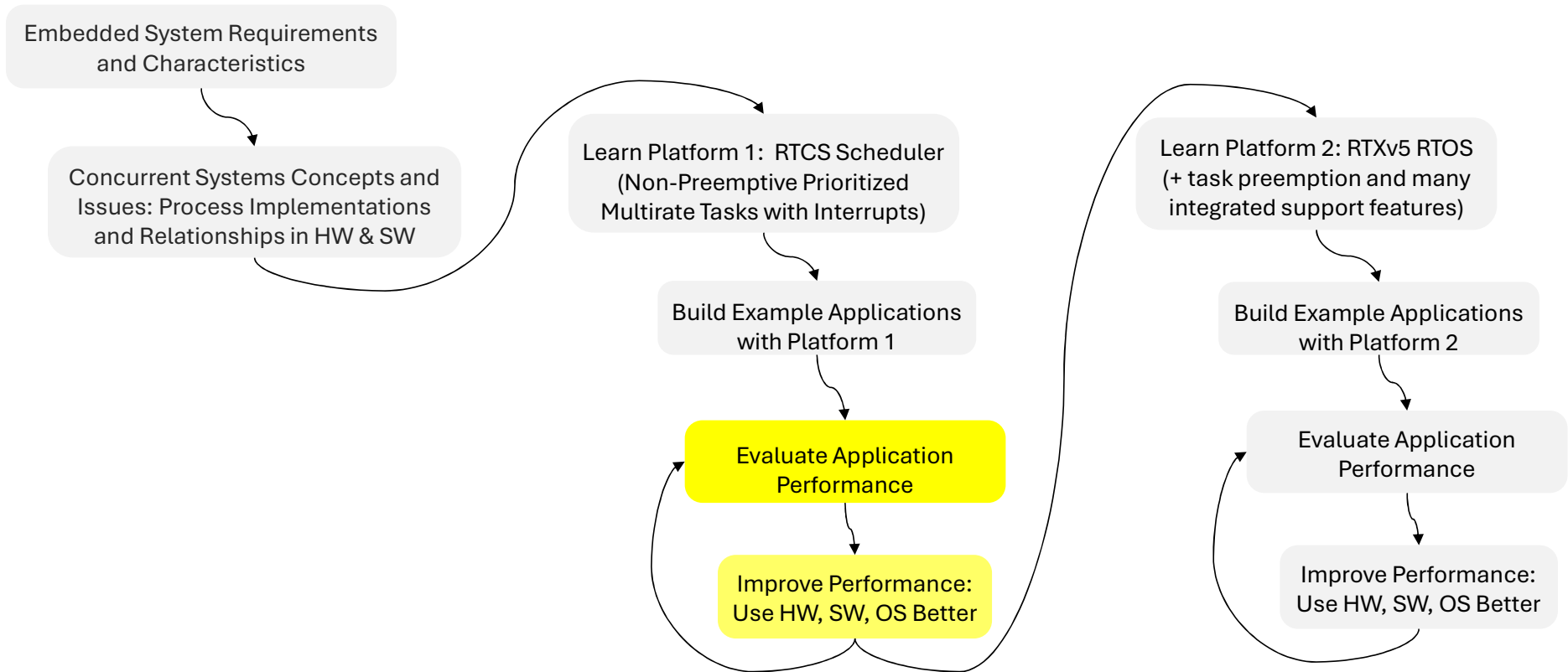


CHALLENGES FOR FIRST IMPLEMENTATIONS (PLATFORM 1, VERSION 1)

V1
10/1/2025

Where are we in the class?



LN13 – Challenges of P1 V1 Implementations

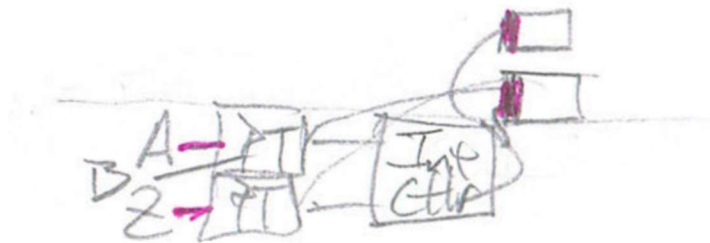
- Evaluate challenges in first implementations
 - Identify limitations imposed by platform 1: RTC process scheduling, basic peripheral, interrupt system.
 - Identify omitted features, risks, performance gaps, risks
 - Classify implementations: good enough or needs work?
 - Develop prioritized plan to solve “needs work” implementations

SUMMARY AND EVALUATION OF INITIAL APPLICATION DESIGN APPROACHES (PLATFORM 1, VERSION 1)

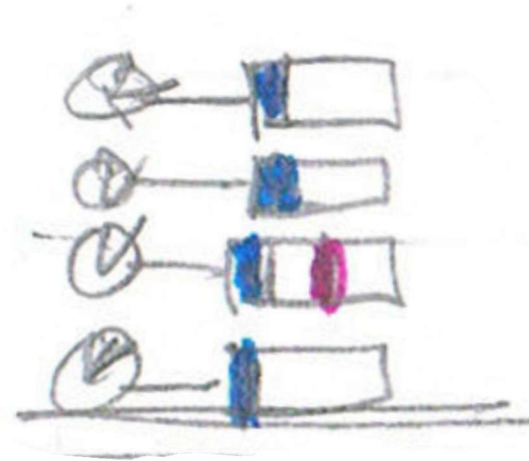
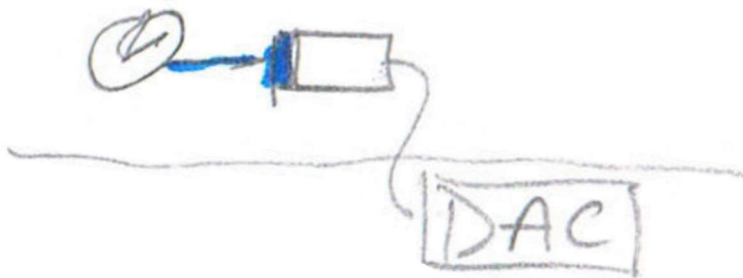
Examples

Event Trigg.
Time Trigg.

- Quadrature Decoder w/Limit Switch
- Blinky Control Panel

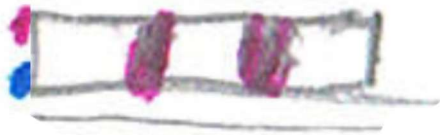


- Waveform Generator

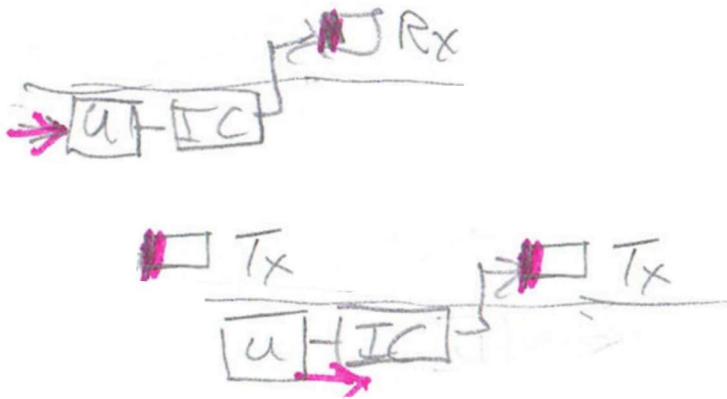


Examples

- Touchscreen



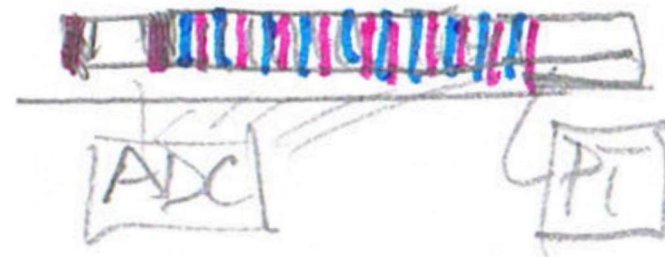
- Serial UART Communications



- LCD Controller

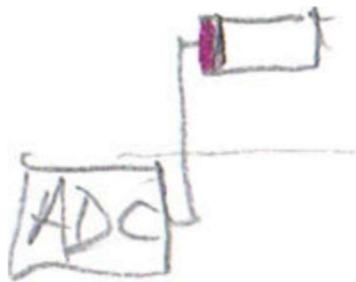


- Scope

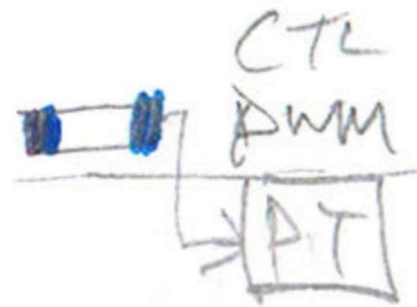


Examples

- SMPS Controller



- PWM



Evaluation of First Implementations (P1 V1)

	Initial Sync		Internal I/O Sync		Top Compromises and Risks	Top Problems
	Event	Time	Event	Time		
Quad. Decoder w/Z Limit Switch	Port interrupts from inputs A, Z		none	none		Shared variable pos vulnerable to data corruption
Waveform Generator		Periodic task at output update frequency	none	none		- Update rate limited by scheduler tick frequency - Unstable output update timing due to task start interference
Blinky Control Panel		Periodic task polls	A/D conversion complete (CoCo)	none	Driving LED with DAC – poor control	
Touchscreen Driver		Periodic task polls	A/D CoCo (2)	none		
Byte-Level Serial UART Comm.	UART Rx, Tx interrupts		none	none	Byte-level interface pushes protocol complexity to application processes	
LCD Ctlr. Interface	Implicit, part of calling process		none	none		

Evaluation of First Implementations (P1 V1), continued

		Initial Sync		Internal I/O Sync		Top Compromises and Risks	Top Problems
		Event	Time	Event	Time		
Scope	Detect Trigger	Event from UI		A/D CoCo (many: in blocking tests)	none		
	Acquire Data	Event: Detect Trigger ends		A/D CoCo (many: once per sample)	Omitted: Delay to start next sample (many: once per sample)	- Greedy: Blocking loop doesn't share CPU not shared during sync to A/D CoCo - No control of sampling rate, since omitting sync to sample period	
	Plot Data	Event: Acquire Data ends		none	none		
PWM Generator			Periodic task at PWM frequency	none	Delay for requested pulse width		
SMPS Controller			Periodic task at control loop frequency	A/D CoCo	none		Poor performance due to ADC sampling not synchronized to PWM drive signal

Example Application Data

Application	Independent Process?	Triggers	Trigger Detection	Scheduler	Work done in ...	Internal Sync. #1 in Work Code	Internal Sync. #2 in Work Code
Quadrature Decoder	Y	Events: $\uparrow A$, $\uparrow Z$	Peripheral (PORT)	Interrupt System	ISR(s) for A, Z	-	
Waveform Generator	Y	Time - Periodic: T_{sample}	RTCS Tick Handler	RTCS	Task_Update_DAC	-	
Blinky Control Panel	Y	Time - Periodic: T_{Poll}	RTCS Tick Handler	RTCS	Task_On_Off	-	
	Y	Time - Periodic: T_{Poll}	RTCS Tick Handler	RTCS	Task_Level_Alarm	-	
	Y	Time - Periodic: T_{Poll}	RTCS Tick Handler	RTCS	Task_Dimmer	Wait for A/D conversion to complete	
	Y	Time - Periodic: T_{Flash}	RTCS Tick Handler	RTCS	Task_Flash	-	
Touchscreen	Y	Time - Periodic: T_{Poll}	RTCS Tick Handler	RTCS		Wait for 1st A/D conversion to complete	Wait for 2nd A/D conversion to complete
Serial UART Comms.	Y	Events: UART Tx events	Peripheral (UART)	Interrupt System	ISR for Tx	-	
	Y	Events: UART Rx events	Peripheral (UART)	Interrupt System	ISR for Rx	-	
LCD Controller	N	When called by process	n/a	n/a		Not needed.	
Oscilloscope	Y	Event: $V_{\text{In}} \uparrow V_{\text{Trigger}}$	Software polling of ADC	?	Detect Trigger	Wait for A/D conversion complete	
		Trigger detected and Time - Periodic: T_{Sample}	?	?	Sample Data	Wait for A/D conversion complete	
		Sample Data completes			Plot Data	-	
SMPS Controller	Y	Event: PWM Timer Phase Reference	Peripheral (ADC)	(direct hardware connection)	ADC Peripheral		
	Y	Event: A/D Conversion Completed	Peripheral (ADC)	Interrupt System	ISR for ADC	Not needed.	
I ² C Comms.	Y	Events: I ² C message components					
μ SD via SPI Comms. 10 13 V1	Y	Events: Data Exchange events				Many: SD Ctlr delays	

TOP-LEVEL VIEW OF APPLICATION PROCESSES

Applications: Functionality First, then Performance

			Quad. Dec. w/Z Limit Switch	Waveform Generator	Blinky Control Panel	Touch screen	Serial Comms.	LCD Controller	Scope	SMPS Controller	I ² C Comms.	μSD via SPI Comms.
Providing Functionality	Interfacing	Simple Digital	In		In, Out	Out				PWM Out		
		Complex Digital			PWM		In, Out	Bus Out			In, Out	In, Out
		Analog		Out	ADC In, CMP In, DAC Out	ADC In			ADC In, Cmp In	ADC In with Sync. Sampling		
	Async	# Processes for async. exec.	1,2	1,2	4	0, 1	2	0	1,2	1	1	2
	Sync and ...	Sync and Do: Coarse Triggering	Digital Edge Detection	Periodic Output Updates			Tx Rdy, Rx Done events. Producer & Consumer		Ana. Edge Det., Periodic In. Smplg., Buffer mgt.	ADC In with Sync. Sampling	Data Producers & Consumers. I2C Device read response.	Tx Rdy, Rx Done events. Prod. & Cons.
		Internal, Fine Grain Block/Sched/Trig			ADC conv. time	ADC conv. time	When to notify receiver?				I2C message internal events & timing reqts. for conditions, data	
		Sync and Don't: Sharing & Races					Tx, Rx byte queues		LCD Ctlr Sharing, Data buffer mgt.		Tx, Rx Msgs	Tx, Rx byte queues
	IPC	Inter-Process Comm.	Shared Position Variable						Data buffer			
	Meeting Perf. Reqts.	Timing Stability		1	1				2	1		
		Responsiveness			1				1	1		1
		Reducing SW Overhead		2				1- Perf. Optimiz.	2	2	1 – series of timed I/O events per message. FSM vs. RTOS	
		Tolerating Timing Mismatches		2			2		2			2

Example Application Data

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Blinky Control Panel	Y	Time - Periodic: T_{Poll}	RTCS Tick Handler	RTCS	Task_On_Off	-	
	Y	Time - Periodic: T_{Poll}	RTCS Tick Handler	RTCS	Task_Level_Alarm	-	
	Y	Time - Periodic: T_{Poll}	RTCS Tick Handler	RTCS	Task_Dimmer	Wait for A/D conversion to complete	
	Y	Time - Periodic: T_{Flash}	RTCS Tick Handler	RTCS	Task_Flash	-	
Touchscreen	Y	Time - Periodic: T_{Poll}	RTCS Tick Handler	RTCS		Wait for 1st A/D conversion to complete	Wait for 2nd A/D conversion to complete
Serial UART Comms.	Y	Events: UART Tx events	Peripheral (UART)	Interrupt System	ISR for Tx	-	
	Y	Events: UART Rx events	Peripheral (UART)	Interrupt System	ISR for Rx	-	
LCD Controller	N	When called by process	n/a	n/a		Not needed.	
Oscilloscope	Y	Event: $V_{\text{In}} \uparrow V_{\text{Trigger}}$	Software polling of ADC	?	Detect Trigger	Wait for A/D conversion complete	
		Trigger detected and Time - Periodic: T_{Sample}	?	?	Sample Data	Wait for A/D conversion complete	
		Sample Data completes			Plot Data	-	
SMPS Controller	Y	Event: PWM Timer Phase Reference	Peripheral (ADC)	(direct hardware connection)	ADC Peripheral		
	Y	Event: A/D Conversion Completed	Peripheral (ADC)	Interrupt System	ISR for ADC	Not needed.	
I ² C Comms.	Y	Events: I ² C message components					
μ SD via SPI Comms. 14 13 V1	Y	Events: Data Exchange events				Many: SD Ctlr delays	

SLIDES FOR LATER