Project Lab Report

Course No: **ME 3110**

Course Title: **Instrumentation & Measurement Sessional**

Project Title: STRUCTURAL HEALTH MONITORING

Group No: B9

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Introduction

A structural health monitoring (SHM) system is an integrated system designed to assess and monitor the integrity and performance of a structure over its lifespan. It utilizes various sensing technologies, data analysis techniques, and communication systems to continuously collect and analyze data related to the structural behavior of a building, bridge, dam, or any other infrastructure. The primary goal of a structural health monitoring system is to detect, locate, and quantify any damage, deterioration, or anomalies in a structure. By doing so, it helps in ensuring the safety and reliability of the structure, optimizing maintenance and repair strategies, and extending the structure's lifespan. SHM systems incorporate a network of sensors strategically placed on or within the structure to monitor parameters such as strain, vibration, temperature, displacement. To monitor vibration accelerometer is an ideal sensor. The ADXL345 sensor is an accelerometer that can play a crucial role in a Structural Health Monitoring (SHM) system. A buzzer is integrated in this device to alert if the amount of vibration is crossing the threshold limit. The ADXL345 sensor has typically 8 pins:

VCC: Power supply pin (typically 3.3V or 5V).

GND: Ground pin (0V reference).

CS (Chip Select): Used for SPI communication mode.

SDO/ALT ADDRESS: Serial Data Output.

SDA: Serial Data line for I2C communication.

SCL: Serial Clock line for I2C communication.

INT1: Interrupt output pin 1.

INT2: Interrupt output pin 2.

Also, to monitor humidity and temperature a moisturizer sensor is used. The DHT11 sensor is a temperature and humidity sensor that provides real-time data on the ambient temperature and relative humidity of its environment. This sensor has 4 pins:

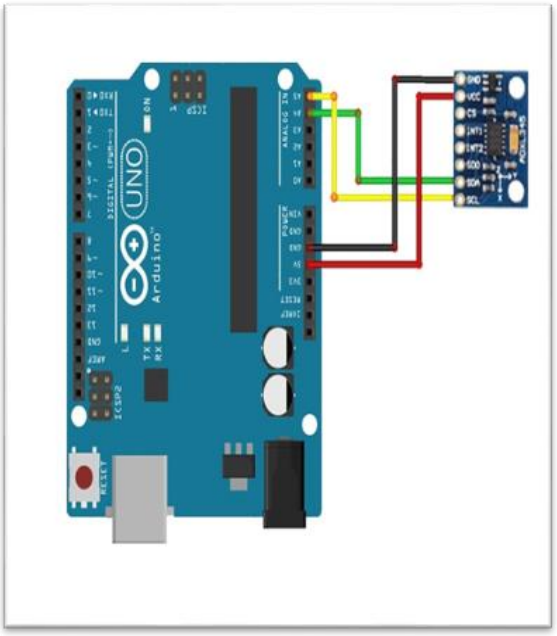
5V: Module power supply – 5 V

DATA: Used for communication with the microcontroller.

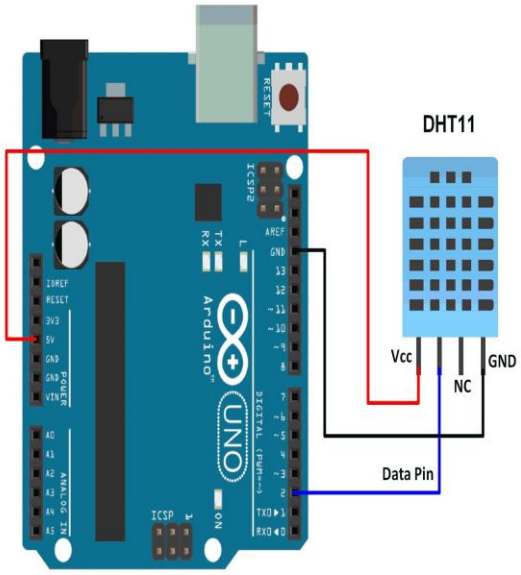
GND: Ground

NC (No Connection): This pin is left unconnected.

Circuit Diagram



Circuit Diagram: ADXL345 Accelerometer



Circuit Diagram: DHT11 Moisturizer Sensor

Objectives

1. To design and develop a structural health monitoring device that can detect the presence and location of any damage or deterioration in a structure.
2. To provide real-time or near real-time monitoring of the structural health.
3. To establish the calibration process to ensure accurate measurements.
4. Identifying limitations and proposals for improvement of the structural health monitoring device.

Function of The Accelerometer

The ADXL345 is a digital accelerometer that operates based on microelectromechanical systems (MEMS) technology.

The ADXL345 consists of a tiny mechanical structure embedded within a silicon chip. This mechanical structure includes three sets of tiny "proof masses" and fixed plates, aligned along the X, Y, and Z axes that move in response to acceleration forces. These proof masses are suspended using tiny springs. Each set of proof masses corresponds to an axis of acceleration measurement. The capacitance changes in response to acceleration are converted into electrical signals. This digital output provides accurate and reliable acceleration measurements along three axes.

Function of The Dust Sensor

The DHT11 sensor uses a capacitive humidity sensor and a thermistor to measure both temperature and humidity.

The capacitive humidity sensor measures the change in capacitance caused by the absorption of water vapor by a moisture-sensitive polymer. The thermistor measures temperature by its resistance

changes with temperature. The DHT11 sensor outputs data in a digital format using a single-wire communication protocol. The communication between the sensor and the microcontroller involves a start signal followed by the sensor's response and the data transmission. This sensor has a relatively slow sampling rate due to its internal signal processing and communication time.