

30. EMBEDDED CONTROL SYSTEM

Topics:

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Objectives:

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30.1 INTRODUCTION

- Elements of embedded systems (with program examples of each)
 - NOTE: emphasize a top-down program structure with subroutines for each one.
 - logical IO - digital inputs and outputs
 - analog outputs - immediate
 - analog inputs - delayed in (show use of nops and loop to wait), use potentiometer
 - timers including PWM to control transistor/h-bridge for motor control, show sound generation also.
 - counters including encoder decoding and tachometer decoding
 - serial IO
 - other peripherals such as displays, sounds, etc.
- Control system fundamentals
 - a simple PID feedback loop using nops and time calcs to ensure time
 - a multiple step process that waits for an input and does a task with the PID loop. Show an executive subroutine and calls to
 - dealing with events
 - event types; asynchronous, delayed
 - polling
 - interrupts
- Concurrent processes
 - single thread vs concurrent processing
 - how to implement a single control thread
 - how to create multiple processes
 - real-time
 - the need for multiple processes
 - non-time critical
 - time critical; regular updates and minimum time between runs

priority levels
hard vs. soft

- Structured Design

- General systems design topics

- show the general structure of a program with an executive routine that calls task routines.

- show a program that mixes an asynchronous GUI mixed with a realtime routine

- Modal System design

- show the use of global mode bits to track the mode of the system

- show how the mode bits changes the flow of execution in the executive routine.

- Flowcharts

- map flowchart structures to program structure

- using a register value to track the location in the flowchart

- State Diagrams

- show the use of state diagrams to model a process and then how the program is written for it.

- Failure Analysis

- show basic probability theory

- show parallel vs serial failures

- show failure estimation using theory for single and chained failure modes

- show the methods for categorizing failures as a hazard, danger, etc.

- Communication

- Receiving and sending strings

- String Handling

- Parsing strings

- Composing strings

- Command and response structures

- Error Checking

- Non byte oriented data

- Networked structured, ie destination address header

- A full feedback control system

- Other topics

- Keyboard multiplexing

- output refreshing, LEDs

30.2 CASE STUDY

30.3 SUMMARY

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30.4 PRACTICE PROBLEMS

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30.5 PRACTICE PROBLEM SOLUTIONS

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30.6 ASSIGNMENT PROBLEMS

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