

Mini-Project

SPI packet detector

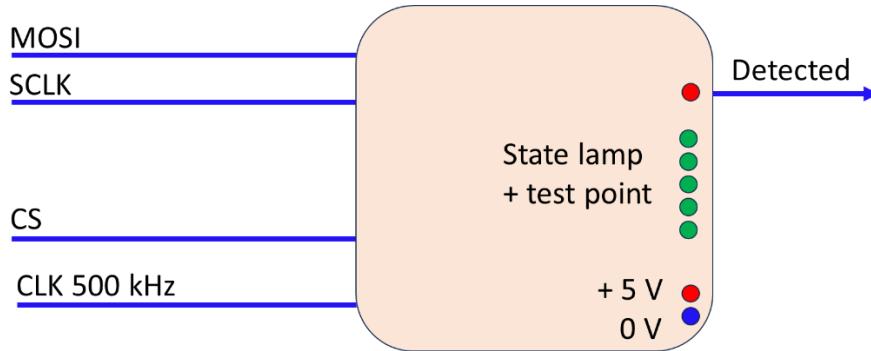
Instruction

Read binary data on the Serial Peripheral Interface (SPI).

If data on SPI are the same as the encoded last 5 digits of your ID.

Then generate the “Detected” signal, square wave signal.

Till the next data is sent, stop the “Detected” signal.



Information

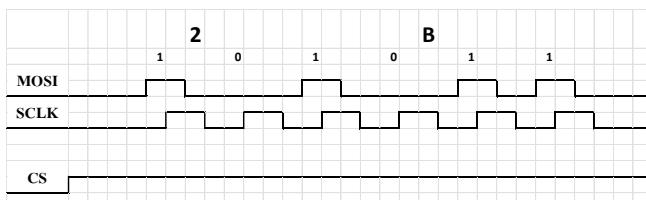
The last 6 bits will be sent in SPI format.

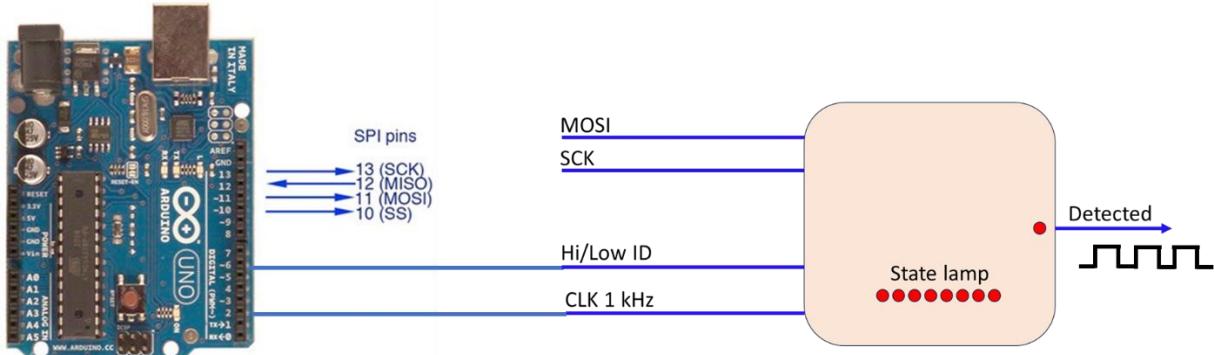
For example:

ID: 660101630827

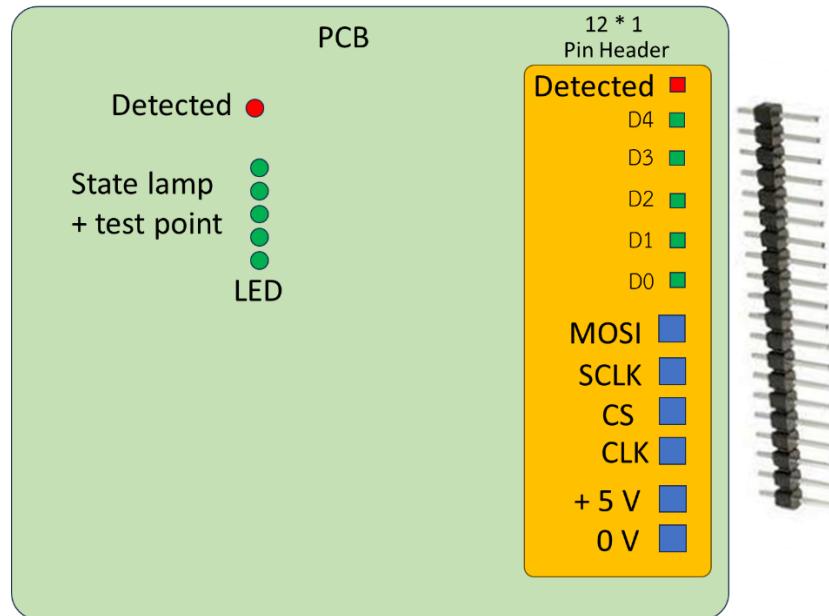
30827_{10} = 0111 1000 0110 1011₂

The last 6 bits = 10 1011₂ = 2B₁₆





The signals interface **must** be provided via pin header with specific order as shown below.



Task No.	Task	Deu Date	full score	Late penalty	min score
1	Learn Video 1,2	2-Dec-25	-	-	-
2	Learn Video 3,6	9-Dec-25	-	-	-
3	Learn Video 8	20-Dec-25	-	-	-
4	Learn how to use Quatus Prime	3-Jan-26	-	-	-
5	Design presentation & simulation results	10-Jan-26	-	-	-
6	Bread board testing & Interview	10-Feb-26	20	-3/DAY	0
7	PCB Hardware testing & Interview	10-Mar-26	20	-3/DAY	-20

Task 5 detail (Video 12 steps)

1. State Diagram Explanation

- 1.1 Explain the origin of the numbers/symbols on the **transition lines** (e.g., why 1xx).
 - 1.2 Demonstrate counting all 2^n transition lines for each state, where n is the number of inputs.
-

2. State Table Development and Relationship

- Display the **state diagram** next to an empty **state table**.
 - Fill in the **state table**, and emphasize the relationship between the **transition lines** in the diagram and the entries in the table
 - Name for each row as min-term format, Ex. m1, m2
-

3. Left Box Equation Derivation

- Write the Boolean equations for the **Left Box** (representing the next-state logic and output logic) using the **state table**.
- Crucially, explain the method used for deriving these equations, detailing why the equations are written that way (do not just state the final equations).

- Explicitly illustrate the covering of each term in left box equation.

Equation	Term	Covering
Q0 =	/Q4 /Q2 /Q0 * SCLK*MOSI	m1, m7, m8
	+/Q3 /Q1 /Q0 * SCLK*MOSI	m2, m4, m5
	+/Q3 /Q2 /Q0 * SCLK*/MOSI	M3, m6, m9
	
Q1=	/Q4 Q2 /Q0 * SCLK*MOSI	m1, m2, m3
	

4. Schematic Conversion Method

- Demonstrate the **step-by-step method** for converting the **Left Box equations** into a **schematic diagram** (stress the need to show the detailed method).
- The use of multiplexers and demultiplexers is not permitted.

5. Quartus Implementation

- Convert the **Left Box circuit** from step 4 into either a **schematic** only (never use **VHDL code**) within Quartus.
- Demonstrate the implementation process/method in Quartus; do not just show the final result.

6. Left Box Testing

- Demonstrate testing the functionality of the **Left Box** (combinational logic) to ensure it works correctly.
 - Demonstrate how to find where the mistake connections are. (2 points of miss connection)
-

7. Middle Box Integration and Testing

- Add the **Middle Box** (the sequential elements, usually flip-flops/registers) and demonstrate testing the combined circuit.
-

8. Right Box Design and Testing

- Design the **Right Box** (output processing, interface, or load-control logic) and demonstrate testing its functionality.
-

9. High-Frequency Testing

- Test the overall circuit operation at a **clock frequency (CLK) 10 times higher** than the serial data clock (SCLK).
-

10. Correct Code Test

- Demonstrate testing the circuit with a **correct input code sequence**.
-

11. 4th Bit Error Test

- Demonstrate testing the circuit with an input code sequence where the **4th bit is incorrect.**
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12. Continuous Sequence Test

- Test the circuit with **five continuous code sequences**, where the **third sequence is correct** and the remaining four are incorrect.
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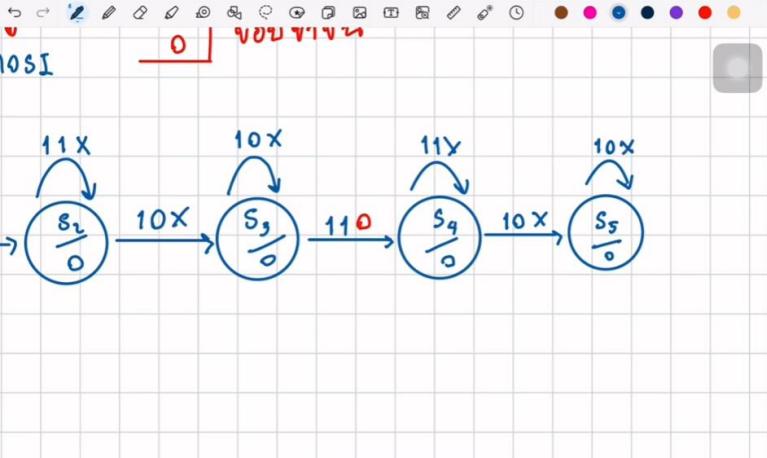


Video Conclusion and Submission Rules

Video Summary

The video must conclude with a **written summary** clearly stating the **start time (in minutes and seconds)** for each of the 12 topics outlined above.

Upload your Video on YouTube with time stamp for each topic as shown below.



Hand-drawn state transition diagram:

```

graph LR
    S1((S1)) -- "10X" --> S2((S2))
    S2 -- "11X" --> S1
    S2 -- "10X" --> S3((S3))
    S3 -- "11Y" --> S4((S4))
    S4 -- "10X" --> S5((S5))
    S5 -- "10X" --> S2
  
```



YouTube video player showing a list of 12 tasks with their start times:

- 1 หัวข้อที่ 1 อธิบายรีวิวด state diagram 1:05:07 SUPITCHAYA THAMMA
- 2 2 เปิดรูป state diagram คู่กับ state table... 39:08 SUPITCHAYA THAMMA
- 3 3 เผยแพร่การของ กล่องเข้า จำก state table 44:43 SUPITCHAYA THAMMA
- 4 4 แปลงวงจรกล่อง ช้ายในข้อสี่ ให้เป็นวงจรหรือ... 11:41 SUPITCHAYA THAMMA
- 5 5 แปลงสมการกล่อง ช้ายให้เป็น schematic 34:21 SUPITCHAYA THAMMA
- 6 6 ทดสอบวงจรกล่องเข้า

Language and Editing

You may use any language or combination of languages for the presentation. Editing is permitted, but the sequence **1 through 12 must be strictly followed** and fully completed.

Mandatory PDF Submission

You must submit a PDF file containing:

1. The **Left Box Equations**.
2. The **Left Box Circuit** (Schematic).
3. The **Right Box Circuit** (Schematic).
4. The **Schematic** used in Quartus.

Academic Integrity

- Crucially, you must not use any files from peers. All work must be **original**.

Quartus Wiring

- The circuit wiring in Quartus should follow **best practices** and be laid out in a way that reflects **sound engineering judgment**.

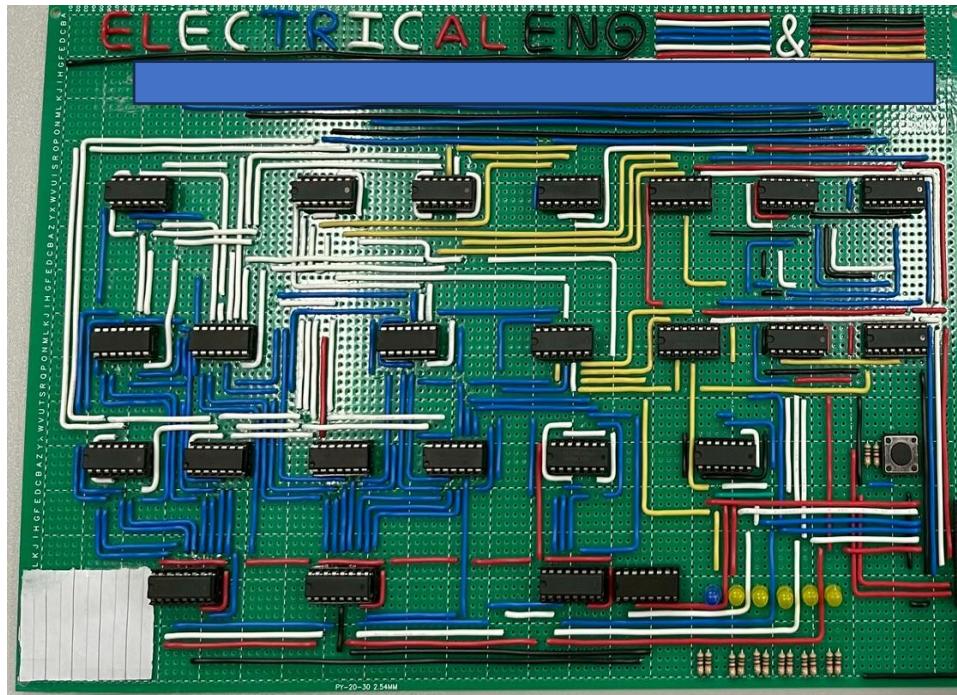
Task 6 Bread Board

Make a digital circuit on **bread board** with these specifications

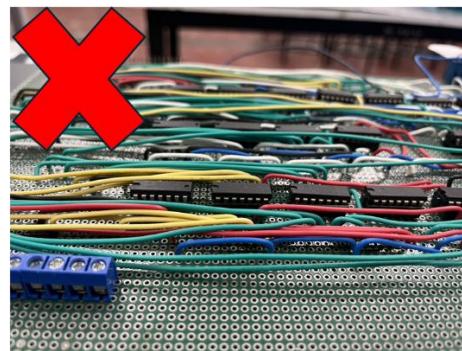
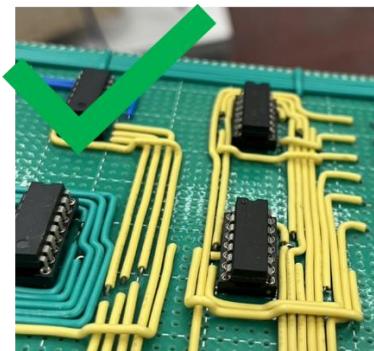
1. Use only solid hard wire.
 2. Bird nest like is un-acceptable.
 3. State lamps are required.
 4. Every Led always be used with R.
 6. Only 90 degree bending is used, 45 30etc are unacceptable
 7. All wires must lay on bread board, no floating wire.
- 8. SELFIE with your board during assembling every 1 hour. !!!!!!!**
9. give me youtube link of your testing with long short (no cutting recording), including your time-lapse selfie.
 10. come to me then do an interview and test your board.

In case of in-complete function board, NEVER NEVER NEVER send to me, it wastes my time.

Task 7 PCB Board

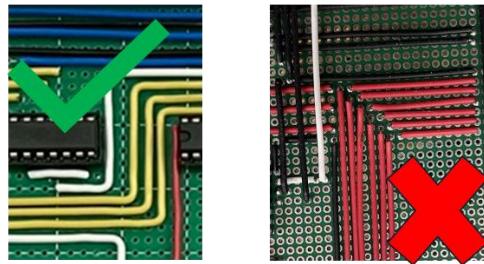


1. Learn how good soldering is done.
2. Record wiring and soldering demonstration for 5 minutes and send me youtube link.
3. Always use soldering flux.
4. Every hour of working, do a selfie.
5. Stretch your wire with cloth.
6. No floating wire.



7. Use the right sequence of male type pin header.

8. Never break your wire between connections.



9. Use solid-core wire only.
10. ICs must be installed using sockets.
11. Wiring must be neat (avoid messy, bird's nest-like wiring).
12. Use appropriate wire colors (share wires with classmates to have more colors available).
13. A state indicator light must be included (e.g., an LED for power or status).
14. LEDs must have a current-limiting resistor (R).
15. Wires must be bent at right angles (bent by tool, not your fingers).
16. Build and test the circuit in modules/stages (Test as you go; do not assemble everything at once and then test).
17. If you encounter a problem, ask Ajarn Nopadol (Do not wait until the time is nearly up to ask).
18. Do not buy expensive components. (e.g., an IC should cost approximately 15 Baht, and a socket no more than 8 Baht).
19. Plan before placing components (Spend at least 6 hours planning). Draw a full-scale diagram first.
20. The use of multiplexers and demultiplexers is not permitted.
21. Use a clock frequency of approximately 100-5,000 Hz.