ELEC6231

VLSI Design Project

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5+ lectures[1]	Monday 09:00-11:00
10 lab sessions	Thursday 15:00-18:00

[1]If there are any lectures after the first four weeks, they will be advertised via the course e-mail list

ELEC6231 VLSI Design Project

Task:

Design and Implement a Sports Altimeter Chip using:

AMS 0.35μm CMOS *or*
TSMC (*or* UMC) 0.18μm CMOS

- Complete IC Design Flow
- Complex System
  - Importance of Systematic Approach
  - Modular Design & Test
  - Manage Complexity through Hierarchy
- Team Exercise
  - Teams of 3 or 4 or 5

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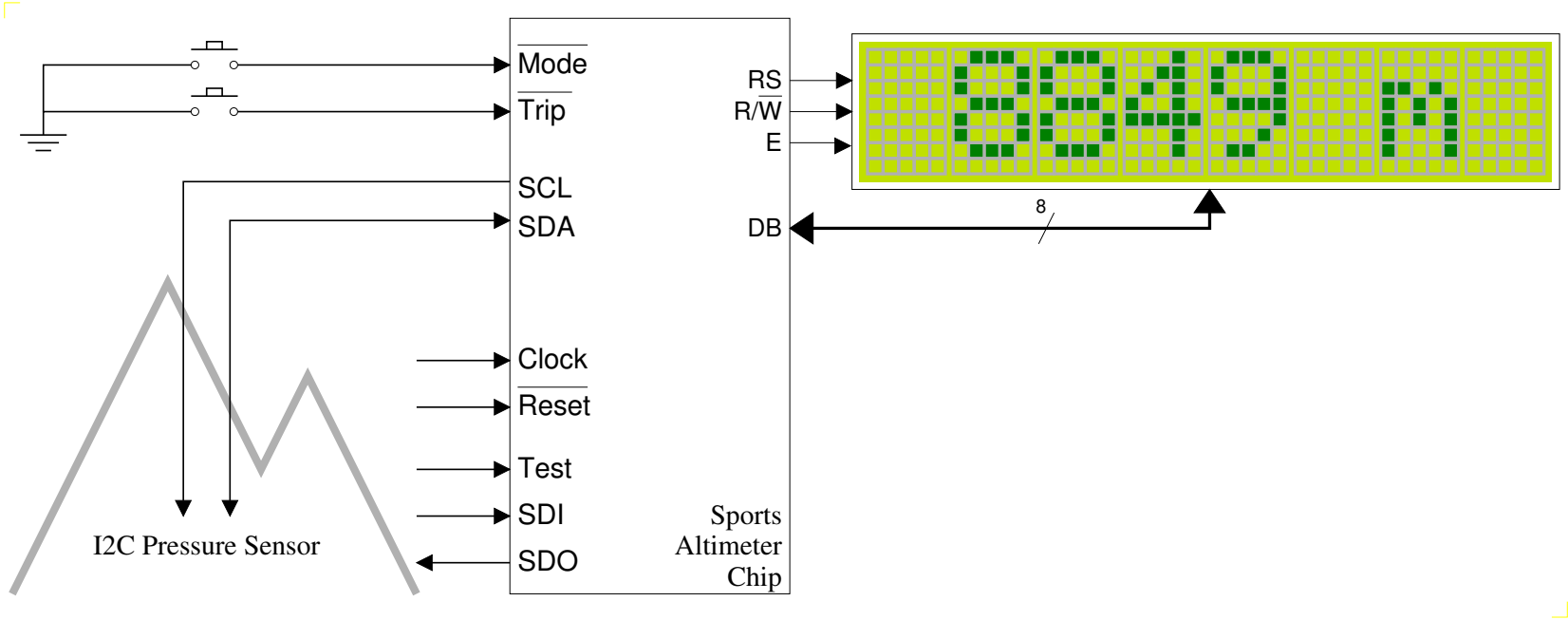

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Flexible Specification[2]:

- Display
  - 8-character L.C.D. +optional Pixel Display
- Functionality
  - Simplified I^2C Pressure Sensor or BMP390 Pressure Sensor
  - Mountain Sports and/or Aerial Sports
  - Height/Pressure Initialisation
  - Additional Functions
- Process
  - AMS 0.35μm CMOS
  - TSMC (or UMC) 0.18μm CMOS

[2]additional functionality will result in extra credit

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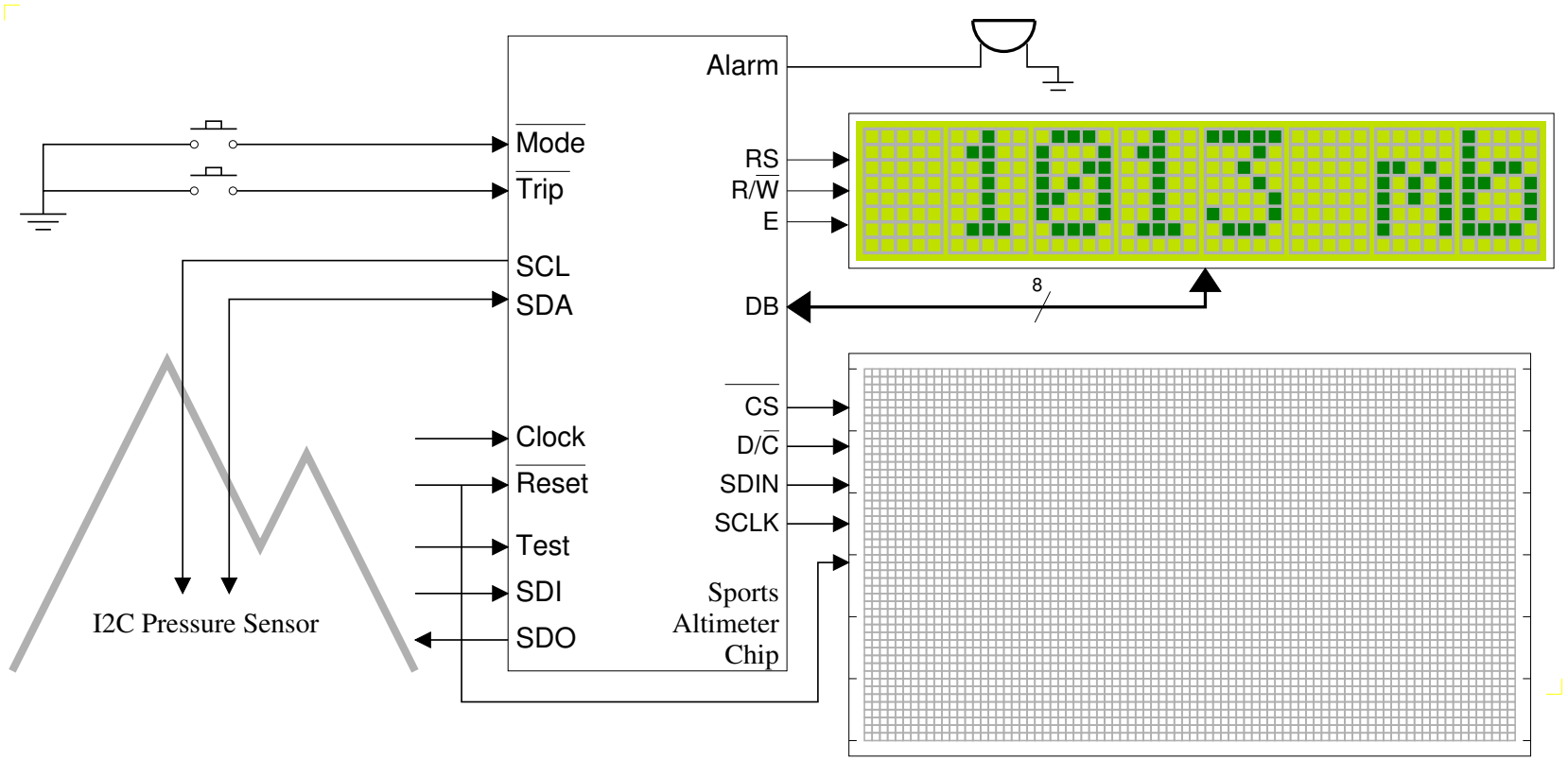

ELEC6231 VLSI Design Project Milestones

1. Practice Chip Design	FRI week 4	(21^{st} February 2025)
2. Design Proposal		
• Architecture and Project Plan	WED week 5	(26^{th} February 2025)
3. Behavioural Model		
• Barometer	WED week 6	(5^{th} March 2025)
• Barometer, Altimeter, Timer (and VSI)	WED week 7	(12^{th} March 2025)
4. Gate-Level Design		
• Gate-level netlist from synthesis stage	WED week 8	(19^{th} March 2025)
5. Full Chip Design		
• Full Cadence Design + Guide/Note	FRI week 10	(2^{nd} May 2025)
6. Supporting Information		
• Demonstration	THU week 11	(8^{th} May 2025)
• Individual Reflection	WED week 12	(14^{th} May 2025)

Practice Chip Design

- Completed individually
- Full chip design based on tools & techniques labs:
  - Synthesis
  - Place & Route
  - Post-Layout Simulation
  - Sign-Off
- Dice chip based on your ELEC6230 design exercise 2.
  - with extra control signal 'Roll'
  - behavioural dtype model to permit synthesis (same signal names)

Design Proposal

- Process:
  - e.g. AMS 0.35um CMOS
- Approach:
  - SoC (hardware/software co-design) or Hardware-Only Design
- Specification:
  - Sensor Choice / Display Choice
  - Mountain Sports, Aerial Sports or Mountain + Aerial Sports?
  - Set of functions to be supported + range and resolution for each
  - Set of buttons required and the procedure used to select each function
- Architecture Diagram showing major design blocks
  - detailed programmer's model for prospective SoC teams
- Division of Responsibilities and Schedule of Work
- 4 A4 pages

Initial Behavioural Model

- Must support barometer readings via the 8-character L.C.D.

Behavioural Model

- Must support barometer, altimeter and trip timer readings via the 8-character L.C.D.[3]
- Should support variometer (VSI) if included in the design proposal.

[3] more advanced features may exist at this time but they will not be tested and they will not result in any extra credit

Gate-Level Design

- Must support barometer, altimeter and trip timer readings via the 8-character L.C.D.
- Should support variometer (VSI) if included in the design proposal.
- Should support height/pressure initialistaion if included in design proposal.
- Should support a simple pixel based display if included in design proposal.
- Simulation including realistic gate delays
- Support for input synchronisation, reset synchronisation and scan path

Full Chip Design

- Complete Cadence Design

  Ready for "Tape Out"

  - Simulated
  - Verified
  - Design Rule Checked

- User's Guide

  All the user needs to know about using your sports altimeter.

- Technical Note

  All an engineer needs to know about building a sports altimeter with your chip.

Proposed Marking Scheme

Tools & Techniques	Practice Chip Design (Individual)	20%
Milestones	Design Proposal	5%
	Initial Behavioural Design	5%
	Behavioural Design	5%
	Gate-Level Design	5%
Final Design	Chip Functionality	45%
	User's Guide + Technical Note	10%
	Reflection (Individual)	5%

Team marks will be distributed to team members based on the input from each team member.

Proposed Marking Scheme

- Chip Functionality

  45 marks are available dependent on the features supported[4]:

	Marks for basic functionality	**Max Marks**
Functions Supported (/cost)	10	25
Display	10	20
Ease of Use (HCI)	5	10
Cost of each additional button	-5	

[4] a minimal system in a standard pad ring using a simplified I^2C pressure sensor to support a barometer, altimeter and trip timer without variometer or height/pressure initialisation via an 8-character L.C.D. may score up to 10+10+5+55 =80%.

week	MON	TUE	WED	THU	mini milestones	FRI
1				LAB *SoC*		
2				LAB *Synthesis*	Confirm Teams	
3				LAB *P&R*	Draft Design Proposal	
4				LAB *Sign-off*		**Dice Chip**
5			**Design Proposal**	LAB	*t.b.a.*	
6			**Initial Behavioural Model**	LAB	*t.b.a.*	
7			**Behavioural Model**	LAB	*t.b.a.*	
8			**Gate-Level Design**	LAB	*t.b.a.*	
9				LAB	*t.b.a.*	
10				LAB	Balloon Debate	**Final Design**
11	*Bank Holiday*				**Demonstrations**	
12			**Reflection**			

ELEC6231 VLSI Design Project Lectures

Week	Day	Time	Topic
1	Monday	09:00	**Introduction to Team Exercise** *This lecture*
	Monday	10:00	**System-on-Chip Design**
2	Monday	09:00	**Synthesis and Constraints**
	Monday	10:00	**Timing Simulation**
3	Monday	09:30	**Place and Route**