Date

Example MTWTFS

Questions Calculations

① Confusion Matrix

| Actual \ Predi | Circle | Idle | left-right | Up down |
|---|---|---|---|---|
| Circle | 205 | 10 | 1 | 46 |
| Idle | 6 | 199 | 0 | 32 |
| left-right | 9 | 17 | 223 | 34 |
| up-down | 21 | 8 | 3 | 186 |

| | for Circle | for Idle | for L-r | for UD |
|---|---|---|---|---|
| TN = | 702 | 728 | 773 | 670 |
| TP = | 205 | 199 | 223 | 186 |
| FP = | 36 | 35 | 4 | 112 |
| FN = | 57 | 38 | 60 | 32 |

Total = 1000

Total Accuracy = $\frac{813}{1000}$ = 81%.

| | Accuracy ($\frac{TP+TN}{Total}$) | TPR ($\frac{TP}{TP+FN}$) Recall | TNR ($\frac{TN}{TN+FP}$) Specificity | PPV ($\frac{TP}{TP+FP}$) Precision | F1 (2 * Precision * Recall / Precision + Recall) |
|---|---|---|---|---|---|
| Circle | 90% | 78% | 95% | 85% | 81% |
| Idle | 92% | 83% | 95% | 85% | 84% |
| left-right | 93% | 78% | 99% | 98% | 87% |
| up down | 85% | 85% | 85% | 62% | 72% |

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Castelli

Frequency - 70Hz.

Sampling rate Calculation

= 2.2 x 70Hz (2 x 70Hz = 140)

= 154 Hz

16 bit analogue to digital Converter.

Data Rate Calculation When channel = 1

Data Rate = Sampling Rate x Bits

= 154 x 16

= 2464 bits/second

when channels = 16

= 39424 bits/second

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N bit ADC Resolution

Number of Quantization levels = $2^N$

Voltage Resolution = $(V_{max} - V_{min}) / 2^N$

~~Reference Voltage~~ 5V
ADC = 10 bit
Input Signal = 3.2

Level = $2^{10}$ = 1024

Resolution = Vref / Level
= 5V / 1024 = 0.00485V

Convert Analog to Digital

Digital Value = (V.input / Vref) * ($2^N$ - 1)
= (3.2V / 5V) x 1023
= 655

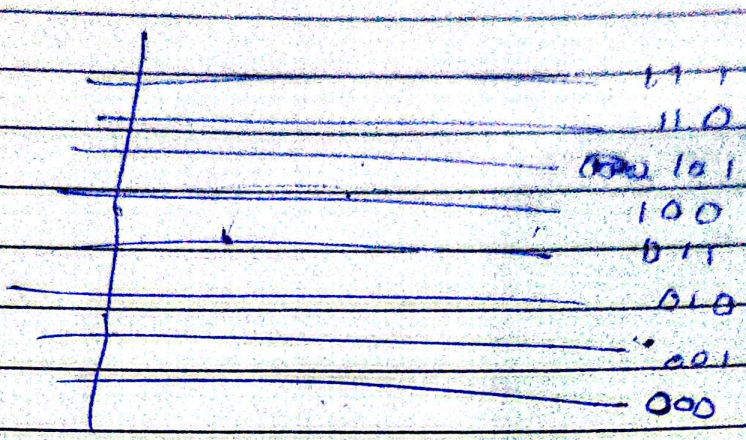
binary 1010001111

Quantization Error

Actual voltage = (655 / 1023) x 5V = 3.201V

Quantization Error = 3.201V - 3.2V = 0.001V

000




0v – 1v → 000
1v – 2v → 001
2v – 3v – 010
3v – 4v – 011
4v – 5v – 100
5v – 6v – 101
6v – 7v – 110
7v – 8v – 111

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Aliasing Effect

Wheel spins forward but appears to move backward

Happens when sampling rate < 2 x std. frequency

Fourier Transform

Convert time domain signal to frequency domain

Notch filter

Remove specific frequency

Mel Frequency

Human Hearing is logarithmic

MFCC

1) Frame Signal
2) Apply FFT ⇒ Frequency Spectrum
3) Apply Mel filter bank → Mel Spectrum
4) Take log → log Mel spectrum
5) Apply DCT → MFCC features

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S2

```
.include "m328pdef.inc"
.org 0

    cbi ddrd, 3
    sbi ddrc, 4

again: nop ;(no operation)
wait: sbis pinb, 3
      rjmp wait

    sbi portc ,4    ; Turn LED ON
    call qdelay
    cbi portc, 4    ; Turn LED OFF
    call qdelay
    rjmp again
```

Clear bit 3 in DDRB → PB3 as input

Set bit 4 in DDRC → PC4 as output

; skip next instruction if PB3 is high (button not pressed)

; if PB3 is low (button pressed), jump to wait

This creates a loop waiting for button release

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```
.INCLUDE "M328pDEF.INC"
.ORG 0

        LDI  R16, HIGH
        OUT  SPH, R16
        LDI  R16, LOW
        OUT  SPL, R16

        LDS  R19, 0xFF
        OUT  DDRD, R19      - PORTD ON

START:
        LDI  R20, 0x55
        OUT  PORTD, R20
        RCALL DELAY1
        LDI  R20, 0xAA
        OUT  PORTD, R20
        RCALL DELAY2

        JMP  START

DELAY1
        LDS  R16, 200
AGAIN4  LDS  R17, 200
AGAIN5  LDS  R18, 10
AGAIN   DEC R18
        BRNE AGAIN5
        DEC R17
        BRNE AGAIN5
        DEC R16
        BRNE AGAIN4
        RET
```