

25/9/2025

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* Data Augmentation:

Intentionally adding noise

50 Hz noise from 220 volt in biomedical sensors. (Notch filter to remove that)

50

* Sample/Data matching:

* Fourier Transform

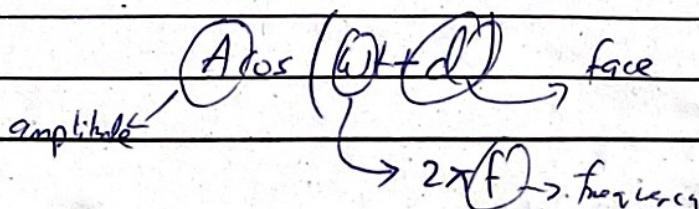
"Fourier Series
for periodic"

"Fourier Transform
for nonperiodic"

"Every speech signal can be represented by
sin."

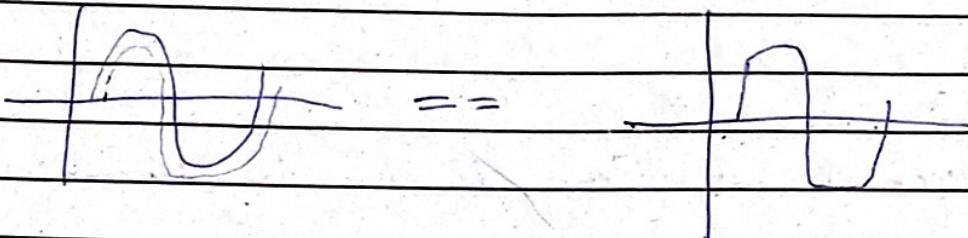
"Complex Signals are combination of multiple
~~sine~~ sinusoidal"

1 Single depends on amplitude, frequency, Face (sample)



Speech Signal max \Rightarrow 8 kHz (can be reconstructable)

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* FFT (Fast Fourier Transform) 8. "Time-varying frequency"

↳ info 2D (spectrogram)

problem: "Added harmonic (aliasing) in the signal"

"will remove it
in preprocessing."

↳ Tyre rotation
(cycles missing)

Theorem \rightarrow Sampling $> 2 \cdot 2 \cdot \omega_{\max}$

* mcs : 9 steps

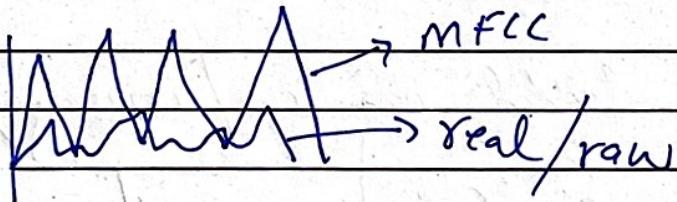
How it helps
in feature extraction?
for audio

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* why MFCC?

- ↗ Speech is not linear it is logarithmic
- ↗ Our hearing is ~~linear~~ logarithmic
- ↗ MFCC applied 31-32 filters in flat & make it linear & we truncate some & choose 12-13 filters only.



- * high frequencies are ignored & we remain in the range of speech signal
- * MFCC exactly mimics the logarithmic scale of the ear's listening.

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Why 5V motor will not work on 5V power? Because

Ampere can be different (only in Motor case)

=> ATmega 328 pinout: (28 total pins)

* 1 pin can be used for multiple features

* Total 6+8+8 pins for data (digital)

Analog pins can be used as digital pin (ADC will be used)

"10 bit already used in I²C → backside"

*

[PD0] D pin 0 => RX => Receive
[PD2] D pin 1 => TX => Transmit

Should Know!

(Serial Vs Parallel) => Cost wise in different aspects

width

[PD3] => PWM => pull ~~so~~ modulation

[VCC] => Always check power using ohmm before giving it to board directly else it will burnout

Decieving motor
 ① Digital input ② Digital output } Experimental on
 ③ Analog input ④ Analog output } this must
 PWM "Impossible!" Date _____
 Duty cycle

↓
 kind of
 Analog
 cycle

Nano BLE sense required only 3.3 Volts.
 other takes 3.7 vts

SPI → Serial

VCC & Ground (not will run microcontrollers)

microcontroller required frequencies in order to run

X ————— X

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* Microchip Studio (Keil - old software
no support for latest boards)

Suggested IDE for ATmel microcontroller (Arduino)

(MicroC for PIC boards)

ATiny => very less power usage board
with less sensors! - with memory
in bytes.

C/C++ or Assembly
then select board - Check its usage of
resources

ATmega328P

, ATmega2560

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* why 3 types of memory? → Due to its cost!!

(Find IDE which produces .hex file)

* Universal super pro programmer (~~atmel zolnic 6lop~~)
↳ used to interface board

→ output files (select .hex file & save it)
→ Build → (Registers, memory, processor status)
→ Debug → (in case of Assembly code)
↳ pins have names

I/O (pre built functions)

→ 3 Registers used to interface 1 port. (328P)

* Port D → 3 registers
3 ports → 9 registers

~~Microcontroller~~ (microcontroller) Hello world → LED Blinking

BIOS memory can also be used as simple memory for code (originate after BIOS / Firmware take its memory.)

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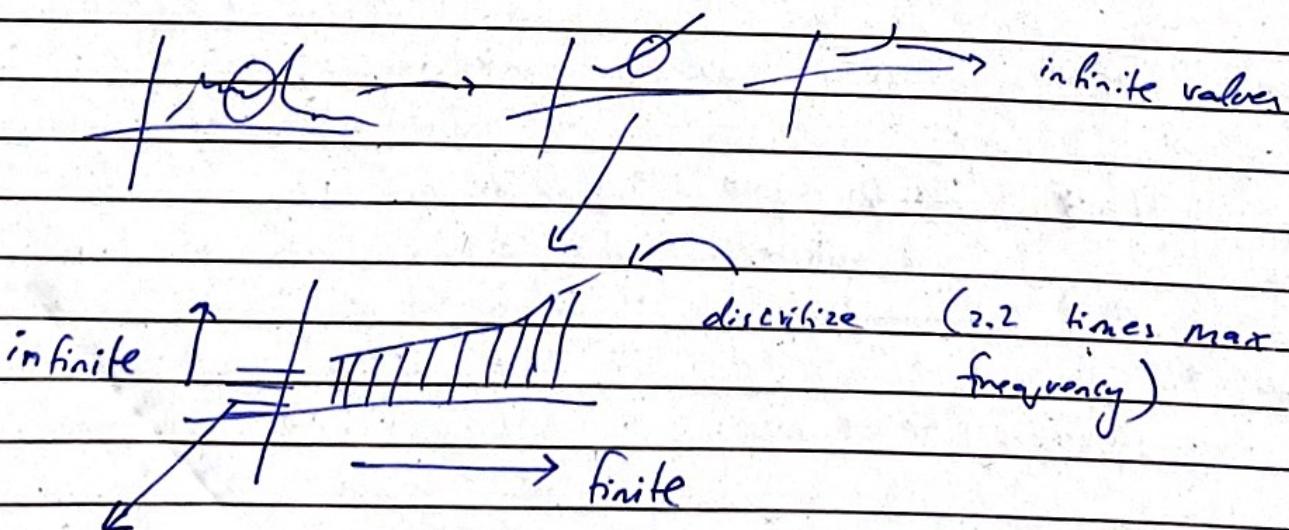
→ Tinker CAD, MATLAB etc for simulations

"need hex file"

if some device not found for that feature
then add device which act like that
feature → we will interpret results from it.

or
Discrete vs Digital

* micro controllers can't handle analog (infinite value of set)



making finite (digital)

↳ quantization (* bit Resolution)

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* interpolation → for connecting this discrete values again

x ————— x

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24/10/2025
30/10/2025 (double)



Tayyab's Notes in the Group!

Emulator → Digital Twins (Emerging Tech)

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* Proteus: (Protus 8 professional)

A simulator (support for every chip)

- 1) component graphical form is called Schematic
- 2) you can design PCB layout
- 3) you can install firmware in board/chip at start too. like in ATmega328P in UNO ~~too~~ having already firmware installed during development of chip.
- 4) (A) Component mode → pick (P)

Arduino (you can install its library - not preinstalled)

* "Exploring components"

microprocessors & microcontrollers are programmed, designed using FPGAs

↳ simulate your own micro-processor on it

"proteus" knows how much voltage any component need - so no need to know about it. but

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We should know about voltages & ground's.

* Terminal mode → Volt, Ground etc components.

* Graphs mode → Fourier; Noise etc

↳ frequency domain.

sampling on twice the max

* Generators → DC, pulse etc as an input

* Instruments mode → Oscilloscope etc [SPI, I2C]

→ later on

(communication b/w
Arduino & Raspberry PI)

for using each other
components)

⇒ Interface: (Schematic)

* 2 devices

- 1) ATmega 328P
- 2) LED, BAN.....

DDRD) All 1's → for output device (fan, etc)

* portD used as input (Defined in Library Assembly)
* out portD, 0000 0000

Pictures 23/10/2025

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(DDRD) All D's \rightarrow for input device (sensors etc)

Port D not used
PIND \rightarrow data from outside (sensors etc)

* IN R0, PIND

X ————— X

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Q. what about analog input & output?

Input:

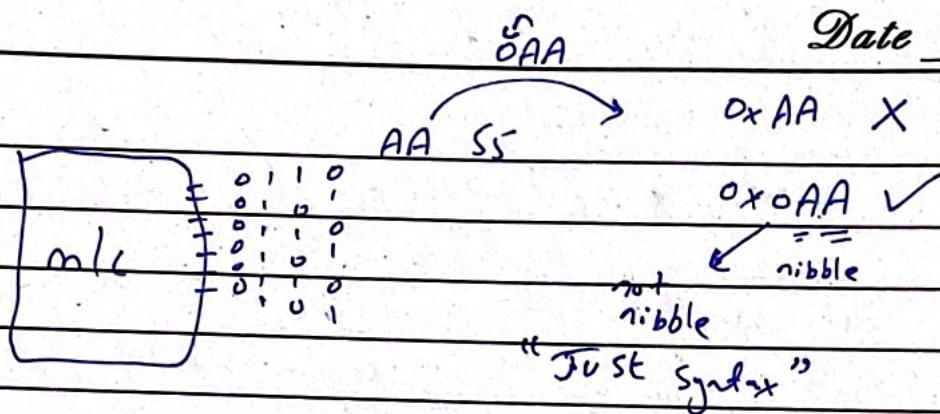
look for ADC if available else we will interface it.

[ATTINY (1604) AVR, AVR2 \Rightarrow for low resource usage \rightarrow IOT purpose
↳ Analog Sensors Interface usage \rightarrow IOT purpose
must]

In microcontroller there is a microprocessor

light = 50 Hz (220V) (USA = 60 Hz (110V))

PWM pins in Arduino



Delay is must

`delay(1000); // 1 second`

"According to crystal oscillator

in firmware."

resistor, (Alternate - but)
capacitors (less Accurate)

clock cycles

e.g. $1\text{MHz} = \frac{1}{10^6} = 1\text{usec}$

Code → Delay (Assembly)

→ defined in firmware

DELAY:

`LDI R16, 0xFF ; 255`

Again1: `LDI R17, 0xFF ; 255`

Again2: `LDI R18, 0x10 ; 16`

Again3: `DEC R18 { 16 times } ; 1 usec`
`BRNE Again1 ; 1 usec`
`; 1 usec`

`DEC R17`

`BRNE Again2 ;`

`DEC R16 ;`

`BRNE Again3 ;`

`RET. ;`

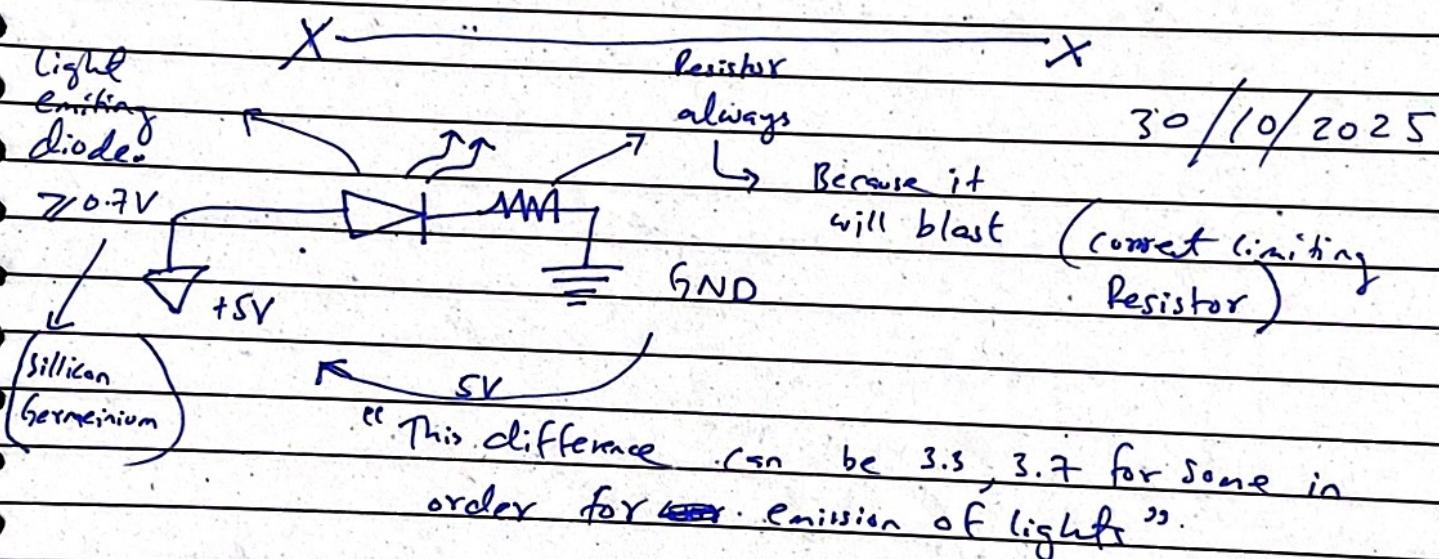
`BRNE`

↳ Branch if not equal (to zero)

Can't take in 1 nano second \rightarrow There is always a delay,
 the mechanism always needs
 Date some time.

$$3^3 \times 510 \times 510 = \cancel{8,583,000} \quad \text{something like that}$$

uscc delay



"Potential Difference"

"Some devices have built-in resistor" \rightarrow LED etc

* Atmega328p:

R0 - R31

(General Purpose Registers) (G.P.R)

LDI

(You can use mov) \rightarrow conceptually



special function register (SFR)

If DDRD all 1's portX will be activated after output devices

fastly \leftarrow R20 is near to port D

0101 0101

0110 0110
0110 0110

ATmega 5(555) Timer IC

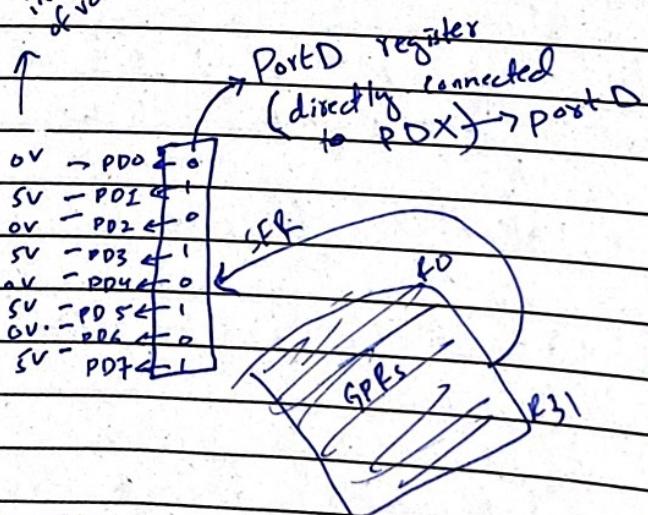
1 GHz = 1 nsec per instruction
2 GHz = 0.5 nsec

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LDI R20, 0x55 ; 0x^{0b}0101 0101
OUT PORTD, R20 Rate

"No delay \Rightarrow so fast that you will not see blinking"

"Click the component \Rightarrow You can configure frequency & other settings too!"



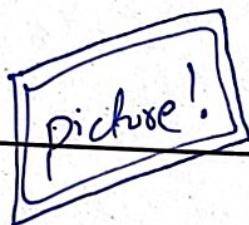
"Why SFR not work as SFR?"

- Because SFR is directly connected with hardware

- * Videos!
- (* Burning code on Device)
- (* Quadisplaced on PCB for burning)
- * ATmega328p: (pinout)

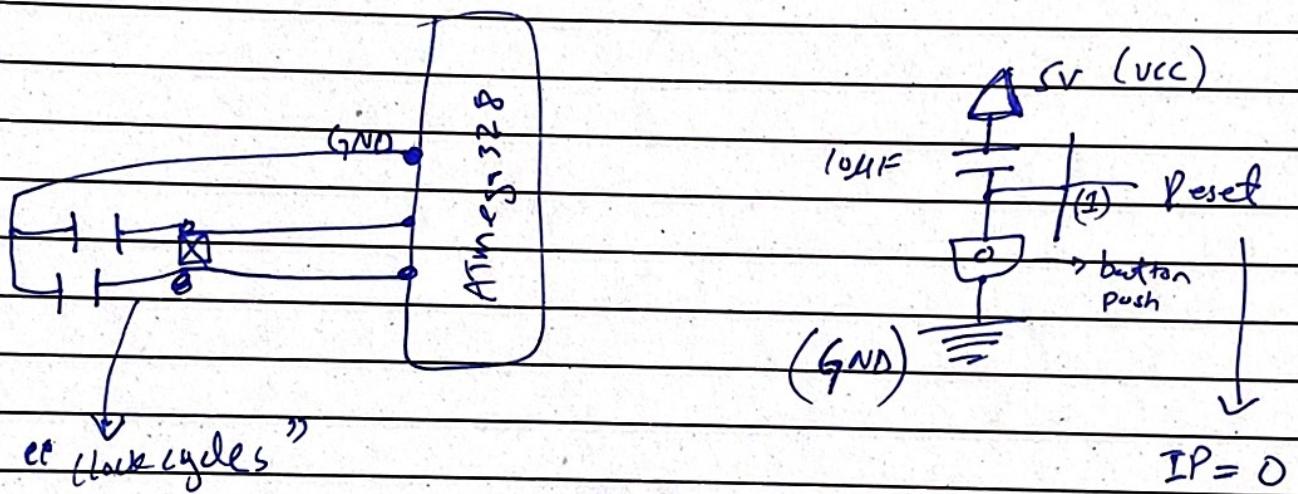
Serious capacitor

(no polarity)



Reset ✓
Crystal Oscillator ✓

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"Quad has some unused pins sometimes"

X ————— X

