45th STUDENT CONFERENCE (E2)
Educational Pico and Nano Satellites (4)

Author: Mr. kamal Lamichhane
Student, India

Mr. Kannan Thotumugath
India
Dr. Sandya S
India

EMBEDDED RTOS IMPLEMENTATION FOR TWIN NANO- SATELLITE STUDSAT2

Abstract

This paper describes the task management and scheduling algorithm for Twin Nano- satellite, "STUDSAT-2". STUDSAT (STUDent SATellite) project is undertaken by a group of students pursuing undergraduate course from INDIA. The mission is to demonstrate inter-satellite communication between two satellites STUDSAT-2A and STUDSAT-2B.Nano-satellites are designed for the dimension 300*300*150 mm weighing 6 kg and 5.5 kg respectively. Developing a reliable and robust Real Time Operating System (RTOS) functioning under the space constraints is of the highest importance. The basic prototype is expanded to operate in sophisticated conditions when system will be in space. The RTOS is developed on ARM CORTEX –M4 platform. This paper illustrates the development of RTOS which includes task management, priority assignment and scheduling their functionality. Hybrid configuration system which is combination of interrupt driven and preemptive priority systems is used for task management and scheduling. Starvation in preemptive scheduling is eliminated by the 'Aging' technique i.e. temporarily boosting the priority of a task which is starving for a long time. In this RTOS, direct to task notifications, queues, binary semaphores, counting semaphores, recursive semaphores and mutexes for communication and synchronisation between tasks, or between real time tasks and interrupts is implemented. The thread tick method is used to switch tasks depending on priority and a round-robin scheduling scheme. Task Synchronization technique, Mutual Exclusion - Sleep Wakeup Events, is implemented in the RTOS which uses notification mechanism for synchronization. Power saving is achieved by the method of tickless mode which is limited by the necessity to periodically exit and then re-enter the low power state to process tick interrupts. Three types of task are defined for the purposed architecture which are Periodic Task, Periodic Update Task and Aperiodic Task. Periodic Task takes action on a regular basis; Periodic Update Task collects data and places it in a global memory area for use by other task on regular basis. Aperiodic Task runs as a result of some external command response from ground station. The real time operating system (RTOS) is designed basically a task-scheduling program that responds to events such as interrupts in real time, i.e. a few milliseconds at most. Flight software architecture is developed using the types of task proposed above which is explained in detail in this paper.

Keywords—STUDSAT; RTOS; Scheduling; Task management.