THOMPSON RIVERS UNIVERSITY

CENG 3020 – Real Time Systems Design and Analysis

Lab Project: Emulating a Real-Time Slot Machine

1. Project Overview

A slot machine creates a game of chance for its customers. The slot machines are a major component in the gaming industry, which contribute billions of dollars to the economy every year. The gaming industry is expected to generate even more revenue in the future.

In this project, we will implement a real-time slot machine using a Real-Time Operating System (RTOS) on STM32F4 Discovery Board. In particular, the customer wins when he or she pulls the lever of the slot machine only at a right time instant which is generated randomly. At all other time instants, the customer loses the game.

Main Implementation Steps:

- Introduction to STM32CubeMx, KEIL μVision and FreeRTOS (Lab 1-2)
- Real-time Task Management in FreeRTOS (Lab 3-4)
- Real-Time Scheduling (Lab 5)
- Synchronization and Queue Management in FreeRTOS (Lab 6)
- Resource Management in FreeRTOS (Lab 7)

Fig 1: An overview of the lab project.

2. Project Learning Outcomes

In the lab project, the students will learn the following:

- Working principles of RTOS;
- Integration of FreeRTOS (an open-source RTOS) with STM32F4 discovery Board;
- Task Management in FreeRTOS and its illustration on Discovery Board;
- Queue management in FreeRTOS and its illustration on Discovery Board;
- Resource management in FreeRTOS and its demonstration on Discovery Board;

Implementing the lab project will help the students to successfully implement their course project.

3. Project Requirements

During the labs, the students will emulate the real-time slot machine which should have the following features:

- A game of chance is created by the machine based on pseudo-random number generation or by a method which cannot be guessed in practice.
- Each episode on a slot machine is independent, unpredictable and unrelated to what happened on the previous episode. A machine is never "due for a win" and it does not "go cold" after a win either.
- The machine should have real-time constraints e.g., the machine should respond within 'x' seconds when a lever is pressed (emulate a lever with a push-button/restart button of Board) and at the start, the user activity remains disabled for exactly 'y' seconds.
- Assume that there is restriction in usage of certain FreeRTOS APIs such as vTaskSuspend() and vTaskResume(), thus avoid them as much as possible.
- The entire gaming experience should be engaging, interactive and the design process should consider the economical, safety, ethical and environmental aspects.

4. Lab Schedule

Lab	Description
1	Introduction to STM32CubeMx, KEIL µVision and Discovery Board
2	Introduction to FreeRTOS
3	Task creation and their priorities in FreeRTOS
4	Implementation of periodic tasks in FreeRTOS
5	Real time Scheduling in simulator
6	Real Time Synchronization and Queue Management
7	Queue sets and Resource management using mutex in FreeRTOS
8	Emulating a real-time slot machine (Lab Project)

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10	Design activity (with final presentation during 12th week)
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