DT0008
Design tip

Simple screen rotation using the accelerometer built-in 4D detection interrupt

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Main components	
LIS3DH	MEMS digital output motion sensor ultra-low power high performance 3-axes “nano” accelerometer
LSM303DLHC	Ultra compact high performance e-compass 3D accelerometer and 3D magnetometer module
LSM330DLC	iNEMO inertial module: 3D accelerometer and 3D gyroscope

Purpose and benefits

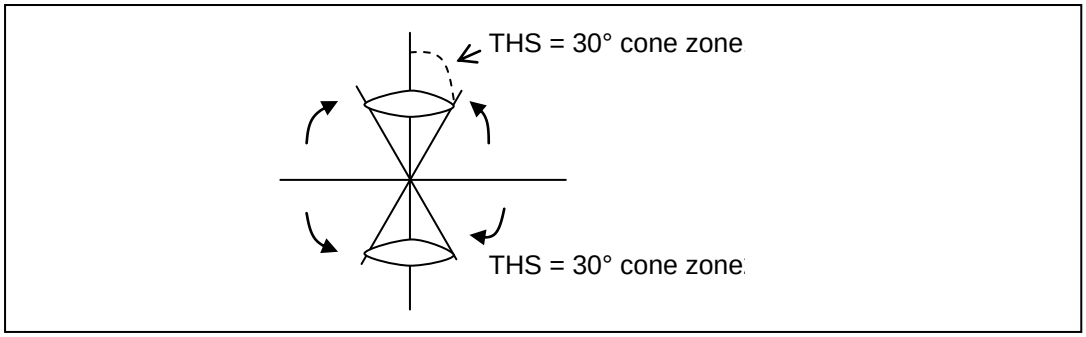
Designing simple screen rotation control can be accomplished quite easily using the LIS3DH accelerometer. The device has a bit,D4D_INT1. in the control register CTRL_REG5(24h) for this function. Used in conjunction with the correct configuration in the set up registers, the LIS3DH INT1 can be programmed to send an interrupt signal from low to high when portrait or landscape orientation is determined. The host processor can then decide how to rotate the screen. Since the host processor doesn’t need to get involved, it can perform other tasks or stay in sleep mode to save battery power.

The LIS3DH sample code is presented for simple screen rotation detection. Users can modify the settings for their own applications.

Description

The value in LIS3DH INT1_THS(32h) threshold register can be translated to two identical cone zones as shown in Figure 1.

Figure 1. Cone zones defined by INT1_THS threshold register



When the LIS3DH accelerometer X axis enters cone zone1 for the time longer than the value in INT1_DURATION(33h) register, the interrupt will be generated on INT1 pin. The value in INT1_SRC(31h) register will show the value of 0x42 meaning that X axis is pointing up. When X axis enters cone zone2, INT1_SRC register will show the value of 0x41 meaning that X axis is pointing down. Similarly, the values of 0x48 or 0x44 from INT1_SRC register mean that Y axis is pointing up or down respectively.

The following sample code shows the LIS3DH initialization after power up. Then the LIS3DH will keep running in the background continuously which has 4uA current consumption.

```
void init_LIS3DH(void)
{
Write 3Fh into CTRL_REG1;       // Set LIS3DH to low power mode with
                                   ODR = 25Hz.
Write 40h into CTRL_REG3;       // AOI1 interrupt generation is
                                   routed to INT1 pin.
Write 80h into CTRL_REG4;       // FS = ±2g low power mode with BDU
                                   bit enabled.
Write 0Ch into CTRL_REG5;       // Interrupt signal on INT1 pin is
                                   latched with D4D_INT1 bit enabled.
                                   If there is an interrupt from
                                   AOI1, INT1 pin will go high from
                                   low and stay high. Reading the
                                   INT1_SRC(31h) register will clear
                                   the interrupt signal on INT1 pin.
Write 20h into INT1_THS;        // Threshold = 32LSBs * 15.625mg/LSB
                                   = 500mg. This corresponds to 30
                                   degrees of tilt (=asin(0.5)) cone
                                   zone around the vertical gravity
                                   vector.
Write 0Ah into INT1_DURATION; // Duration = 10LSBs * (1/25Hz) =
                                   0.4s. 1LSB = 1/ODR = 40mS. If the
                                   X or Y axis enters the cone zone1
                                   or cone zone2 for longer than 0.4s
                                   duration, then the interrupt will
                                   be generated. Duration = 0 means
                                   that the interrupt will be
                                   generated immediately.
Write 4Fh into INT1_CFG;        // 6D movement detection with Z axis
                                   disabled and YUPE, YDOWNE, XUPE
                                   and XDOWNE bits enabled.
}
```

If the LIS3DH X or Y axis stays within the same cone zone, there will be no more interrupts generated. This is different from 6D position detection which continuously generates interrupts as long as the X or Y axis stays in the same cone zone.

When the LIS3DH X or Y axis exits the cone zone, there will be no interrupt generated unless either X axis or Y axis enters the cone zone1 or cone zone2 again.

Support material

Related design support material
Product / system Evaluation boards STEVAL-MKI109V2, eMotion motherboard based on STM32F103 STEVAL-MKI105V1, LIS3DH adapter board for standard DIL24 socket STEVAL-MKI106V1, LSM303DLHC adapter board for standard DIL24 socket STEVAL-MKI122V1, LSM330DLC adapter board for standard DIL24 socket
Documentation
Datasheets: LIS3DH, MEMS digital output motion sensor ultra-low power high performance 3-axes “nano” accelerometer LSM303DLHC, ultra compact high performance e-compass 3D accelerometer and 3D magnetometer module LSM330DLC, iNEMO inertial module: 3D accelerometer and 3D gyroscope
User manual: UM0979, STEVAL-MKI109V1 and STEVAL-MKI109V2 – eMotion motherboards for MEMS adapter boards UM1049, Unico GUI: software guide
Application notes: AN3308, LIS3DH: MEMS digital output motion sensor ultra-low power high performance 3-axis “nano” accelerometer AN3192, Using LSM303DLH for a tilt compensated electronic compass
Schematics: STEVAL-MKI105V1 LIS3DH adapter board schematics STEVAL-MKI106V1 LSM303DLHC adapter board schematics STEVAL-MKI122V1, LSM330DLC adapter board schematics
White papers: Applying the interrupt features of a MEMS accelerometer The embedded self-test feature in MEMS inertial sensors

Revision history

Date	Version	Changes
09-Nov-2012	1	Initial release

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