Angle Measurement using Accelerometer MMA8451Q

Objective: To measure tilt angle using accelerometer MMA8451Q on freedom KL25Z board, where in zero-degree calibration of angle is achieved via touch sensor.

Block diagram:

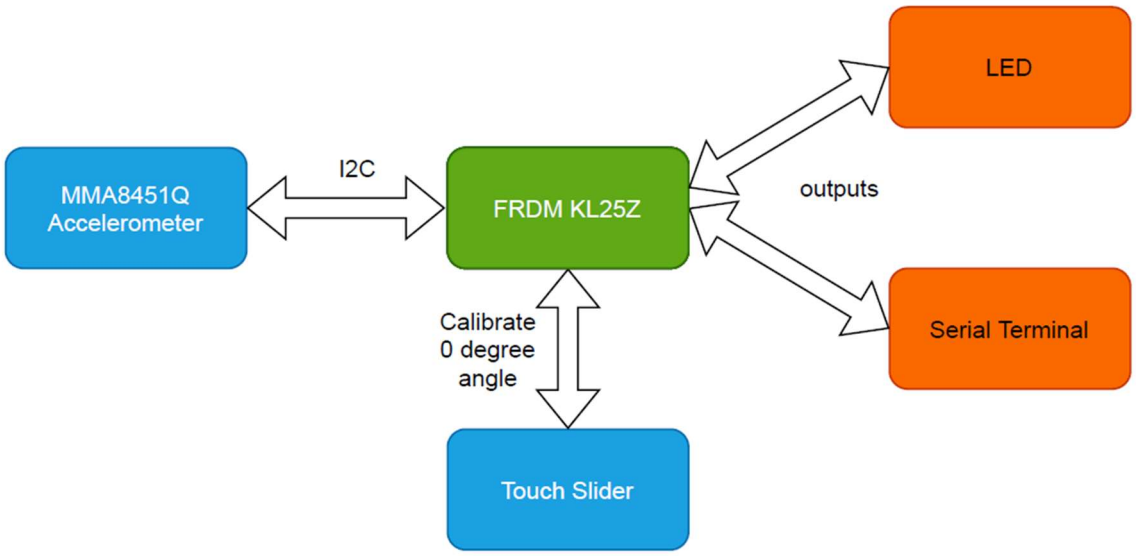

Diagram-1

Project Description:

In order to measure the tilt angle, we are utilising the MMA8451Q accelerometer on freedom KL25Z board. The accelerometer sensor is interfaced using I2C protocol to KL25Z. Also, the calibration of zero degrees is achieved via touch on the capacitive slider situated on board.

The user is prompted to input an angle of his choice, then the current angle measured is compared to that of user input. If the angle measured is less than user input, then Red led shall be turned on. If the angle is equal to that of user input, then Green led shall be lit and if the angle measured is greater than user input, then blue led shall be illuminated. Also, the current angle measured is consistently displayed on serial terminal.

One of the used cases i.e., application of this product would be setting saw blade at exactly 45 degrees relative to that of table.

Learning Outcomes:

- I2C protocol
- Working of Accelerometer sensor
- UART protocol
- Computation of tilt angle using Accelerometer readings.
- Interrupts

One of the important learnings from this project would be the computation of tilt angle using accelerometer readings. Also, since I2C communication protocol is utilised for interfacing accelerometer sensor with kl25Z, this is another new learning.

Testing:

1. Manual testing of the product, where in the angle displayed on serial terminal is compared to that of actual angle measured.
2. Automated testing of circular buffers involved in UART communication.

References:

1. KL25Z sub-family reference manual
2. Kinetis KL25 sub-family
3. https://www.nxp.com/files-static/sensors/doc/app_note/AN3461.pdf
4. MMA8451Q data sheet by NXP.
5. Chapter 8 of “Embedded Systems fundamentals with ARM Cortex-M based microcontrollers: A practical approach” by Alexander Dean.