التاريخ: / /

الموضوع: Building Process

Text Editor

↓ File.h ↓ File.c

Pre-Processor

↓ file.i

Compiler

↓ file.asm

Assembler

↓ file.obj

Linker

File.exe / file.hex

#define Text replacement
#include < > Defined lib.
" " User Defined lib.

Replace all functions and Variable inside Header file.

#Warning Display Warning to user
#Error Display Error to user
#Pragma Talk to Compiler to change specific behaviour

#ifndef
#define
#endif
Safety Guard to avoid function or Variable re-definition....

Types of Errors { Syntax - Runtime - Logical - Sematic - Linker - user Defined }

Optimizer { Functionality - Size - Execution }

Padding Problem → #Pragma Pack (1)

Enum → Enumeration to not use magic numbers to describe Variable

structure → User-Defined Data-type that holds different Data-types.

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الموضوع:

"typedef. → Renaiming Primitive Data type (Defined /user-Defined)

```
#define ptr int*
int* x,y;
```
(1)

Pointer ← * → integer

```
typedef ptr int*
int* x,y;
```
(2)

→ Both are Pointers.

Bit_Math

- `>>` → Shift Right
- `<<` → Shift Left
- `~` → Not
- `&` → AND
- `|` → OR
- `^` → XOR

Mask → to get specific Value of Register

- SET_BIT (Reg, bit) → Reg |= (1<<bit)
- CLR_BIT (Reg, bit) → Reg &= (1<<bit)
- TGL_BIT (Reg, bit) → Reg ^= (1<<bit)
- GET_BIT (Reg, bit) → ((Reg>>bit) & 1)
- GET_LOW_NIPPLE (Reg) → Reg & 0b00001111
- GET_HIGH_NIPPLE (Reg) → (Reg>>4) & 0b00001111
- GET_PORT (Reg) → Reg & 0xFF
- TGL_PORT (Reg) → Reg ^= 0xff

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Const → Variable that Can't be changed in anyplace in Code
Volatile → Garbage Collector Avoidance (according to optimizer)
Static → extend lifetime of Variable to end of Program
extern → use Variable Value in another file.

structure: user defined data type that Can holds different datatypes

Enum: To not use magic numbers to describe Variable state, or name.

Type of Enum: - Describe state
- Describe name
- Describe Mode

- use typedef before enum to make user-define datatype
- enum took only 1 byte or 2 bytes according to Compiler

Dynamic Memory Allocation.....
(Malloc, Calloc, realloc).....
1. Are not allowed to use in Embedded Automative, as it uses only static Memory (.stack)

التاريخ: / /

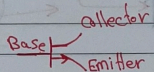
العوضوع:

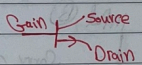
Comfuter Arch.

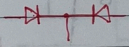
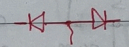
Automotive → static memory
IoT → Dynamic memory

Diodes → 

Transistors

- BJT → 

- MosFET → 

- PNP → 
- NPN → 

Logical Gates

- AND → &
- OR → |
- XOR → ^
- NOT → ~

Logic → Actual
Zero (0) → 0 Volt
one (1) → 5 Volt

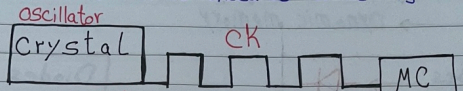
Diodes
↓
Transistors
↓
Logical Gates
↓
Latches
↓
FliP FLOP
↓
Register

التاريخ: / /

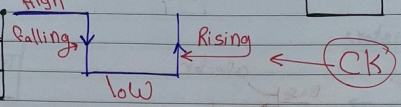
الموضوع: _____

Flip_Flop → When to Keep charge...

- It uses clock...
- Each instruction Will be executed While high Pulse



1. High Pulse
2. Low Pulse
3. Falling Edge
4. Rising Edge

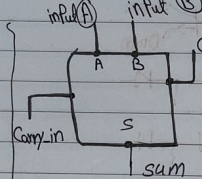


Full_Adder

Carry_out ← (1)

```
  0 1 0 1
+ 1 0 1 1
---------
  1 1 1 0
```

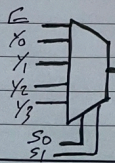
"Adding two Binary Numbers"



A	B	C_i	C_o	S
0	0	0	0	0
0	0	1	0	1
0	1	0	0	1
0	1	1	1	0
1	0	0	0	1
1	0	1	1	0
1	1	0	1	0
1	1	1	1	1

Multiplexer

E Y_0 Y_1 Y_2 Y_3 O



E	S_0	S_1	O
1	0	0	Y_0
1	0	1	Y_1
1	1	0	Y_2
1	1	1	Y_3
1	X	X	None

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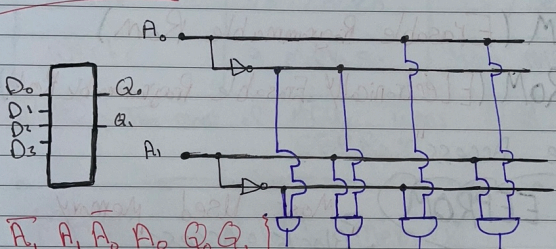
العوضوع:

Binary Decoder (2 inputs _ 4 outputs)

- if("enable" → E) is low(0) so, the result is zero, whatever input is, result will be always low ....

E	W_0	W_1	Y_0	Y_1	Y_2	Y_3
1	0	0	1	0	0	0
1	0	1	0	1	0	0
1	1	0	0	0	1	0
1	1	1	0	0	0	1
0	X	X	0	0	0	0

Binary Encoder



$\bar{A_1}$	A_1	$\bar{A_0}$	A_0	Q_0	Q_1
0	0	0	1	0	0
0	0	1	0	0	1
0	1	0	0	1	0
1	0	0	0	1	1
0	0	0	0	X	X

summary

- Logical gates (AND-OR-XOR...)
- latches, flipflop → sequential logic component
- Combinational logic Component.. (Multiplexer, Full Adder, Decoder, Encoder)

Memory

Memory → Non-Volatile → ex. ROM
Memory → Volatile → ex. RAM (Random Access Memory)

- ROM (Read Only Memory)
- OTP ROM (One Time Programmable ROM)
- EPROM (Erasable Programmable ROM)
- EEPROM (Electronically Erasable Programmable ROM)
  - "Byte Access"
- Flash EEPROM → Most Used Memory ... "Block Access"

- Types of Flash EEPROM:
  1. NoR Memory
  2. NAND Memory

Hint: ROM uses floating gate transistor, which is give (supply) Memory with excess Voltage higher than needed to be sure it keeps 5V charge inside...

Class \ Flash EEPRom	NoR Flash EEPRom	NaND Flash EEPRom
Size	<= 512 MB	from 1-8 GB
Block	1 MB	1 MB
Speed Read	< 80 Nanos	20 Millis
Erase	1s / Block	1s / Sector
Write	9 micros.	400 micros

Note → The most of MCUs uses NoR Flash-EEPRoM

RAM → Volatile Memory

Class \ RAM	Static RAM	Dynamic RAM
	Made of Transistors	Made of Capacitors
Power Behavior	need Continous Power Source	High Power Consumption

التاريخ: / /

الموضوع:

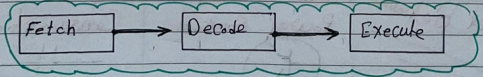
Registers

- User-Accessable Register → Register Can be read/Write by machine instruction
  - Example:
    - Accumulator
    - Address register
    - general Purpose register
    - Special Purpose register
      [Status - ProgramCounter - StackPointer]

- Internal Register → Register used internally for Processor operation and not accessible by instruction
  - Example:
    - Instruction Register
    - Memory Buffer Register
    - Memory Data Register
    - Memory Address Register

Instruction Cycle

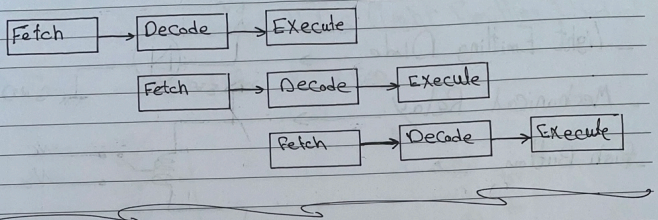
- Fetch → Get instruction from RAM and send it to ALU
- Decode → specify typedef operation to ALU
- Execute → Execute Atomic instruction



التاريخ:

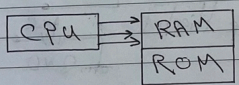
الموضوع:

Pipeline

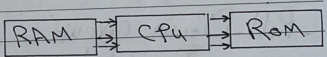


Computer Architecture

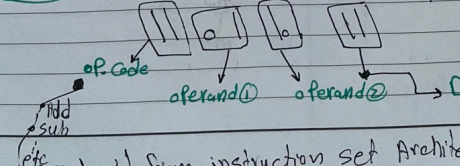
Von-Neumann



HarVard



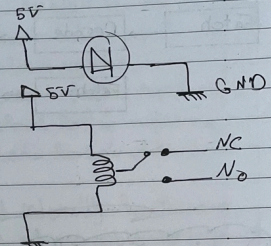
instruction Decoder → Divide instruction to several bits to understand it



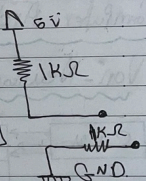
التاريخ: 4 / 3 / 23 الموضوع:

Input and Output Modules

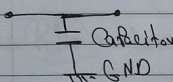
- Light Emitting Diode →
- Mechanical Relay →
- Push Button



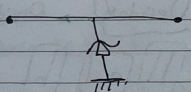
- Pull-UP Circuit [Active low]
  - "Wait logic Zero"
- Pull-Down Circuit [Active High]
  - "Wait logic one"



- Low-Pass Filter



- Safety Circuit

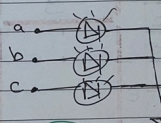


التاريخ: 9/3/23 الموضوع:

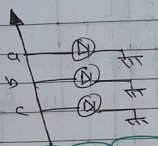
7-Segment

It contains several LEDs (Light Emitting Diode)

There are two types of 7 Seg:

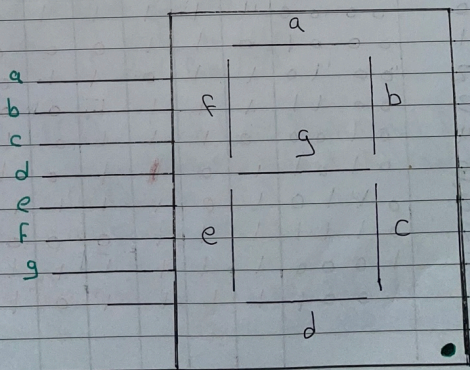


Common Kathode (GND)

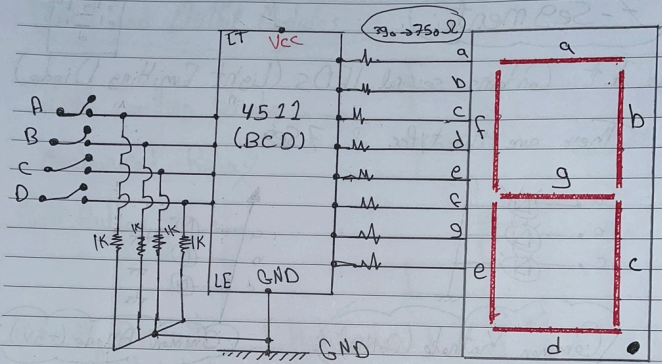


Common ANode (+5V)

- It depends on decode (Binary Decoder), 4 inPuts (4Pins) with 8 outPuts (8 LEDs)



الموضوع: _____ التاريخ: 10 / 3 / 23

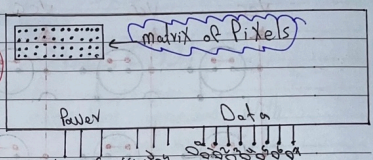


Decimal	A B C D	a	b	c	d	e	f	g
0	0 0 0 0	1	1	1	1	1	1	0
1	0 0 0 1	0	1	1	0	0	0	0
2	0 0 1 0	1	1	0	1	1	0	1
3	0 0 1 1	1	1	1	1	0	0	1
4	0 1 0 0	0	1	1	1	0	1	1
5	0 1 0 1	1	0	1	1	0	1	1
6	0 1 1 0	1	0	1	1	1	1	1
7	0 1 1 1	1	1	1	0	0	0	0
8	1 0 0 0	1	1	1	1	1	1	1
9	1 0 0 1	1	1	1	1	0	1	1

التاريخ: 11/3/23 الموضوع:

Liquid Crystal DisPlay (LCD)

- LCD has two memories → CGRAM, DD-RAM

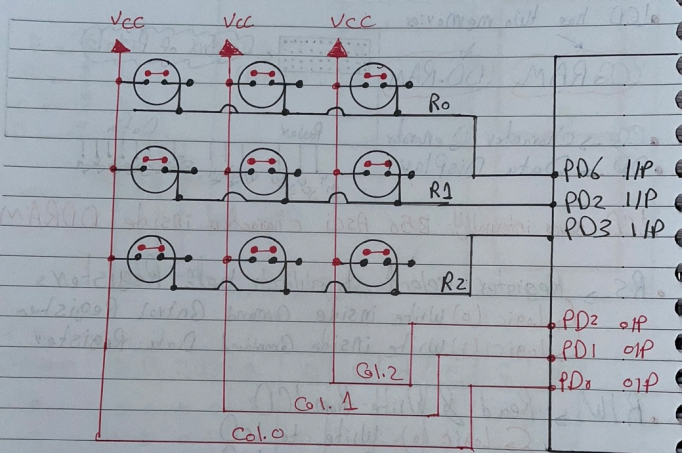


- CG → Character Generator
- DD → Data DisPlay
- LCD saves internally 256 Asci characters inside DDRAM
- RS → Register select to sWitch betⁿ Registers
  - Logic (0) Write inside Command Cntrol Register
  - logic (1) Write inside Command Data Register
- R/W → Read & Write from LCD
  - Logic (0) Write to LCD
  - Logic (1) Read from LCD
- E → Enable LCD, "Latch Logic High Until finish Writing", "wait till get high Pulse"
  - Logic (0) Disable LCD
  - logic (1) Enable LCD

LCD has two modes → ① 8-Bit Mode (0X38) ② 4-Bit Mode (0X28)

التاريخ: 12 / 3 /23 الموضوع:

Key Pad Considered as matrix of Buttons



- Each Pin Connected internally by Pull-up Resistor
  why ?
- Activate internal Pull-up Resistor AVR →
  - Define DDRX direction as input
  - Define PORTX, Pin needed by set Logic(1)
  - DDRA = 0X00 = 0000 0000
  - PORTA = 0X01 = 0000 0001