Exp. No #9 Date:

MEASUREMENT OF TEMPERATURE, SPEED, DISTANCE USING SENSORS

OBJECTIVE

The purpose of the experiment is to study the use of Sensors for the measurement of temperature, speed and distance

PRELAB

1. Study various types of analog and digital sensors available for the measurement of temperature, speed and distance.

EQUIPMENT AND COMPONENTS USED

Regulated Power Supply
Mono pulse trigger
4 ½ digit digital multimeter
100kΩ, 10kΩ, 220Ω Resistors, ¼ W
LM35 Temperature sensor
H22A2 Optical Sensor
HC-SR04 Ultrasonic Sensor
Breadboard and Connecting wires
Measurement Probes

THEORY

- A sensor is a device that detects events or changes in quantities and provides a corresponding output, as an electrical or optical signal.
- LM35 is an integrated circuit sensor that can be used to measure temperature with an electrical output proportional to the Centigrade (^{o}C) temperature.
- The low output impedance, linear output, and precise inherent calibration of the LM35 make easy interfacing to readout or control circuitry.
- Slotted optical switch or optical sensor consists of an infrared emitting diode and a PIN photodiode with a polysulfone housing that is opaque to visible light, but transmissive to infrared.
- Slotted optical switch is used in applications like Speed and direction indication, rotary encoders, top of form, end of travel and home position in printers and automotive sliding doors.
- Ultrasonic sensors evaluate the attributes of a target by interpreting the echoes from radio or sound waves.
- Active ultrasonic sensors generate high frequency sound waves and evaluate the echo which is received back by the sensor, measuring the time interval between sending the signal and receiving the echo to determine the distance to an object.

FURTHER READING

1. LM35 Precision Centigrade Temperature Sensors, Data Sheet, Texas Instruments, 2013.
2. Slotted Optical Switch Data Sheet, Fairchild Semiconductor, 2012.
3. HC-SR04 Ultrasonic Sensor Product User's Manual, Cytron Technologies, 2013.

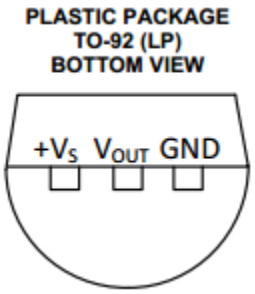
SPECIFICATION & OPERATION

LM35

Features

• Calibrated Directly in ° Celsius (Centigrade)
• Linear + 10 mV/°C Scale Factor
• 0.5°C Ensured Accuracy (at +25°C)
• Rated for Full −55°C to +150°C Range
• Operates from 4 to 30 V
• Low Impedance Output, 0.1 Ω for 1 mA Load

Pin Layout



Sensor has a sensitivity of 10mV / ^{o}C, Use a conversion factor that is the reciprocal that is 100 ^{o}C/V.

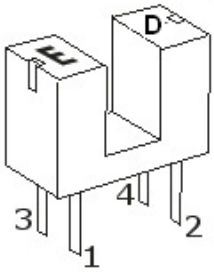
The equation used to convert output voltage to temperature is,

Temperature (^{o}C) = Vout * (100 ^{o}C/V)

Slotted Optical Switch

Features

- Lead spacing 0.300"
- Gap width of 0.150"
- Printed circuit board mounting
- 2mm aperture width



HC-SR04

Parameter	Min	Typ.	Max	Unit
Operating Voltage	4.50	5.0	5.5	V
Quiescent Current	1.5	2	2.5	mA
Working Current	10	15	20	mA
Ultrasonic Frequency	-	40	-	kHz

Time = Width of Echo pulse, in uS (micro second)

- Distance in centimeters = Time / 58
- Distance in inches = Time / 148

CIRCUIT DIAGRAM

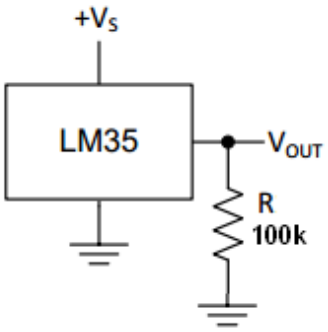


Figure 1

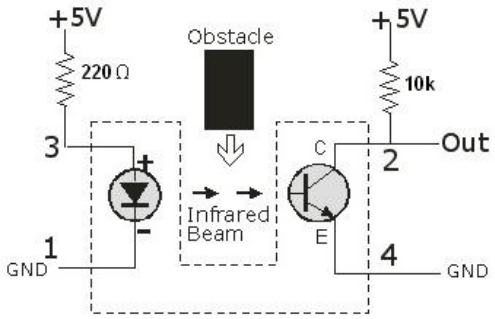


Figure 2

VCC = +5VDC

Trig = Trigger input of Sensor

Echo = Echo output of Sensor

GND = GND

Figure 3

PRACTICE PROCEDURE

Temperature Sensor

1. Connect the circuit as shown in Figure 1.
2. Apply +5V to Vs terminal.
3. Measure the voltage drop across the resistor R. This gives the voltage equivalent to room temperature.
4. Place a soldering iron near the sensor and note down the voltage drop for every degree rise in temperature.

Table1:

S.No	Temperature from Thermometer (^{0}C)	Voltage drop across R, Vout (V)	T= Vout * (100 ^{o}C/V)	Error %

Inference

Optical Sensor

1. Connect the circuit as shown in Figure 2.
2. Cut the infrared beam with obstacle and observe the pulse using DSO.

Inference

Ultrasonic Sensor

Note:

- The module is not suggested to connect directly to Vcc. Connect the GND terminal first and then connect the Vcc terminal.

1. Apply Vcc and mono-pulse trigger for the respective pins of the sensor as shown in Figure 3.
2. Place the object at a distance and apply the trigger pulse.
3. Observe the width of the echo pulse using DSO.
4. Calculate the distance from the time interval.

Table2:

S.No	Distance to Object (cm)	Echo pulse width, Time (µs)	Distance = Time / 58 (cm)

Inference

UNDERSTANDING & LEARNING

RESULTS AND CONCLUSION

Prepared by:
Name: _____ Reg. No.: _____

Experiment Date: ……

Report Submission Date: ……

Submission Delay: ……..

Signature

ASSESSMENT

Student Task	Max. Marks	Graded Marks
Pre-lab Preparation	15	
Performance	10	
Observation & Inference	10	
Post-lab / Viva-voce	15	
Total	50	