Fall 2022 ECEN 5813
Course Project Proposal

"Levelling using Accelerometer"

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1. Project Proposal

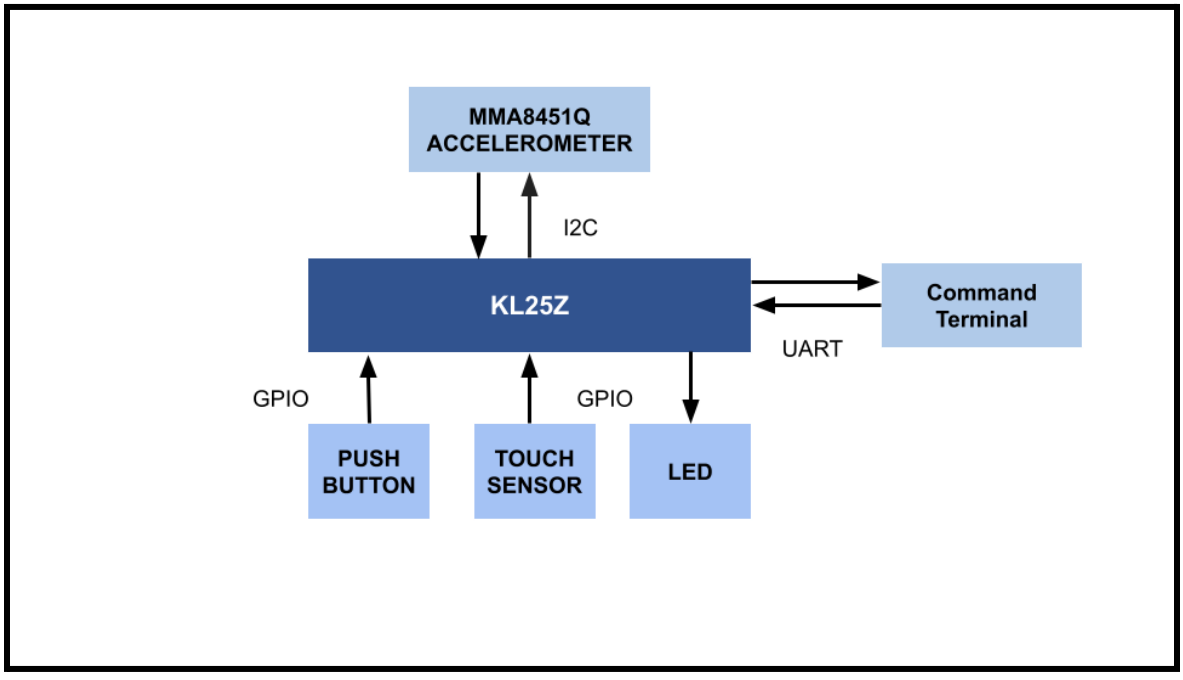
1.1 Project Overview

Objective: Levelling with the help of MMA8451Q built-in Accelerometer, Touch sensor and LEDs on FRDM-KL25Z.

1.2 High-Level Design

Accelerometers are used to measure the absolute inclination of an object, such as a large machine or mobile phones. Self-leveling application is in high-demand as absolute precision is required. A microcontroller uses the tilt-angle information for leveling. To achieve this, we are developing a module using FRDM-KL25Z microcontroller and on-board MMA8451Q Accelerometer. User can input the desired angle level on the command terminal and tilt-angle level shall be indicated using LEDs.

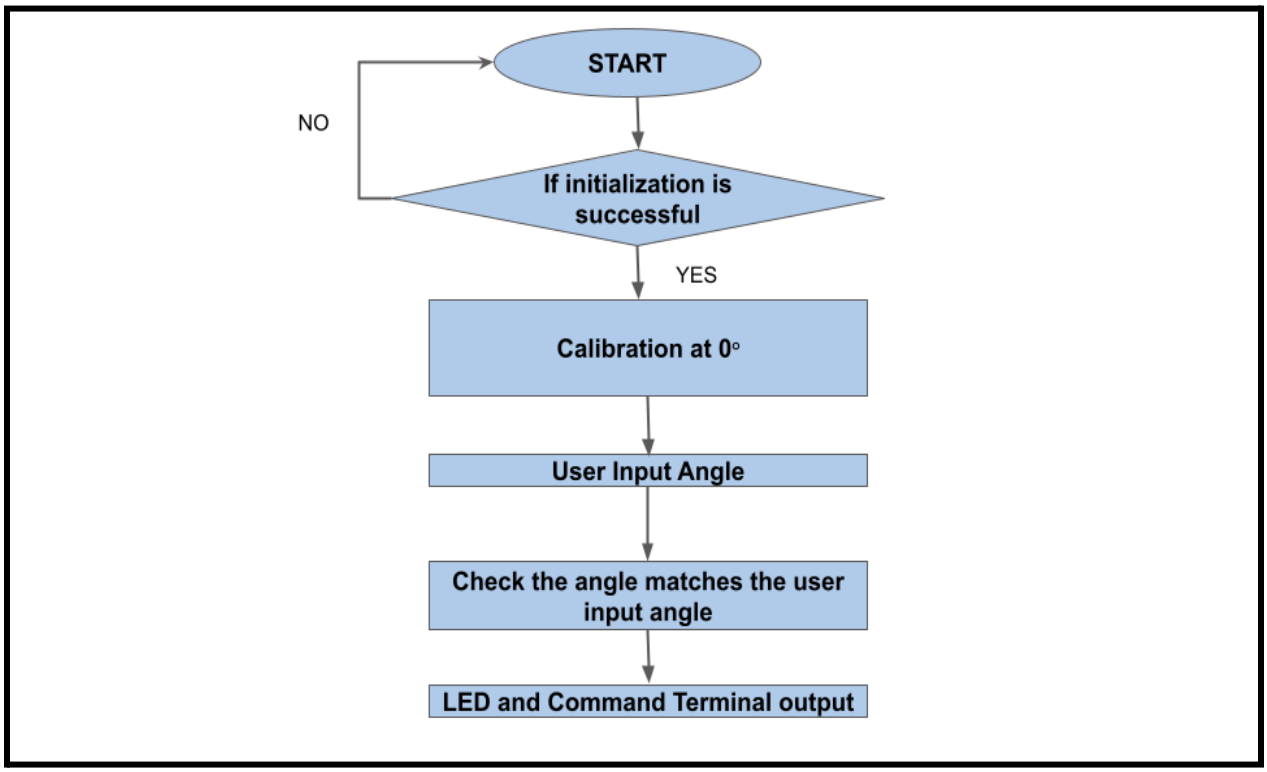
1.2.1 Block diagram



1.2.2 Design Overview

1. If the initialization of the sensor and code fails, red led shall glow.
2. On successful initialization, led color shall change from red to yellow.
3. For 0° calibration touch sensor shall be used and white led shall glow.
4. After the calibration, user will be asked to input the desired angle.
5. If the angle is less than the desired angle then, red led shall glow.
6. If the angle is more than the desired angle then, blue led shall glow.
7. Once the desired angle is achieved, green led shall glow.
8. Push button shall be used to generate an interrupt for the feedback to the user.

1.2.3 Functionality flow



1.2.4 Technologies

1. Pulse width modulation
2. Interrupts
    a. Touch sensor interrupt
    b. GPIO interrupt
3. I2C
4. Circular buffers
5. UART

1.3 Required learning

- Learning and implementing I2C protocol and UART communication.
- Interfacing the Accelerometer using I2C protocol and implmenting all the modules together.

1.4 Hardware requirements

- Most of the in-built modules are used.
- Additional GPIO would be required for the interrupt.

1.5 References

- FRDM-KL25Z User's Manual
- MMA8451Q 3-Axis, 14-bit/8-bit Digital Accelerometer, Data sheet
- Chapter 8, Alexander, Dean. Embedded Systems Fundamentals with ARM Cortex-M Based Microcontrollers : A Practical Approach

1.6 Test Plan

- Manual testing will be done for the calibration of the accelerometer, Touch sensor and LEDs.
- Automated testing will be done for handling the errors in the code, handle the touch sensor offset and CBFIFO implementation.