**Lab 7 – Finishing the Testbed**

**Objective**

The main goal of this lab is two add two additional functionalities to the existing fully operational test bed. The list of options includes:

* RFID card reader-for security purposes
* LCD screen (with button to toggle display of different data)
* Remote operation with IR transmitter and sensor for speed control and system start/stop
* 4-Digit, 7-segment display for RPM display
* Accelerometer used to shut down system in case of excessive tilt or vibration

For this project, the 7-segment display and Accelerometer were chosen to be implemented.

**Equipment List**

* Existing Test Bed
* 4-Digit, 7-Segment Display
* GY-521 Module

**Procedure**

The 7-segment display is set up and tested first. It is connected to the DAQ Arduino using the pinout diagram shown below in Figure 1, and is programmed to update and display, in real time, the current RPM that is received by the DAQ from the main controller via serial communication. Each digit of the 7-segment display needs to be programmed and updated individually, so a function to breakdown the incoming RPM value into its separate digits and display them in the corresponding position of the 7-segment is written.

A picture containing sky

Description automatically generated

Figure : 4-Digit, 7-Segment Display Pinout

Next, the accelerometer is set up and tested using the GY-521 module. The breakout board for the module is connected to the main controller using the diagram shown below in Figure 2. This module requires the built-in “Wire” library in Arduino to initiate I2C communication. The module measures acceleration and tilt in the XYZ planes individually and sends the data through the communication channel to the Arduino where it is read and programmed to initiate the emergency shutdown protocol if any of the planes registers an excessive acceleration or tilt that crosses the set threshold values.

A circuit board

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Figure : GY-521 Module Pinout

**Deliverables**

1. Arduino code
2. Full integration and functional system

**Results**

The 7-segment display updates each digit separately and so it was programmed to update from left to right. Due to circuit switching limitations, a small delay needed to be added in between the update of each digit in order to prevent short circuits. This delay was determined to be 4ms through repeated experiments.

The GY-521 module showed to have a high sensitivity to small changes in movement of the system. Small vibrations and tilts would result in large changes in the readings, so the thresholds for the movements were set to be relatively high; -8000 to 8000 for the X and Y planes, and 3000 to 19000 for the Z plane. These values were based on the initial, non-zero values that were being returned by the component even when it was stationary.