

Reminder:

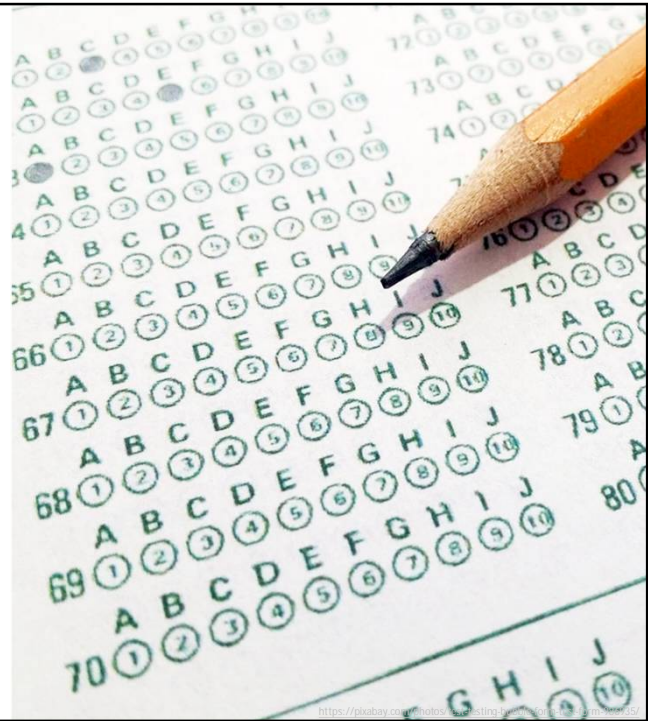
Please complete all "student evaluations of instruction."

There are several such evaluations being sent out from different offices of Dordt University.

I hear that some professors are requesting students to inform them when the evaluations have been completed. I prefer not to ask that of you.

That said, in a class as small as ours **100% participation from all students in all requested evaluations is important.** Even one student not participating will seriously reduce the significance of the results.

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1



2

In the category

1/17/2020, #22, Parallel Ports of the Past

2/14/2020, #16, Doorbell

"Worst of the Worst"

2/03/2020 #21, Observations about Temperature

2/26/2020, #7, The Schedule Table

The nominees are...

2/14/2020 #10, Speeding up di/dt

3/23/2020, #20, Serial Interfacing Tech.

4/22/2020, #19, Arrows All Over The Place

4/29/2020, #1, Reminder

3

In the category

1/27/2020, #7, Accuracy ≠ Precision

2/10/2020, #6, Holding Torque

"Best of the Best"

1/29/2020 #7, Capacitive Coupling

2/14/2020, #14, V-Scan Encoding

The nominees are...

2/05/2020 #8, What, Me Worry?

2/19/2020, #5, Diamond Mine

2/24/2020, #24, Hardware Interrupt

3/23/2020, #20, Serial Interfacing Tech.

4

In the category

1/17/2020, #22, Parallel Ports of the Past

"Worst of the Worst"

The first round of voting


Parallel Ports of the Past

The type of parallel port described on previous slides should not be confused with some legacy ports which are only subsets of what has been presented.


The "Centronics Parallel Port" was popular on legacy IBM PC's and clones of those. Those are indeed parallel ports, a subset of what is described above, but they are not nearly so configurable as a general parallel port.

The Centronics parallel port is now highly standardized. The "Centronics parallel port standard" is IEEE-1284. It is 8-bits, bidirectional. The Centronics parallel port standard requires a "DB-25 female" connector on the computer and a "female Centronics connector" on the printer. A Centronics parallel printer cable has the mating connectors, A "DB-25 male" and a "male Centronics connector" on the other end.


Another mostly obsolete parallel port standard of historical significance (still in some minor use) is the GPIB, (not GPI) or HP-IB port, defined by IEEE-488. It is 8-bit, bidirectional. Devices always have a female connector. Cables always have a male/female stacking connector on each end.



Female DB-25 Centronics parallel port on a computer



Female Centronics parallel port on a printer



GPIB parallel port on the back of an oscilloscope



IEEE-488 connectors on a cable. (Both ends are electrical)

2/03/2020 #21, Observations about Temperature

Techniques in temperature measurement.

Observations about temperature measurement:

Measurements from about -50 C to about 150 C with accuracy of about ± 2 C and precision of about ± 0.1 C are routine and inexpensive now. (ADT7302 is about \$3.00 in single quantities, < \$1.00 each in quantity)

Use a precision temperature sensor with a digital (SPI or I2C or Dallas One-Wire) output if possible. Texas Instruments TMP107, Maxim DS18B30, Analog Devices

Otherwise use a precision resistor network, a precision low-temperature coefficient reference resistor located near the ambient temperature to sample the signal. Pay attention to range, precision and digital resolution and make them as suitable as practically possible.

If you need more precision, it is going to get expensive fast. Question the need before taking it on! (Sometimes people just specify things they "want" with little understanding of the trade-offs involved.)

If you need to work at higher temperatures, look to RTDs and thermocouples. Consider using stand-alone processing equipment to do the A/D conversion. Although a thermocouple can be purchased for \$5.00, you will need expensive equipment to get accurate results.

5

In the category

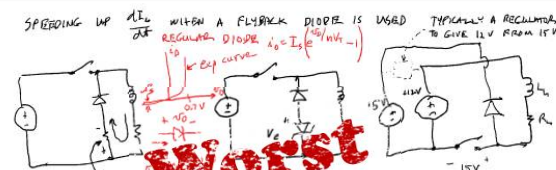
2/14/2020 #10, Speeding up di/dt

"Worst of the Worst"

The first round of voting

Speeding up di/dt

WITH A FLIPPY DIODE IS USED TYPICALLY A REGULATOR TO GIVE 12V FROM 15V




USE SERIES RESISTOR SUBSTITUTES THE $\frac{1}{R}$ TIME CONSTANT WHEN SW. IS OFF BUT AT A COST OF RISING THE VOLTAGE ACROSS THE SWITCH - NEED A BETTER SWITCH

CHANGES EXP. DECAY TO A CONSTANT RAMP WHICH IS FASTER A/F A GIVEN INDUCTIVE LOADS THE SWITCH

USE A HIGHER VOLTAGE SUPPLY - REGULATES SW IN NEG. SIDE - GIVES CONSTANT RAMP

Worst

2/14/2020, #16, Doorbell



Doorbell...
Better go answer it.

Ah...
Delivery guy is bringing slides about
Interrupt Driven I/O!

(Here we leave most of the hobby-oriented Web pages behind.)

6

In the category

2/26/2020, #7, The Schedule Table

"Worst of the Worst"

The first round of voting

The Schedule Table

A shared resource in global memory
A row of data for each Task.

3/23/2020, #20, Serial Interfacing Tech.

Serial interfacing techniques

Serial interfacing is one of two important styles of digital communication. The other style is parallel interfacing.

7

In the category

4/22/2020, #19, Arrows All Over The Place

"Worst of the Worst"

The first round of voting

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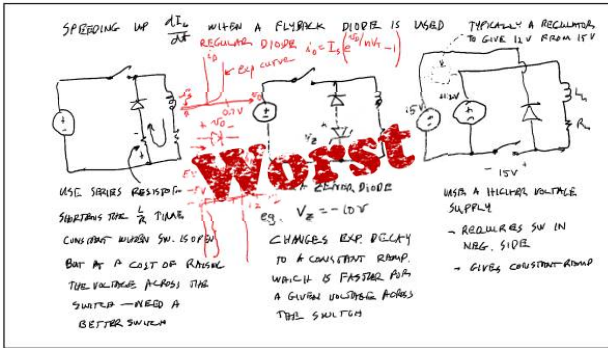
8

In the category

"Worst of the Worst"

The second round of voting

2/14/2020 #10, Speeding up di/dt



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If you need to work at higher temperatures, look to RTDs and thermocouples. Consider using stand-alone processing equipment to do the A/D conversion. Although a thermocouple can be purchased for \$5.00, you will need expensive equipment to get accurate results.

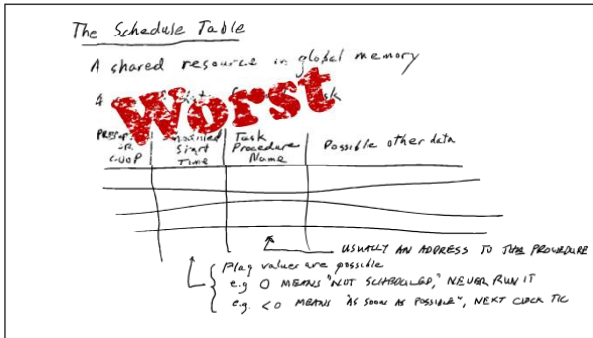
9

In the category

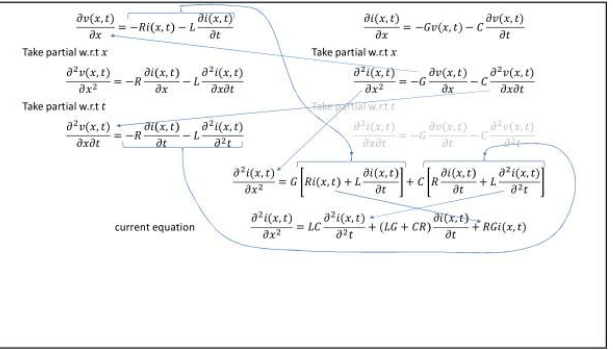
"Worst of the Worst"

The second round of voting

2/26/2020, #7, The Schedule Table



4/22/2020, #19, Arrows All Over The Place



10

In the category
"Worst of the Worst"
The final round voting

2/26/2020, #7, The Schedule Table

The Schedule Table

A shared resource in global memory
A row of data for each Task

PREVIOUS OR CUSP	scheduled start time	Task Procedure Name	Possible other data

↑ usually an address to the procedure

{ Play values are possible
e.g. 0 means "NOT SCHEDULED", NEVER RUN IT
e.g. < 0 means "AS SOON AS POSSIBLE", NEXT CIRCUIT

2/14/2020 #10, Speeding up di/dt

11

In the category
"Best of the Best"
The first round of voting

1/27/2020, #7, Accuracy ≠ Precision

Accuracy ≠ Precision

1/29/2020 #7, Capacitive Coupling

12

In the category
"Best of the Best"
The first round of voting

2/05/2020 #8, What, Me Worry?
2/10/2020, #6, Holding Torque

"What? Me worry?"
"What's the good of anything? Nothing!"

Ephraim [Israel] is joined to idols, let him alone. Yet it was I [the LORD] who taught Ephraim to walk, I took them up in my arms. (A short paraphrase of Hosea.)


Many couples choose not to have children. It is not that they do not want any in their homes and lives. Children are not to risk and spend yourself for children, and they can be a burden on your home.

God has chosen to have children. God is fatherly. In Hosea, God Ephraim, Ephraim wanders for Israel and all God's children. God Ephraim has gradually been breaking his father's heart. A woman, Ephraim has been wanting his father's gifts, Marking the forehead with eyes and with an affliction which spurs remorse.

There have been numerous fatherly warnings from God. "Don't do this, son! Look at how you have come to me! You are sick and hurt and desperately wrong. You are looking on me. Come home!"

But Ephraim will not listen. At times it seems he cannot listen.

Finally God let Ephraim go. He does not get even. He just goes out. Here is the agonized parent of a hurt, angry and deeply disappointed parent. He has



and everything else is to say. He has tried everything he can think of, but it doesn't work. Now it is time for silence and restraint. "Ephraim is joined to idols, let him alone." He forces himself to let go, let it be known, let us see what comes. If we were to destroy ourselves—all, all right.

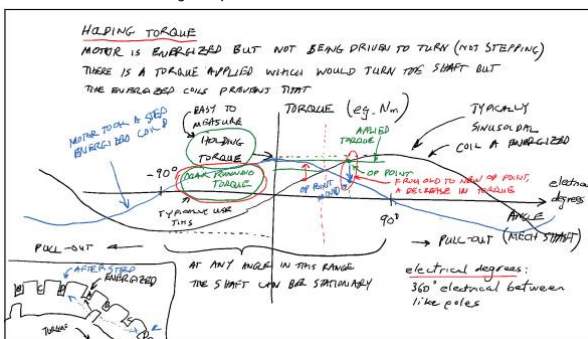
He cannot let us go. For he the one we filled and held on when we were right? Isn't he the one who has to deal with our hunger with child and adult? He has to watch us at times through the watches of the night?

How can I give you up, O Ephraim!
How can I hand you over, O Israel...
I will not expose my face again...
for I am God and not man.

"I am God and not man." In these words lies hope for children who would otherwise make themselves fatherless.

(Hosea 11:1-9, 13:14-17)

HOLDING TORQUE
MOTOR IS ENERGIZED BUT NOT BEING DRIVEN TO TURN (NOT STEERING)
THERE IS A TORQUE APPLIED WHICH WOULD TURN THE SHAFT BUT THE ENERGY COILS PREVENTS THAT



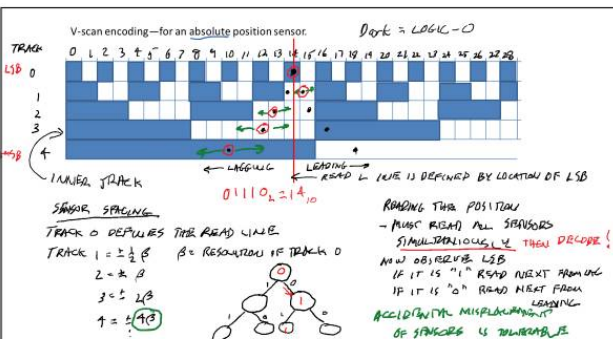
MEANS TOOK A STEP BEHIND COIL
TYPICALLY SWISS-ARMED COIL A ENERGIZED
TORQUE (eg Nm)
APPLIED TORQUE
ELECTRICAL DISCONNECT
PULL-OUT
AT ANY ANGLE IN THIS RANGE THE SHAFT CAN BE STATIONARY
ELECTRICAL DISCONNECT: 360° electrical between 1/2 inch coils

13

In the category
"Best of the Best"
The first round of voting

2/14/2020, #14, V-Scan Encoding
2/19/2020, #5, Diamond Mine

V-scan encoding—for an absolute position sensor. Data = LOGIC-0



TRACK 0 DEFINES THE READ LINE
TRACK 1 = 1/2 B
TRACK 2 = 2/3 B
TRACK 3 = 3/4 B

READING THE POSITION - PLUS RIGHT ALL SENSORS SIMULTANEOUSLY THEN DECODE!
NO OBSERVABLE LSB
IF IT IS "1" READ NEXT FROM LEFT
IF IT IS "0" READ NEXT FROM RIGHT
ACCORDING TO THE MIXED PATTERN OF SPACES IS TO BE READ

Advantages of interrupts—foundational to object-oriented programming

The concept of object-oriented programming illustrates the programming language Scratch (aimed at K-12). Unfortunately, Scratch is bundled with Raspbian on the Raspberry Pi. It does not use the GPIO port; it uses the I2C port.

An illustration of an interrupt-driven game. (There is no main() or usleep() or usleep() routine in scratch.)
<https://scratch.mit.edu/projects/360941305/editor>


Scratch's purity is object-oriented.

Each "sprite" is an object in memory and available at all times.

The objects can talk to each other via global variables, here called "broadcasts."

The objects have "methods" that can be invoked from other objects. Once invoked the method runs to completion without further supervision or return to the invoking program.

Methods can be invoked by interrupts like key-presses, mouse clicks, etc.



14

In the category

2/24/2020, #24, Hardware Interrupt

"Best of the Best"

The first round of voting

Interrupt example, Three interrupts (Interrupt 1 is highest priority)

There are no critical regions, the longest instruction takes 1 ms to execute
 Interrupts run with interrupts disabled

For interrupt #1, $T_{p1} = 60 \text{ ms}$, $T_{i1} = 1.0 \text{ ms}$, $T_{i2} = 2.5 \text{ ms}$
 For interrupt #2, $T_{p2} = 20 \text{ ms}$, $T_{i1} = 2.5 \text{ ms}$, $T_{i2} = 1 \text{ ms}$
 For interrupt #3, $T_{p3} = 4 \text{ ms}$, $T_{i1} = 1.0 \text{ ms}$, $T_{i2} = 1 \text{ ms}$

STEP 1 CHECK INTERRUPT DENSITY RATIO
 $\frac{T_i}{T_p} = \frac{1 \text{ ms}}{60 \text{ ms}} + \frac{2.5}{20} + \frac{1}{4} = 0.392 < 1.0$ (OK)

STEP 2 EVALUATE T_{i1} VALUES (START W/ HW)
 \therefore MUST CHECK INTERRUPT INTERVALS

STEP 3 APPLY INTERVAL FORMULA
 $T_{i1} + N(i,1)T_{i1} + N(i,2)T_{i2} + \dots + N(i,n)T_{in} < T_{p_i}$

FOR INTR #1 $T_{i1} + N(1,1)T_{i1} < T_{p1} \rightarrow 2.5 \text{ ms} + (1)1 \text{ ms} < 60 \text{ ms} \rightarrow 3.5 < 60$ (OK)

FOR INTR #2 $T_{i2} + N(2,1)T_{i1} + N(2,2)T_{i2} < T_{p2} \rightarrow 1 \text{ ms} + (1)1 \text{ ms} + (1)2.5 \text{ ms} < 20 \text{ ms}$ (OK)

$N(i,2) = \left\lceil \frac{T_{p_i} - T_{i1}}{T_{i2}} \right\rceil$ $N(2,1) = \left\lceil \frac{T_{p2} - T_{i2}}{T_{i1}} \right\rceil = \left\lceil \frac{20 \text{ ms} - 2.5 \text{ ms}}{60 \text{ ms}} \right\rceil = 1$

FOR INTR #3 $T_{i3} + N(3,1)T_{i1} + N(3,2)T_{i2} + N(3,3)T_{i3} < T_{p3}$
 $N(3,1) = \left\lceil \frac{T_{p3} - T_{i1}}{T_{i1}} \right\rceil = \left\lceil \frac{4 - 1}{1} \right\rceil = 3$
 $N(3,2) = \left\lceil \frac{T_{p3} - T_{i1} - N(3,1)T_{i1}}{T_{i2}} \right\rceil = \left\lceil \frac{4 - 1 - 3}{2.5} \right\rceil = 1$

Best (circled in blue)

5.5 ← 1 (circled in blue)
FAILURE! (circled in blue)

3/23/2020, #20, Serial Interfacing Tech.

Serial interfacing techniques

Serial interfacing is one of two important styles of digital communication. The other style is parallel interfacing.

15

In the category

1/27/2020, #7, Accuracy ≠ Precision

"Best of the Best"

The second round of voting

Accuracy ≠ Precision

Better precision than accuracy

Better accuracy than precision

Probability density

Reference value

Accuracy

Precision

Value

2/05/2020 #8, What, Me Worry?

"What? Me worry?"

"What's the good of anything? Nothing!"

Ephraim [Israel] is joined to idols, let him alone. Yet it was I [the LORD] who taught Ephraim to walk, I took them up in my arms. (A short paraphrase of Hosea.)

Many people choose not to have children. It is not that they dislike children particularly. They just do not want any more children. They have had their share. You have to wait and spend time for children. Children need time and take time away from you. How is God our Father, as someone put it, "twisting the room, being by his hands gripped tightly behind his back." He forces himself to let us go, let us let him go, let us see what life is like in the darkness. If we want to discover ourselves—well, all right.

And yet, he cannot do it. He cannot let us go. Isn't he the one who lifted and held us when we walked into mortality? Isn't he the one who bears us and our hunger with child-sized bits of food? How do we get on with so many times through the weakness of the night?

How can I give you up, O Ephraim? How can I hand you over, O Israel? I will not execute my fierce anger... For I am God and not man.

"For I am God and not man." In those words his hope for children who would otherwise make themselves faithless.

Best (circled in blue)

16

In the category

"Best of the Best"

The second round of voting

2/19/2020, #5, Diamond Mine

Advantages of interrupts—foundational to object-oriented programming

The concept of object-oriented programming illustrated in the programming language Scratch (aimed at K-12) Scratch is bundled with Raspbian on the Raspberry Pi. Unfortunately, it completely ignores the GPIO port;-)

An illustration of an interrupt-driven game. (There is no main () or setup () or loop () routine in scratch.) <https://scratch.mit.edu/projects/360841305/editor/>



Scratch is purely object-oriented. Each "sprite" is an object in memory and available at all times. The objects can talk to each other via global variables, here called "broadcasts." The objects have "methods" that can be invoked from other objects. Once invoked the method runs to completion without further supervision or return to the invoking program. Methods can be invoked by interrupts like key-presses, mouse clicks, etc.

2/24/2020, #24, Hardware Interrupt

Interrupt example, Three interrupts (Interrupt 1 is highest priority)

There are no critical regions, the longest instruction takes 1 ms to execute Interrupts run with interrupts disabled

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 For interrupt #2, $T_{P2} = 20 \text{ ms}$, $T_{I2} = 2.5 \text{ ms}$, $T_{I2} = 1 \text{ ms}$
 For interrupt #3, $T_{P3} = 4 \text{ ms}$, $T_{I3} = 1.0 \text{ ms}$, $T_{I3} = 2 \text{ ms}$

STEP 1: APPLY INTERRUPT FORMULA

FOR INTR #1 $T_{I1} + N(1,1)T_1 < T_{P1} \rightarrow 2.5 \text{ ms} + (1)1 \text{ ms} < 60 \text{ ms} \rightarrow 3.5 < 60$ (OK)

FOR INTR #2 $T_{I2} + N(2,1)T_2 + N(2,2)T_2 < T_{P2} \rightarrow 1 \text{ ms} + (1)1 \text{ ms} + (1)2.5 \text{ ms} < 20 \text{ ms}$ (OK)

FOR INTR #3 $T_{I3} + N(3,1)T_3 + N(3,2)T_3 + N(3,3)T_3 < T_{P3}$
 $1 \text{ ms} + (1)1 \text{ ms} + (1)2.5 \text{ ms} + (1)1 \text{ ms} < 4 \text{ ms}$
 $5.5 < 4$ FAILURE!

STEP 2: CHECK INTERRUPT DENSITY RATIO

$\frac{T_I}{T_P} = \frac{1 \text{ ms}}{60 \text{ ms}} + \frac{2.5}{20} + \frac{1}{4} = 0.392 < 1.0$ (OK)

STEP 3: EVALUATE T_n + VALUES (START w UN)

$N(1,1) = \left\lfloor \frac{T_{P1} - T_{I1}}{T_1} \right\rfloor = \left\lfloor \frac{60 \text{ ms} - 1 \text{ ms}}{1 \text{ ms}} \right\rfloor = 59$

$N(2,1) = \left\lfloor \frac{T_{P2} - T_{I2}}{T_2} \right\rfloor = \left\lfloor \frac{20 \text{ ms} - 1 \text{ ms}}{1 \text{ ms}} \right\rfloor = 19$

$N(3,1) = \left\lfloor \frac{T_{P3} - T_{I3}}{T_3} \right\rfloor = \left\lfloor \frac{4 \text{ ms} - 1 \text{ ms}}{1 \text{ ms}} \right\rfloor = 3$

$N(3,2) = \left\lfloor \frac{T_{P3} - T_{I3}}{T_2} \right\rfloor = \left\lfloor \frac{4 \text{ ms} - 1 \text{ ms}}{2.5 \text{ ms}} \right\rfloor = 1$

$N(3,3) = \left\lfloor \frac{T_{P3} - T_{I3}}{T_3} \right\rfloor = \left\lfloor \frac{4 \text{ ms} - 1 \text{ ms}}{2 \text{ ms}} \right\rfloor = 1$

17

In the category

"Best of the Best"

The final round of voting

2/05/2020 #8, What, Me Worry?

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God has chosen to have children. God is fatherly. In Hosea, God's child is called Ephraim. Ephraim stands for Israel and all God's children. God loves Ephraim. But Ephraim has gradually been breaking his father's heart. A carbon and endotherm prodigious work, Ephraim has been weaving his father's gifts, stealing the family name, and reaching over his own wall with an agliness which ruins character.

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said everything there is to say. He has tried everything he can think of to get his son to work. Now it is time for silence and restraint. "Ephraim is joined to idols; let him alone!"

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And yet, he cannot do it. He cannot let us go. Isn't he the one who lifted and held us when we waddled into reach? Isn't he the one who bent so fond our hunger with child steel lines of God's? He is not our savior with us more than through the weakness of the right?

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 For interrupt #2, $T_{P2} = 20 \text{ ms}$, $T_{I2} = 2.5 \text{ ms}$, $T_{I2} = 1 \text{ ms}$
 For interrupt #3, $T_{P3} = 4 \text{ ms}$, $T_{I3} = 1.0 \text{ ms}$, $T_{I3} = 2 \text{ ms}$

STEP 1: APPLY INTERRUPT FORMULA

FOR INTR #1 $T_{I1} + N(1,1)T_1 < T_{P1} \rightarrow 2.5 \text{ ms} + (1)1 \text{ ms} < 60 \text{ ms} \rightarrow 3.5 < 60$ (OK)

FOR INTR #2 $T_{I2} + N(2,1)T_2 + N(2,2)T_2 < T_{P2} \rightarrow 1 \text{ ms} + (1)1 \text{ ms} + (1)2.5 \text{ ms} < 20 \text{ ms}$ (OK)

FOR INTR #3 $T_{I3} + N(3,1)T_3 + N(3,2)T_3 + N(3,3)T_3 < T_{P3}$
 $1 \text{ ms} + (1)1 \text{ ms} + (1)2.5 \text{ ms} + (1)1 \text{ ms} < 4 \text{ ms}$
 $5.5 < 4$ FAILURE!

STEP 2: CHECK INTERRUPT DENSITY RATIO

$\frac{T_I}{T_P} = \frac{1 \text{ ms}}{60 \text{ ms}} + \frac{2.5}{20} + \frac{1}{4} = 0.392 < 1.0$ (OK)

STEP 3: EVALUATE T_n + VALUES (START w UN)

$N(1,1) = \left\lfloor \frac{T_{P1} - T_{I1}}{T_1} \right\rfloor = \left\lfloor \frac{60 \text{ ms} - 1 \text{ ms}}{1 \text{ ms}} \right\rfloor = 59$

$N(2,1) = \left\lfloor \frac{T_{P2} - T_{I2}}{T_2} \right\rfloor = \left\lfloor \frac{20 \text{ ms} - 1 \text{ ms}}{1 \text{ ms}} \right\rfloor = 19$

$N(3,1) = \left\lfloor \frac{T_{P3} - T_{I3}}{T_3} \right\rfloor = \left\lfloor \frac{4 \text{ ms} - 1 \text{ ms}}{1 \text{ ms}} \right\rfloor = 3$

$N(3,2) = \left\lfloor \frac{T_{P3} - T_{I3}}{T_2} \right\rfloor = \left\lfloor \frac{4 \text{ ms} - 1 \text{ ms}}{2.5 \text{ ms}} \right\rfloor = 1$

$N(3,3) = \left\lfloor \frac{T_{P3} - T_{I3}}{T_3} \right\rfloor = \left\lfloor \frac{4 \text{ ms} - 1 \text{ ms}}{2 \text{ ms}} \right\rfloor = 1$

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2/24/2020, #24, Hardware Interrupt

The grand prize winners!

Interrupt example, Three interrupts (Interrupt 1 is highest priority)

There are no critical regions, the longest instruction takes 1 ms to execute. Interrupts run with interrupts disabled.

For interrupt #1, $T_{P1} = 60 \text{ ms}$, $T_1 = 1.0 \text{ ms}$, $T_{1+} = 2.5 \text{ ms}$
 For interrupt #2, $T_{P2} = 20 \text{ ms}$, $T_2 = 2.5 \text{ ms}$, $T_{2+} = 1 \text{ ms}$
 For interrupt #3, $T_{P3} = 4 \text{ ms}$, $T_3 = 1.0 \text{ ms}$, $T_{3+} = 1 \text{ ms}$

STEP 1 CHECK INTERRUPT DENSITY RATIO
 $\frac{T_1}{T_{P1}} = \frac{1 \text{ ms}}{60 \text{ ms}} + \frac{2.5}{20} + \frac{1}{4} = 0.992 < 1.0$ (OK)

STEP 2 EVALUATE T_{i+} VALUES (START W LOW)
 \therefore MUST CHECK INTERRUPT INTERVALS

STEP 3 APPLY INTERVAL FORMULA
 $T_{i+} + N(i,1)T_1 + N(i,2)T_2 + \dots + N(i,i)T_i < T_{Pi}$

FOR INTR #1: $T_{1+} + N(1,1)T_1 < T_{P1} \rightarrow 2.5 \text{ ms} + (1)1 \text{ ms} < 60 \text{ ms} \rightarrow 3.5 < 60$ (OK)

FOR INTR #2: $T_{2+} + N(2,1)T_1 + N(2,2)T_2 < T_{P2} \rightarrow (1)1 \text{ ms} + (2)2.5 \text{ ms} < 20 \text{ ms}$ (OK)

$N(i,j) = \left\lceil \frac{T_{Pi} - T_{i+}}{T_j} \right\rceil$
 $N(2,1) = \left\lceil \frac{20 \text{ ms} - 2.5 \text{ ms}}{1 \text{ ms}} \right\rceil = 17$
 $N(3,1) = \left\lceil \frac{4 \text{ ms} - 1 \text{ ms}}{1 \text{ ms}} \right\rceil = 3$
 $N(3,2) = \left\lceil \frac{4 \text{ ms} - 1 \text{ ms} - (3)1 \text{ ms}}{2.5 \text{ ms}} \right\rceil = 1$

FOR INTR #3: $T_{3+} + N(3,1)T_1 + N(3,2)T_2 + N(3,3)T_3 < T_{P3}$
 $1 \text{ ms} + (1)1 \text{ ms} + (1)2.5 \text{ ms} + (1)1 \text{ ms} < 4 \text{ ms}$
 $5.5 < 4$ (FAILURE!)

Best of the Best

Worst of the Worst

2/14/2020 #10, Speeding up di/dt

SPEEDING UP $\frac{di}{dt}$ WITH A FLYBACK DIODE IS USED TYPICALLY A RECTIFIER TO GIVE 12V FROM 15V

USE SQUARE RESISTOR - $-V$ STARTS THE $\frac{L}{R}$ TIME CONSTANT WHEN SW. IS OFF BUT AT A COST OF RISING THE VOLTAGE ACROSS THE SWITCH - NEED A BETTER SWITCH

USE A ZENER DIODE
 eg. $V_Z = -10V$
 CHANGES EXP. DECAY TO A CONSTANT RAMP. WATCH IS FASTER FOR A GIVEN VOLTAGE ACROSS THE SWITCH

USE A HIGHER VOLTAGE SUPPLY
 - REQUIRES SW IN NEG. SIDE
 - GIVES CONSTANT RAMP

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James 4:13-17

¹³ Now listen, you who say, "Today or tomorrow we will go to this or that city, spend a year there, carry on business and make money." ¹⁴ Why, you do not even know what will happen tomorrow. What is your life? You are a mist that appears for a little while and then vanishes. ¹⁵ Instead, you ought to say, "If it is the Lord's will, we will live and do this or that." ¹⁶ As it is, you boast in your arrogant schemes. All such boasting is evil. ¹⁷ If anyone, then, knows the good they ought to do and doesn't do it, it is sin for them.

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We cannot see the Lord's will on our own. Jesus is the light of the world. Thinking reflectively about, "I did this. . ." or "I thought this. . ." will not bring up the greatest memories for us. Seeing our humble place in our universe is a step toward significance in God's universe.

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