EE 316 - Electronic Design Project
Project Topics

P1. Optic Angular Encoder (3 students)

- Tracks angular position by detecting the light intensity transmitted through a patterned disk. Disk diameter is **15 cm** or less.
- Finds the speed of the disk.
- Has one LED as a light source and light sensors that generate quadrature encoder signals.
- Angular position range is **0…360** degrees.
- Position detection accuracy is **+/-1.0** degree.
- Position and speed information is displayed.

Study:

1. Quadrature encoder principles.
2. LEDs, photodiodes, phototransistors.
3. Trans-impedance amplifiers.
4. Frequency counter.
5. BCD up/down counters.

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P2. L-C Meter (2 students)

Project Description:

1. Measurement range is 1 nF to 100 nF for capacitance and 0.1 mH to 10 mH for inductance.
2. Required accuracy is +/-2%.

Study Topics:

1. Basic oscillator circuits
2. Phase or time delay of basic R-C and L-R circuits
3. Phase detection and comparison
4. Non-linear amplifiers
5. Analog to digital converters
6. Converting binary numbers into decimal
7. Feed-back extension for noisy measurement conditions

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P3. PWM Data Encoder and Decoder (3 students)

Project Description:

Binary data can be encoded as short and long pulses to transmit data over a single line at variable data rates. Pulse width modulation (PWM) can be received without any clock signal for synchronization.

- Data to be transmitted is generated with a variable clock frequency. The encoder receives data with the clock signal and generates a single PWM output.
- Duty cycles of transmitted pulses are set to **25%, 50%, 75% and 99%** corresponding to "**00**", "**01**", "**10**" and "**11**" logic levels at the input.
- Error in duty cycle of output pulses is kept below **+/-5%** as the data rate varies between **8 kHz** and **24 kHz**.
- This project also includes a decoder that recovers the original data and clock signals by using the PWM-encoded signal as input.

Related subjects:

1. Monostable multi-vibrators (MMVs) for pulse generation.
2. Controlling MMV pulse duration with a varying voltage source.
3. Frequency-to-voltage and period-to-voltage conversion methods.

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P4. Violin Tuner (2 students)

- Measures the first harmonic frequency generated by a violin string.
- Built for tuning single string, but the circuit should be upgradeable for tuning all four strings.
- Displays offset from the target frequency in a seven segment display and two LEDs. Display shows 0 and the LEDs are OFF when the first harmonic is within +/-0.5 % of the target frequency. If the frequency error is more than +/-0.5 %, then the display shows the frequency error and one of the LEDs is ON indicating positive or negative frequency difference. Display shows the number 8 when the frequency difference is more than +/-4 %.
- Proteus will be the simulation environment.

Related subjects

1. Frequency of musical notes. Fundamental frequency and harmonics…
2. Harmonic content of violin sound.
3. Filtering techniques.
4. Frequency/period measurement techniques.

P5. DC Motor Speed Controller (3 students)

Implement closed-loop control of motor speed with a PWM driver.

- Detects motor revolution time by using a patterned disk attached to the motor shaft and an optic sensor.
- Target motor speed is adjustable between two rpm limits by using a potentiometer.
- Controls PWM motor driver according to the speed information received from the optic sensor and the potentiometer setting.
- Close-loop control is completed with a solution block that will simulate the motor, patterned disc and optical sensor.
- Motor revolution time is shown with 0.1 ms resolution, or motor speed is shown with 10 rpm resolution on a 3-digit display

Related subjects

1. DC motor characteristics, back-EMF generation, torque generation.
2. LEDs, photodiodes, phototransistors.
3. Trans-impedance amplifiers used with optic sensors.
4. Basics of switching power driver circuits. Comparison of power efficiency in linear versus PWM drivers.
5. PWM driver circuits for inductive loads and DC motors.
6. Closed-loop proportional control.
7. BCD up/down counters
8. Timer circuits.