Dordt University

Engineering 304, Embedded Systems, Spring 2023

PS#6, Problems on Encoders and Interrupts

1. Write up the requirements for a rotary relative position encoder than has one degree (or somewhat better) of resolution and can keep track of the direction of rotation. Specify the number of teeth and the location of sensors. Make an illustrative drawing showing any important details. You may abbreviate repetitious elements of the situation.

2. (This problem is not assigned.)

3.17 **Interrupt Density and Interval Constraints**. Consider a design which has four sources of interrupts, all of which can be active at the same time. The sources are identified by numbers 1, 2, 3, and 4, with 1 representing the highest priority source and 4 the lowest. The corresponding interrupt service routines take $T\_{1}=31$, $T\_{2}=29$, $T\_{3}=37$, and $T\_{4}=43$ µs, respectively. The minimum time between interrupts from the same source is $T\_{P1}=120,$ $T\_{P2}=200,$ $T\_{P3}=150,$ and $T\_{P4}=1000,$ respectively. For reliable operation, each source must be serviced before its next interrupt occurs.

a.) Will operation be reliable? Assume further interrupts are disabled for the duration of each interrupt service routine. Explain your answer.

b.) If the mainline routine is to be permitted to include critical regions, during which interrupts are temporarily turned off, then how long can these last and still maintain reliable operation?

c.) For case (a), given critical regions of no longer than 13 µs, then how much could $T\_{1}$ be lengthened and still ensure reliable operation.

d.) If the interrupts always happen at the minimum times between interrupts specified in the initial problem statement (meaning all the interrupt requests have become a periodic drum beat, each with period $T\_{Pi}$), then for case (a), what percentage of CPU time is available to the mainline routine, on the average?

Problems 3.17 is derived from a nearly identical problems in
Peatman, John B, *Design With Microcontrollers*, McGraw Hill, 1988.