiescent current: 7uA (standby) • PWM duty cycle: 1% -100% PWM frequency: 20khz
8		**Project Board GL-6** • Size: 83x54mm

9		**Junction Box** • Put all circuit/component inside
10		**Push-button Switch** • Normally close/open contact
11		**Conveyor** • Material: Metals • Size Chart: 33cmx9.5cmx8cm
12		**Cable** • Size: 0.5mm2
13		**Battery Storage Box** • For double AA: 1.5vdc

4. DRAW THE PROJECT FLOWCHART

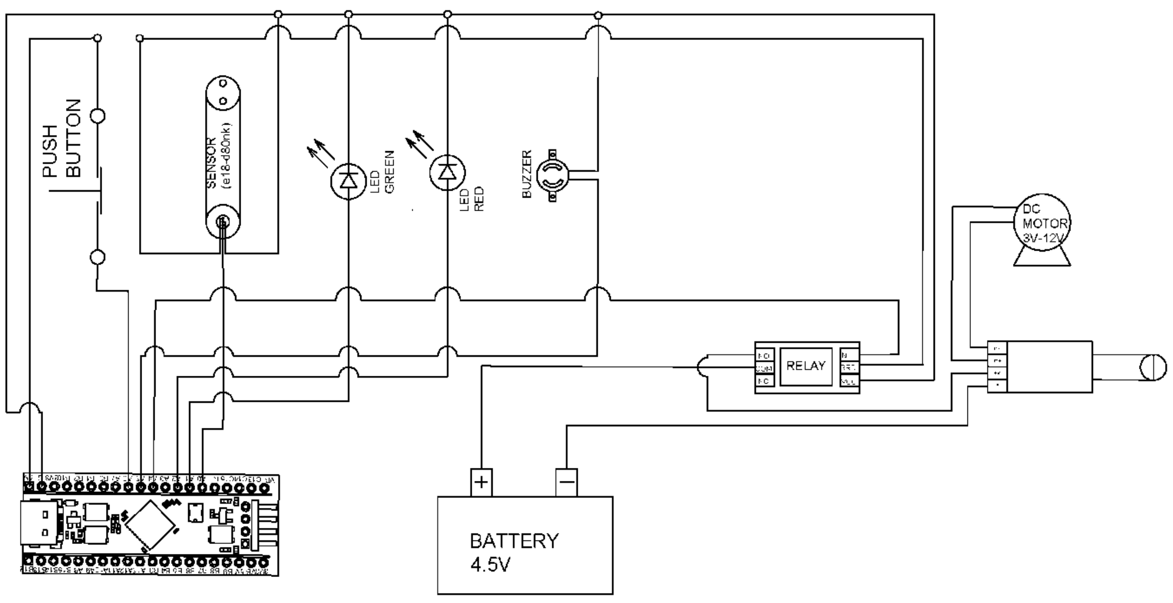


5. DRAW CIRCUIT DIAGRAM

Circuit Diagram Design

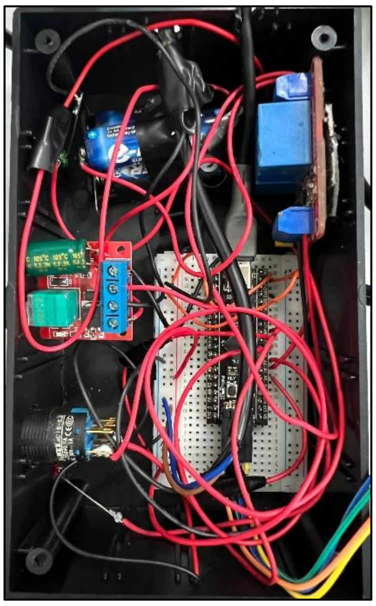
• **Software Used:** AutoCAD was utilized to create the circuit diagram for the smart conveyor system.

• **Components Included:**
  - o STM32 Microcontroller
  - o E18-D80NK Sensors
  - o 5V DC Motor
  - o 5V 2 Channel Level Trigger Optocoupler Relay Module
  - o LED
  - o Buzzer
  - o Push button
  - o Power Supply connection

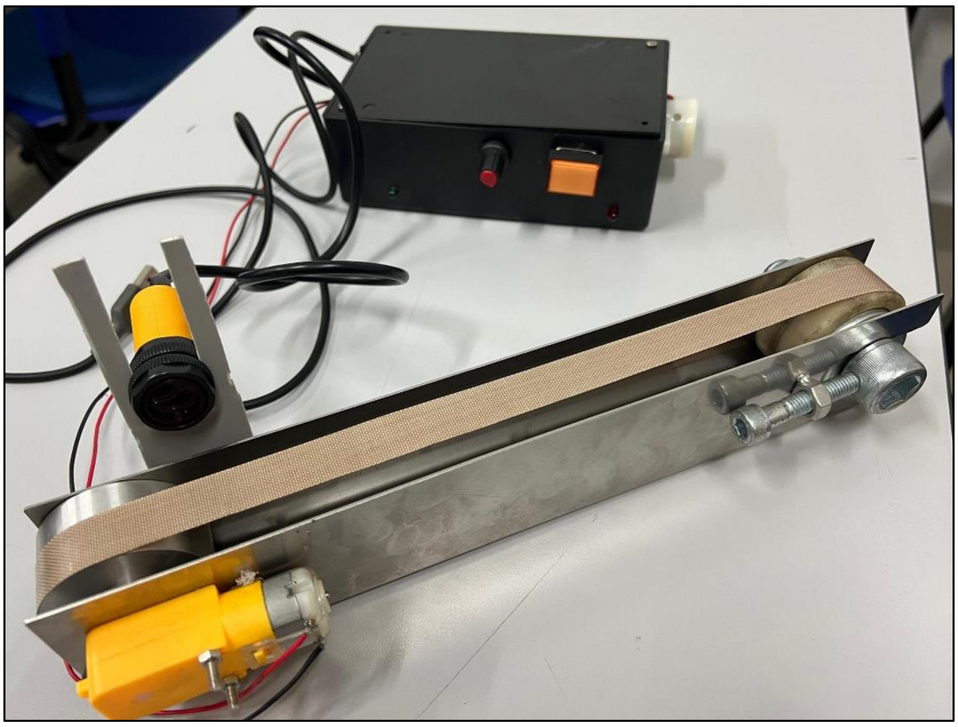


Circuit Diagram Design

6. HARDWARE BUILT (TAKE PHOTO) / COMPLETED PROJECT



Hardware – Circuit inside the box

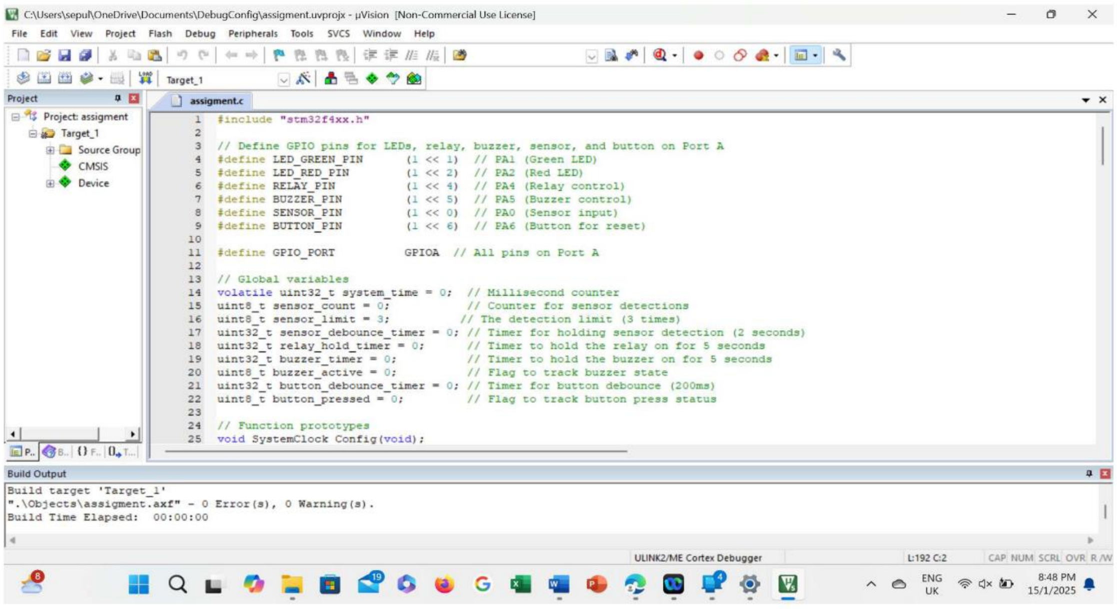


The Project Prototype – EcoSmart Conveyor Systems

7. EXPLANATION OF DESIGN FUNCTIONALITY WITH KEIL UVISION (SIMULATION PICTURE). INCLUDE THE WINDOWS SHOWING THE PROCESSORS, I/O REGISTERS, AND MEMORY

Introduction

Keil uVision is an integrated development environment (IDE) widely used to develop and simulate embedded systems. It supports a variety of microcontrollers and provides tools for coding, debugging, and simulating embedded designs. This report demonstrates the design functionality of a microprocessor-based system using Keil uVision. The simulation includes views of the processor's behavior, I/O registers, and memory.



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File Edit View Project Flash Debug Peripherals Tools SVCS Window Help
Target_1
Project
Project: assigment
Target_1
Source Group
CMSIS
Device
assigment.c
Build Output
ULINK2/ME Cortex Debugger
L:192 C:2
CAP NUM SCRL OVR R/W
ENG UK
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```c
#include "stm32f4xx.h"

// Define GPIO pins for LEDs, relay, buzzer, sensor, and button on Port A
#define LED_GREEN_PIN       (1 << 1)  // PA1 (Green LED)
#define LED_RED_PIN         (1 << 2)  // PA2 (Red LED)
#define RELAY_PIN           (1 << 4)  // PA4 (Relay control)
#define BUZZER_PIN          (1 << 5)  // PA5 (Buzzer control)
#define SENSOR_PIN          (1 << 0)  // PA0 (Sensor input)
#define BUTTON_PIN          (1 << 6)  // PA6 (Button for reset)

#define GPIO_PORT          GPIOA  // All pins on Port A

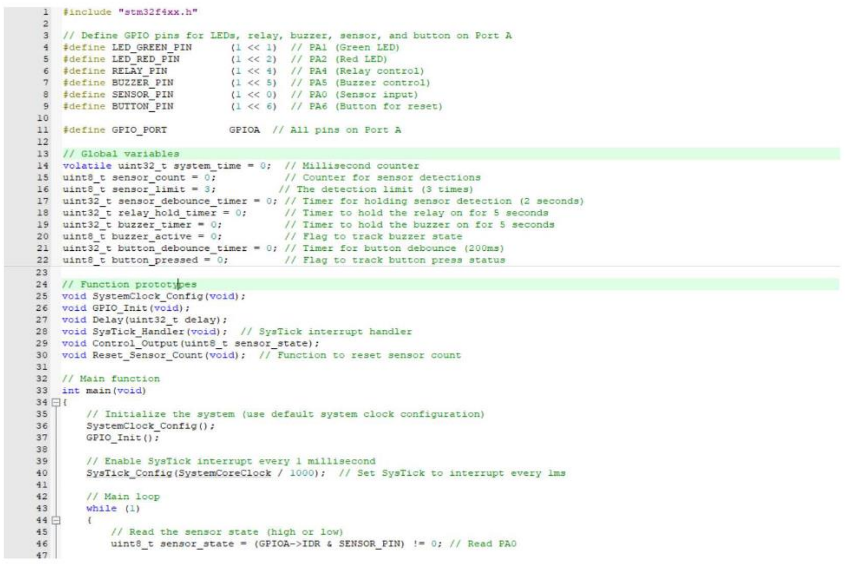
// Global variables
volatile uint32_t system_time = 0;  // Millisecond counter
uint8_t sensor_count = 0;            // Counter for sensor detections
uint8_t sensor_limit = 3;           // The detection limit (3 times)
uint32_t sensor_debounce_timer = 0; // Timer for holding sensor detection (2 seconds)
uint32_t relay_hold_timer = 0;      // Timer to hold the relay on for 5 seconds
uint32_t buzzer_timer = 0;          // Timer to hold the buzzer on for 5 seconds
uint8_t buzzer_active = 0;          // Flag to track buzzer state
uint32_t button_debounce_timer = 0; // Timer for button debounce (200ms)
uint8_t button_pressed = 0;         // Flag to track button press status

// Function prototypes
void SystemClock_Config(void);
```

```
Build target 'Target_1'
".\Objects\assigment.axf" - 0 Error(s), 0 Warning(s).
Build Time Elapsed:  00:00:00
```

Keil uVision Application

Coding



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uint8_t buzzer_active = 0;          // Flag to track buzzer state
uint32_t button_debounce_timer = 0; // Timer for button debounce (200ms)
uint8_t button_pressed = 0;         // Flag to track button press status

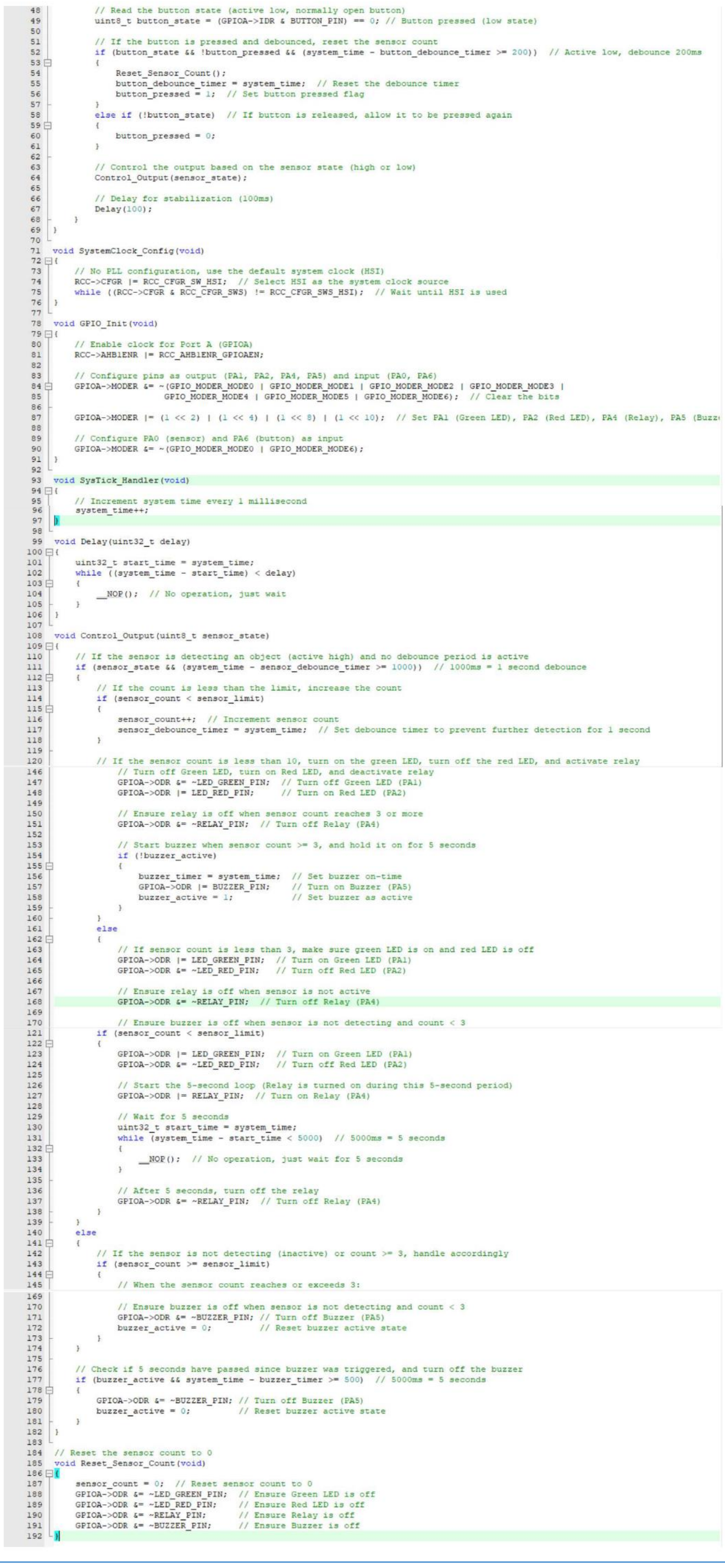
// Function prototypes
void SystemClock_Config(void);
void GPIO_Init(void);
void Delay(uint32_t delay);
void SysTick_Handler(void);  // SysTick interrupt handler
void Control_Output(uint8_t sensor_state);
void Reset_Sensor_Count(void);  // Function to reset sensor count

// Main function
int main(void)
{
    // Initialize the system (use default system clock configuration)
    SystemClock_Config();
    GPIO_Init();

    // Enable SysTick interrupt every 1 millisecond
    SysTick_Config(SystemCoreClock / 1000);  // Set SysTick to interrupt every 1ms

    // Main loop
    while (1)
    {
        // Read the sensor state (high or low)
        uint8_t sensor_state = (GPIOA->IDR & SENSOR_PIN) != 0; // Read PA0

```



```c
        // Read the button state (active low, normally open button)
        uint8_t button_state = (GPIOA->IDR & BUTTON_PIN) == 0; // Button pressed (low state)

        // If the button is pressed and debounced, reset the sensor count
        if (button_state && !button_pressed && (system_time - button_debounce_timer >= 200))  // Active low, debounce 200ms
        {
            Reset_Sensor_Count();
            button_debounce_timer = system_time;  // Reset the debounce timer
            button_pressed = 1;  // Set button pressed flag
        }
        else if (!button_state)  // If button is released, allow it to be pressed again
        {
            button_pressed = 0;
        }

        // Control the output based on the sensor state (high or low)
        Control_Output(sensor_state);

        // Delay for stabilization (100ms)
        Delay(100);
    }
}

void SystemClock_Config(void)
{
    // No PLL configuration, use the default system clock (HSI)
    RCC->CFGR |= RCC_CFGR_SW_HSI;  // Select HSI as the system clock source
    while ((RCC->CFGR & RCC_CFGR_SWS) != RCC_CFGR_SWS_HSI);  // Wait until HSI is used
}

void GPIO_Init(void)
{
    // Enable clock for Port A (GPIOA)
    RCC->AHB1ENR |= RCC_AHB1ENR_GPIOAEN;

    // Configure pins as output (PA1, PA2, PA4, PA5) and input (PA0, PA6)
    GPIOA->MODER &= ~(GPIO_MODER_MODE0 | GPIO_MODER_MODE1 | GPIO_MODER_MODE2 | GPIO_MODER_MODE3 |
                      GPIO_MODER_MODE4 | GPIO_MODER_MODE5 | GPIO_MODER_MODE6);  // Clear the bits

    GPIOA->MODER |= (1 << 2) | (1 << 4) | (1 << 8) | (1 << 10);  // Set PA1 (Green LED), PA2 (Red LED), PA4 (Relay), PA5 (Buzz

    // Configure PA0 (sensor) and PA6 (button) as input
    GPIOA->MODER &= ~(GPIO_MODER_MODE0 | GPIO_MODER_MODE6);
}

void SysTick_Handler(void)
{
    // Increment system time every 1 millisecond
    system_time++;
}

void Delay(uint32_t delay)
{
    uint32_t start_time = system_time;
    while ((system_time - start_time) < delay)
    {
        __NOP();  // No operation, just wait
    }
}

void Control_Output(uint8_t sensor_state)
{
    // If the sensor is detecting an object (active high) and no debounce period is active
    if (sensor_state && (system_time - sensor_debounce_timer >= 1000))  // 1000ms = 1 second debounce
    {
        // If the count is less than the limit, increase the count
        if (sensor_count < sensor_limit)
        {
            sensor_count++;  // Increment sensor count
            sensor_debounce_timer = system_time;  // Set debounce timer to prevent further detection for 1 second
        }

        // If the sensor count is less than 10, turn on the green LED, turn off the red LED, and activate relay
            // Turn off Green LED, turn on Red LED, and deactivate relay
            GPIOA->ODR &= ~LED_GREEN_PIN;  // Turn off Green LED (PA1)
            GPIOA->ODR |= LED_RED_PIN;     // Turn on Red LED (PA2)

            // Ensure relay is off when sensor count reaches 3 or more
            GPIOA->ODR &= ~RELAY_PIN;  // Turn off Relay (PA4)

            // Start buzzer when sensor count >= 3, and hold it on for 5 seconds
            if (!buzzer_active)
            {
                buzzer_timer = system_time;  // Set buzzer on-time
                GPIOA->ODR |= BUZZER_PIN;    // Turn on Buzzer (PA5)
                buzzer_active = 1;           // Set buzzer as active
            }
        }
        else
        {
            // If sensor count is less than 3, make sure green LED is on and red LED is off
            GPIOA->ODR |= LED_GREEN_PIN;  // Turn on Green LED (PA1)
            GPIOA->ODR &= ~LED_RED_PIN;   // Turn off Red LED (PA2)

            // Ensure relay is off when sensor is not active
            GPIOA->ODR &= ~RELAY_PIN;  // Turn off Relay (PA4)

            // Ensure buzzer is off when sensor is not detecting and count < 3
        if (sensor_count < sensor_limit)
        {
            GPIOA->ODR |= LED_GREEN_PIN;  // Turn on Green LED (PA1)
            GPIOA->ODR &= ~LED_RED_PIN;   // Turn off Red LED (PA2)

            // Start the 5-second loop (Relay is turned on during this 5-second period)
            GPIOA->ODR |= RELAY_PIN;  // Turn on Relay (PA4)

            // Wait for 5 seconds
            uint32_t start_time = system_time;
            while (system_time - start_time < 5000)  // 5000ms = 5 seconds
            {
                __NOP();  // No operation, just wait for 5 seconds
            }

            // After 5 seconds, turn off the relay
            GPIOA->ODR &= ~RELAY_PIN;  // Turn off Relay (PA4)
        }
    }
    else
    {
        // If the sensor is not detecting (inactive) or count >= 3, handle accordingly
        if (sensor_count >= sensor_limit)
        {
            // When the sensor count reaches or exceeds 3:

            // Ensure buzzer is off when sensor is not detecting and count < 3
            GPIOA->ODR &= ~BUZZER_PIN; // Turn off Buzzer (PA5)
            buzzer_active = 0;         // Reset buzzer active state
        }
    }

    // Check if 5 seconds have passed since buzzer was triggered, and turn off the buzzer
    if (buzzer_active && system_time - buzzer_timer >= 500)  // 5000ms = 5 seconds
    {
        GPIOA->ODR &= ~BUZZER_PIN; // Turn off Buzzer (PA5)
        buzzer_active = 0;         // Reset buzzer active state
    }
}

// Reset the sensor count to 0
void Reset_Sensor_Count(void)
{
    sensor_count = 0;  // Reset sensor count to 0
    GPIOA->ODR &= ~LED_GREEN_PIN;  // Ensure Green LED is off
    GPIOA->ODR &= ~LED_RED_PIN;    // Ensure Red LED is off
    GPIOA->ODR &= ~RELAY_PIN;      // Ensure Relay is off
    GPIOA->ODR &= ~BUZZER_PIN;     // Ensure Buzzer is off
}
```

Table: Explanation of Design Functionality and Simulation in Keil uVision

Step	Description	Keil uVision Windows	Expected Behavior
1. Project Setup	Create a new STM32 project and configure the target microcontroller (e.g., STM32F401RE).	Project Explorer	The project structure is visible in the Project Explorer window.
2. Code Development	Paste the code into main.c and include necessary CMSIS and peripheral libraries.	Code Editor	Code compiles without errors.
3. Build the Project	Compile the program to generate the executable.	Build Output	There are no errors or warnings in the build output.
4. Debug Configuration	Start the debugger to monitor the system's behavior. Configure simulation tools for peripherals (e.g., GPIO).	Debug Toolbar, Peripherals, and Simulation Control	The debugger initializes successfully, ready for step-by-step simulation.
5. Processor Registers	Monitor key processor registers like the Program Counter (PC) and Stack Pointer (SP) during execution.	Registers Window	Registers update dynamically as the code executes.
6. I/O Port Simulation	Simulate GPIO input states for PA0 (Sensor) and PA6 (Button). Monitor the status of PA1, PA2, PA4, and PA5.	I/O Ports Window	Changes in GPIO input affect the outputs (LEDs, relay, and buzzer).
7. Memory Observation	Track variables like sensor_count, buzzer_active, and system_time to confirm correct behavior.	Memory Window	Variables update in memory, reflecting program logic.
8. Test Sensor Input	Simulate the high (active) state for the sensor pin (PA0) multiple times and observe the increment of sensor_count.	I/O Ports Window, Memory Window	The green LED turns on, relay activates for 5 seconds if sensor_count is below the limit.
9. Test Buzzer Activation	Continue triggering the sensor until sensor_count equals 3, then observe buzzer activation for 5 seconds.	I/O Ports Window	The red LED turns on, buzzer activates for 5 seconds.
10. Reset via Button	Simulate a button press (PA6) and ensure that sensor_count resets, and all outputs are turned off.	I/O Ports Window, Registers Window	All outputs (LEDs, relay, and buzzer) are turned off, and sensor_count resets to 0.

Conclusion

The Keil uVision simulation provides valuable insights into the functionality of embedded designs. By monitoring the processor, I/O registers, and memory, developers can debug and optimize their programs effectively.

8. DISCUSS OF THE RESULTS BY OBSERVING THE HARDWARE PROTOTYPE. INCLUDE PITCURES TO SUPPORT YOUR EXPLANATION

Results And Discussion

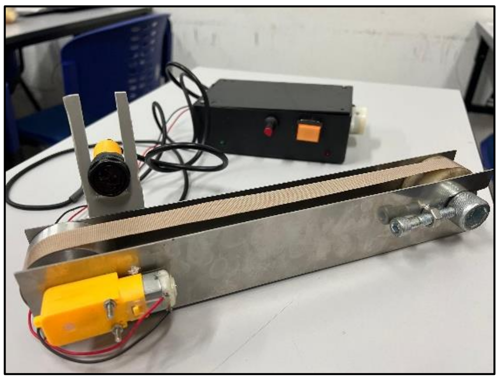
Hardware Prototype Observation

The hardware prototype of the smart conveyor control system was assembled and tested to verify its functionality. Key observations are as follows:

- Object Detection:
  - The sensor reliably detected objects on the conveyor belt at various distances.
  - E18-D80NK sensors provided accurate and consistent results in detecting objects.
- Motor Control:
  - The motor PWM Speed Controller effectively controlled the DC motor, allowing for precise adjustments in speed and direction based on signals from the STM32 microcontroller.
  - Smooth acceleration and deceleration were observed when the conveyor belt was tested under different load conditions.
- System Responsiveness:
  - The STM32 microcontroller processed input signals from the sensors in real-time, ensuring minimal delays in stopping or slowing the conveyor when objects were detected.

Hardware Prototype Pictures

- The fully assemble hardware prototype showing the STM32 microcontroller, sensors, motor, and connections.
- The conveyor system in operation, with an object detected by the sensors.
- Close-ups of critical components, such as the sensor setup and motor driver circuit.



Challenges Observed

1. Occasional noise in sensor readings required additional software filtering to ensure consistent performance.
2. The power supply design needed refinement to prevent voltage drops when the motor operated at higher speeds.

Conclusion from Observations

The prototype successfully demonstrated the Eco-Smart Conveyor System's ability to detect objects and control conveyor movement dynamically. The use of STM32 ensured real-time processing and seamless integration of components.

9. CONCLUDE THE PROJECT

Execute the Project

System Design and Planning

- Identify the hardware components, including the STM32 microcontroller, LEDs, relay, buzzer, sensor, and push button.
- Design the circuit schematic to connect these components to GPIO Port A.

Hardware Setup

- Assemble the hardware components on a breadboard or PCB.
- Connect the LEDs, relay, buzzer, sensor, and button to their respective pins on GPIO Port A.

Software Development

- Configure the system clock for accurate timing using the SysTick timer.
- Write code to initialize the GPIO pins for input and output.
- Develop the main program to read sensor input, control LEDs, operate the relay, and manage the buzzer.
- Implement debounce logic for the sensor and button to prevent false triggers.
- Create a reset function to restart the system after completing 10 cycles.

Testing and Debugging

- Test the system to ensure the conveyor motor activates correctly when an object is detected.
- Verify that the green and red LEDs, relay, and buzzer operate as intended.
- Debug and refine the code to eliminate errors or inconsistencies.

Final Integration and Demonstration

- Integrate the software and hardware for the complete system.
- Conduct multiple tests runs to validate the system's reliability and performance.

10. REFERENCES

Here are some ideas for references you can use to support your project. You should aim for a mix of books, research papers, and technical documentation:

1. Books

"The Definitive Guide to the ARM Cortex-M3 and Cortex-M4 Processors" by Joseph Yiu.
A comprehensive guide to the ARM Cortex-M series, covering microcontroller programming, peripherals, and real-time applications.
https://pdfcoffee.com/yiu-j-the-definitive-guide-to-arm-cortex-m3-and-cortex-m4-processors-3rd-edition-pdf-free.html

"Embedded Systems: Introduction to ARM Cortex-M Microcontrollers" by Jonathan Valvano.
Provides practical examples and in-depth explanations of microcontroller systems, including GPIO and timers.
https://pdfcoffee.com/embedded-systems-introduction-jonathan-valvanopdf-pdf-free.html

2. Research Papers

"Sensor-Based Automation Systems in Manufacturing: A Review"
A study highlighting the importance of sensor-based automation in modern industries, focusing on efficiency and safety improvements.

"Design and Implementation of Conveyor-Based Sorting Systems"
Discusses automation systems using conveyors, sensors, and microcontrollers, relevant to your project.

The link references:

- *https://www.researchgate.net/publication/319193103_Smart_Manufacturing_Through_Sensor_Based_Efficiency_Monitoring_System_SBEMS*
- *https://www.researchgate.net/publication/368320757_Control_Design_for_Sorting_Conveyor_System*

3. ChatGPT

Many people use this platform to seek information because it provides quick, reliable, and easily accessible answers. It offers a wide range of knowledge across various topics, saving time compared to traditional research methods. Additionally, the interactive nature of the platform allows users to refine their queries and get more precise or tailored responses including about STM32 microprocessor.

Technical Documentation

STM32 Microcontroller Datasheet and Reference Manual

- Official documentation from STMicroelectronics, detailing the features, pin configurations, and peripherals of the STM32.

ARM Cortex-M4 Technical Reference Manual

- Provides detailed information about the Cortex-M4 processor architecture, essential for understanding microcontroller programming.

Online Tutorials and Forums

- STMicroelectronics Official Website (https://www.st.com)
  Contains application notes, example codes, and tutorials for STM32 development.
- Community forums like **Stack Overflow** or **STM32 Forum**
  Useful for troubleshooting and learning from others' experiences with similar projects. By citing these references, you ensure your project is well-supported with credible technical and academic sources.

11. OVERALL CONCLUSION ABOUT THIS PROJECT

Conclusion

This project successfully implements an automated conveyor system using the STM32 microcontroller, providing an efficient and controlled process for object handling. The system employs a sensor to detect objects, LEDs for visual feedback, a relay to control the conveyor motor, and a buzzer for auditory alerts. The green LED indicates system readiness for object insertion, while the red LED and buzzer signal that the maximum cycle limit has been reached. A push button allows the system to reset, ensuring smooth and continuous operation.

The project demonstrates the importance of precise timing, achieved through the SysTick timer, and reliable debounce logic for the sensor and button, preventing false triggers. This ensures the system operates accurately and consistently. Testing confirmed the system’s ability to handle objects in 10 cycles, with each detection activating the conveyor for 5 seconds.

The project highlights the value of microcontroller-based automation in industrial applications, offering increased efficiency and safety. It serves as a foundational step for more advanced systems, such as those with user interfaces or remote monitoring capabilities. Overall, this project showcases the practical integration of hardware and software to achieve a functional and effective automated conveyor system.

12. CODING LINK IN GITHUB

13. PROTOTYPE COSTING

NO.	PART ITEM	PRICE
1.	Channel Level Trigger Optocoupler Relay Module	RM 15.00
2.	MC27 3-24VDC BUZZER	RM 3.00
3.	LED-607R 5MM	RM 0.20
4.	LED-607G 5MM	RM 0.20
5.	4.5VDC MOTOR	RM 8.00
6.	E18-D80NK IR Proximity Sensor	RM 18.00
7.	ZS-X4B 3V~35V 5A Motor PWM Speed Controller	RM 15.00
8.	GL-6 Project Board	RM 7.00
9.	Conveyor All Part (1 SET)	RM 300.00
10.	Push-button Switch	RM 15.00
11.	Junction Box	RM 20.00
12.	Conveyor Belt DIY Set	RM 21.30
	TOTAL CONSUMPTION	**RM 422.70**

14. TEAM MEMBERS