॥ सा विद्या या विमुक्तये ॥

भारतीय प्रौद्योगिकी संस्थान धारवाड़

Indian Institute of Technology Dharwad

Stopwatch with IR Interrupter input and PC console output

EE615 : Embedded Systems Lab
Course Project

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Topics covered for project

- Initializing GPIO port for IR interrupt
- Systick timer for counting timing value(stopwatch)
- Initializing GPIO port for Reset interrupt
- Initializing GPIO port as Output(LEDs)
- Initializing UART for GPIO port
- Transmit data using UART protocol through UART module to PC
- Receive serial input on PC console through UART module.

GPIOF_Handler

- **Purpose:** Handles the SW1 button press interrupt to reset the timer and stop operations.

- **Key Actions:**
  - Clear Interrupt: Acknowledge the button press by clearing the interrupt flag.
  - Reset Timer: Stop the timer (running = 0) and reset all timing variables to 0.
  - Update LEDs: Turn red LED ON (indicates timer is stopped).
  - Send Feedback: Sends "Timer Reset" message via UART for user notification.

- **Context:** Ensures a complete reset of the timing operation upon button press.

GPIOA_Handler(if (object detected))

- **Purpose:** Handles IR sensor interrupt when an object is detected (active low signal).
- **Key Actions (Object Detected):**
  - Clear Interrupt: Clears the interrupt flag for PA2.
  - Start Timer:
  - If not already running (running = 0), set running = 1.
  - Reset all timer variables to 0.
  - Update LEDs: Turn green LED ON (indicates timing has started).
  - Send Feedback: Sends "Object Detected - Timing Started" message via UART.
- **Context:** Begins timing operation when an object is detected by the IR sensor.

GPIOA_Handler(if (object not detected))

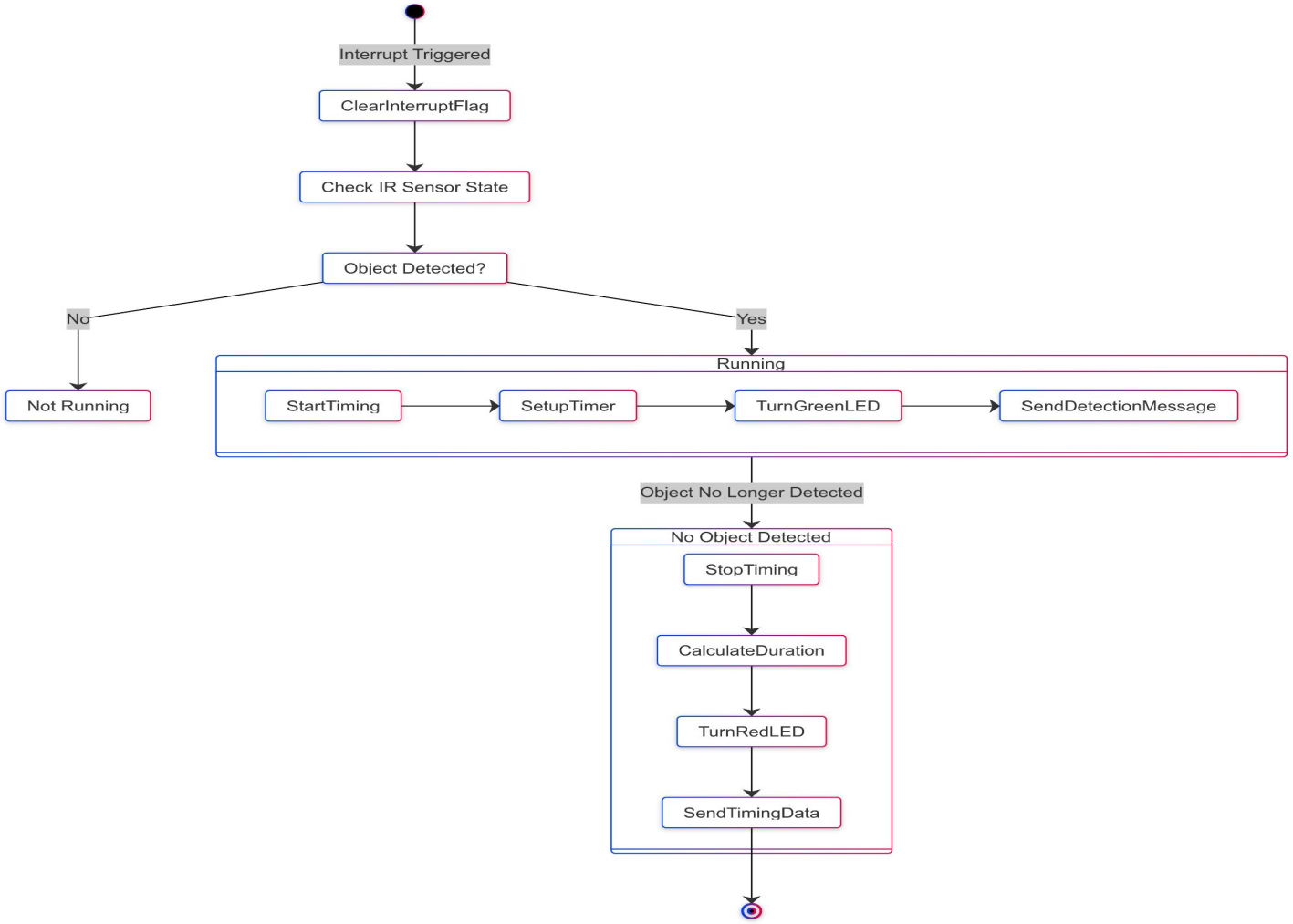
- **Purpose:** Handles IR sensor interrupt when the object is no longer detected.

Key Actions (Object Not Detected):

1. Stop Timer:
   - If the timer is running (running = 1), set running = 0.
2. Calculate Timing:
   - Compute elapsed time in milliseconds, seconds, and minutes.
3. Update LEDs: Turn red LED ON (indicates timing has stopped).
4. Send Feedback:
   - Sends "Timing Duration:" message via UART, followed by the elapsed time in minutes, seconds, and milliseconds.

Context: Ends timing operation and communicates the total elapsed time to the user.

GPIOA_Handler



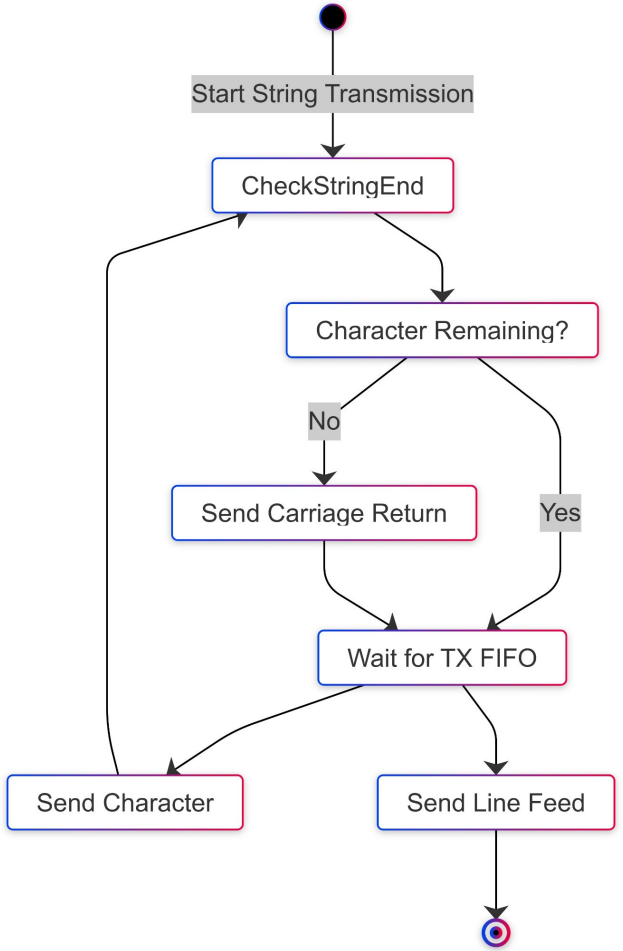
Systick Timer

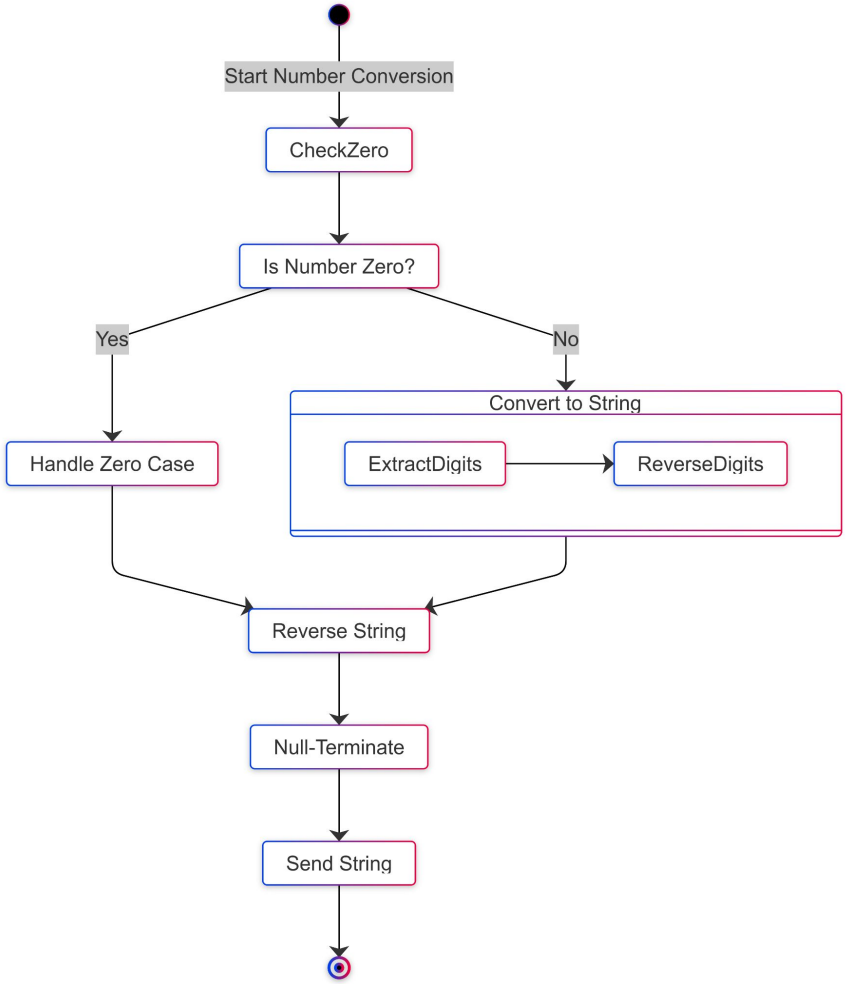
- Used to create a 1 millisecond time base for accurate timekeeping.
- Increments a global counter (countdown_value) whenever the timer overflows.
- Counter starts incrementing when an object is detected by the IR sensor.
- Timer stops when the object is no longer detected.
- Calculates and displays the elapsed time (in minutes, seconds, and milliseconds) via UART.

UART Data Transmission: Send Data and Send String Functions

- Check if the Transmit FIFO (TX FIFO) is full.
- Waits if TX FIFO is full to prevent data loss.
- Sends the data by writing it to the UART Data Register.
- Loop processes each character until the null terminator (\0) is reached.
- Ensures TX FIFO has space before sending each character by checking UART flag register 'TX buffer full' bit.
- Sends each character by writing to UART Data register
- Sends a carriage return (\r) and newline (\n) for readable formatting.

UART Data Transmission: Send Data and Send String Functions





Overall Flow