MODELLING OF AN INTEGRATED DIRECTIONAL UNIT

Team Members

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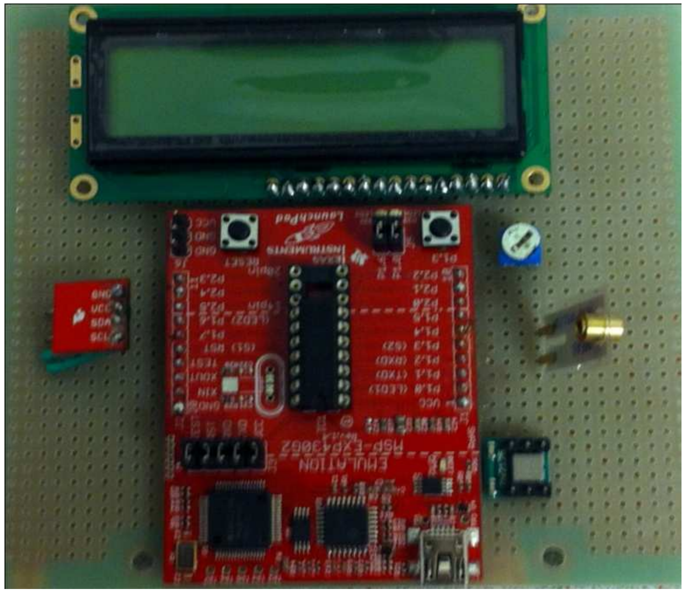
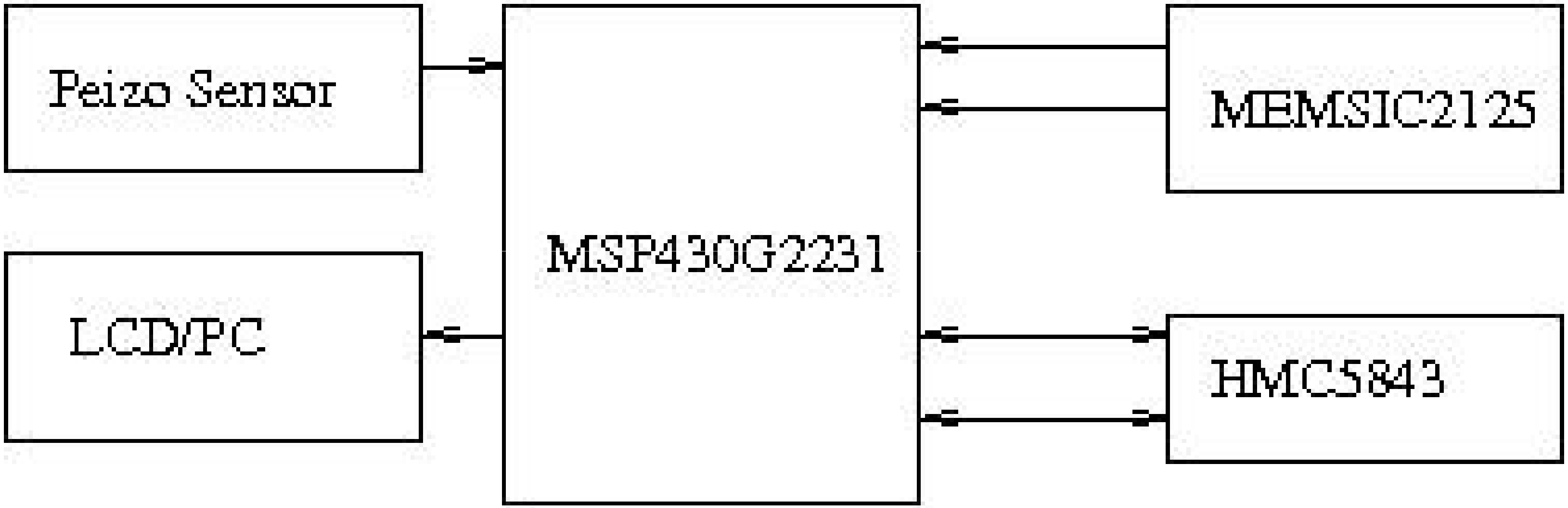
INTRODUCTION

Intergrated Directional Unit system

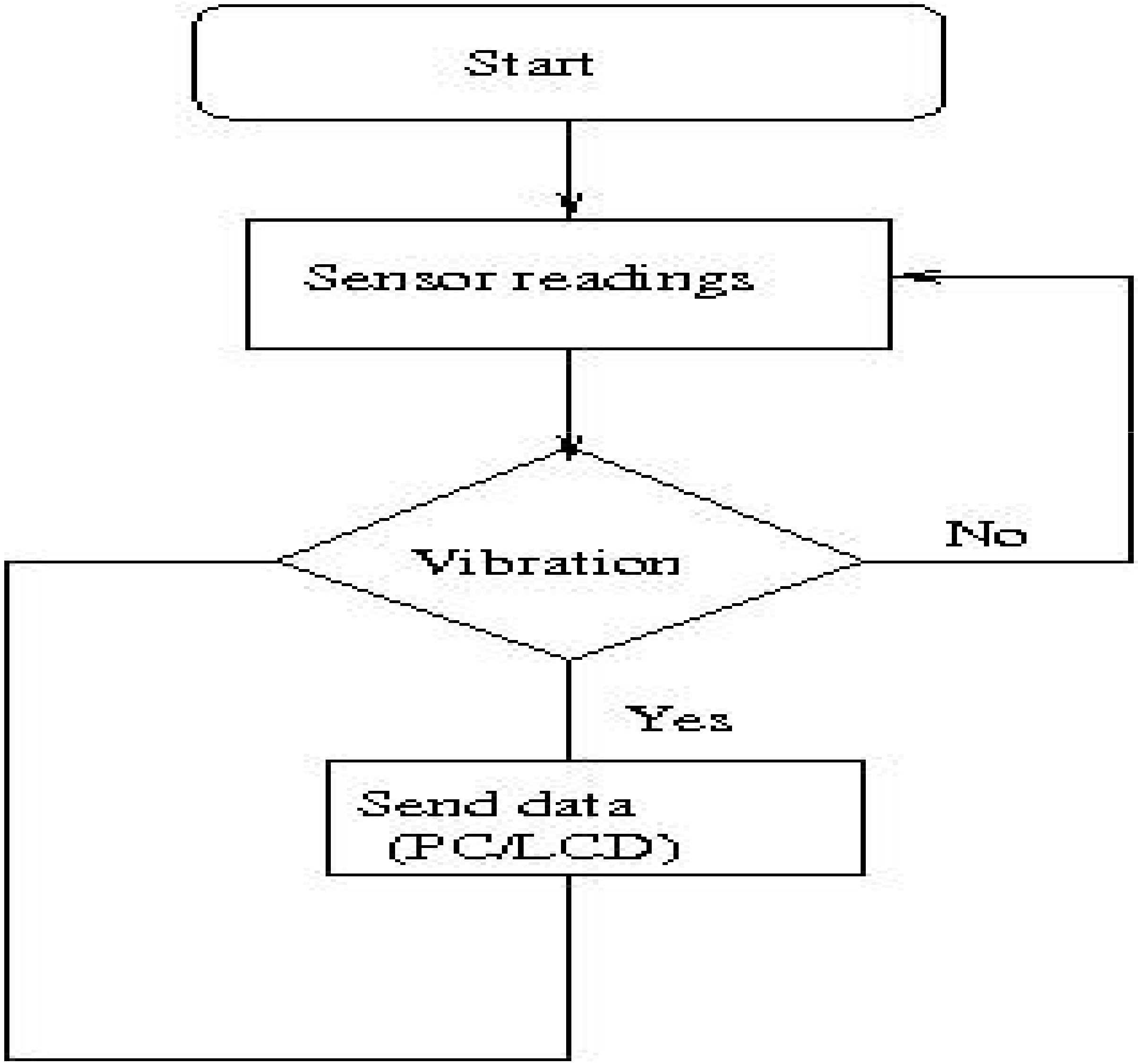


MOTIVATION



BASIC BLOCK DIAGRAM

FLOW CHART



ACCELEROMETER

•Measures Tilt & Vibration

•Simple PWM pulse output of
g-force for each axis

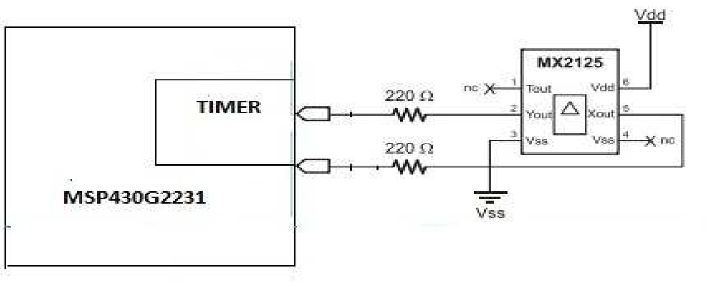
•Power Requirements:3.3 to 5 VD

•Analog output of temperature
 (TOut pin)

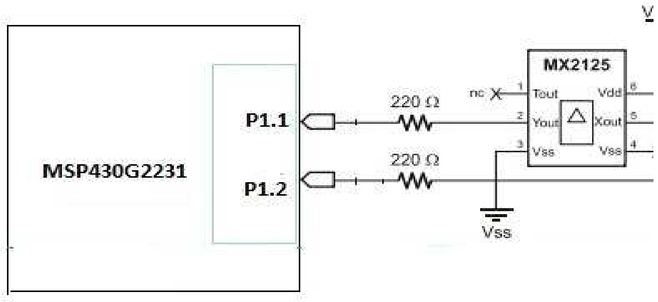
•Operating temperature over 0 to 70℃

ACCELEROMETER

MEMSIC2125 Hardware Interface (Using Timer)



MEMSIC2125 Hardware Interface: (Using Port1 Interrupts)



SOFTWARE INTERFACE

Configure 2 port pins to get PWM input from the Accelerometer

Detect rising edge using port interrupt

Within the Timer ISR:

- Check if rising edge
  - Capture Start time from TAR
  - Switch to falling edge capture settings
- If falling edge, then
  - Capture Stop time from TAR
  - Switch to rising edge

Reset TAR, Clear P1IFG

Determine the tilting angle from Duty cycle:

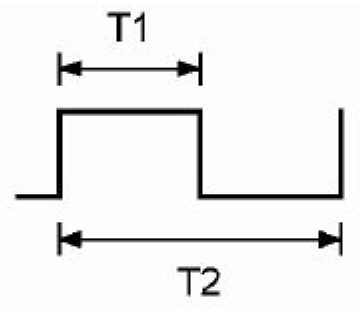
Formula for calculating g force.

A(g) = ((T1 / T2) -0.5) / 12.5%

The T1 duration (Memsic output) is captured by PULSIN in the variable xRaw.

xRaw = xRaw */ Scale

xGForce = ((xRaw / 100) - 500) * 8



At this point the standard equation provided by Memsic can be applied, adjusting the values to account for the pulse-width in microseconds. Fortunately, one divided by divided by 0.125 (12.5%) is eight,hence the final multiplication. The result is a signed value representing g-force in milli-g’s (1/1000th g).

g = ((t1 / 100 ms) - 0.5) *8

The calculation of tilt from g-force can be handled with a linear equation.

=> $$\text{Tilt} = g \times k$$

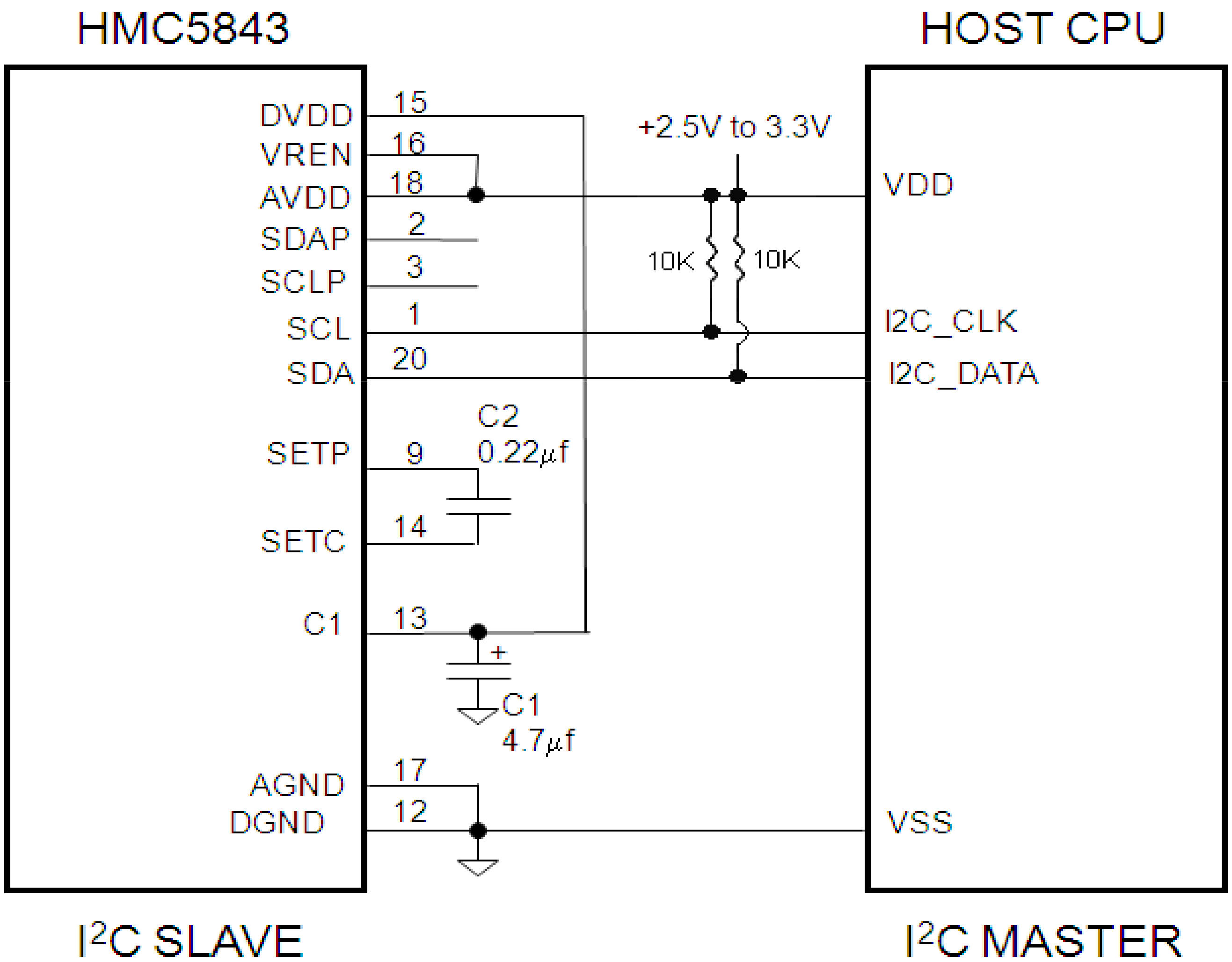
where k is taken from the following table (provided by Memsic):

inclination range (°arc)	*k* (°arc/g)	maximum error (°arc)
±10	57.50	±0.02
±20	58.16	±0.16
±30	59.04	±0.48
±40	60.47	±1.13
±50	62.35	±2.24

MAGNETOMETER

- HMC5843
- Low Voltage Operations (2.5 to 3.3V)
- Low Cost
- I2C Digital Interface
- Used as Slave
- Supports 100kHz to 400kHz data speed
- Gives X, Y, Z values

Hardware interface



Program Flow

- Start Sequence
- Send Slave write address
- Send the mode register address
- Send mode register configuration
- Send Slave read address
- Send the address of the register to be read
- Read Data from the slave
- Stop sequence

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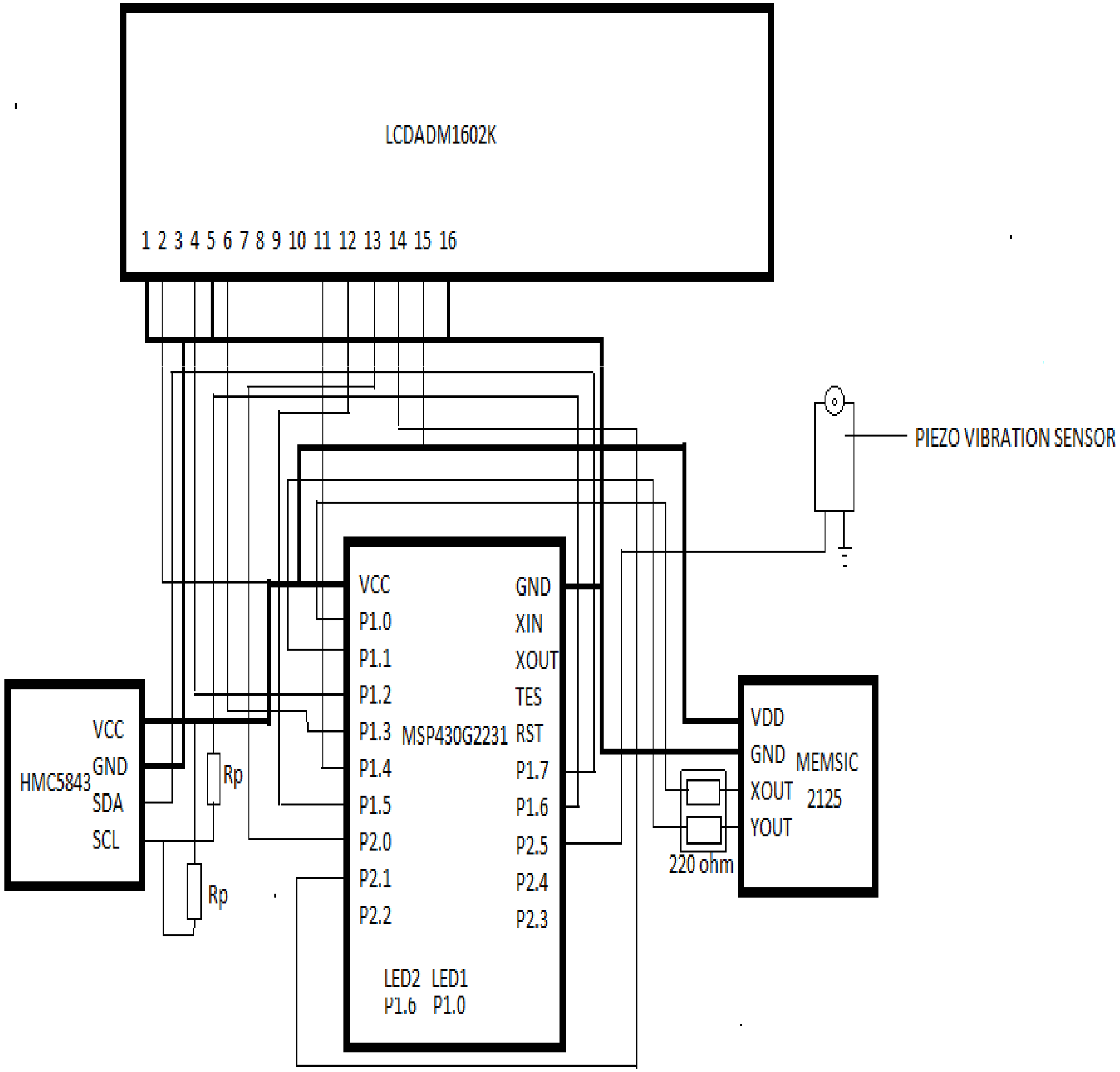
The maximum value of Hx and Hy depend on the strength of the earthÕs field at that point.

Direction (y>0) = 90 - [arcTAN(x/y)]*180/^{1}
Direction (y<0) = 270 - [arcTAN(x/y)]*180/^{1}
Direction (y=0, x<0) = 180.0
Direction (y=0, x>0) = 0.0

To determine true north heading, add or subtract the appropriate declination angle.

LCD



LCDADM1602K
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
PIEZO VIBRATION SENSOR
VCC
P1.0
P1.1
P1.2
P1.3
P1.4
P1.5
P2.0
P2.1
P2.2
MSP430G2231
GND
XIN
XOUT
TES
RST
P1.7
P1.6
P2.5
P2.4
P2.3
LED2 LED1
P1.6 P1.0
HMC5843
VCC
GND
SDA
SCL
Rp
Rp
VDD
GND
XOUT
YOUT
MEMSIC
2125
220 ohm

PIEZO VIBRATION SENSOR

Physical Appearance:

- Mass attached at the tip increases

the sensitivity to motion.

- Laminated for higher voltage output.

Piezoelectric Effect:

- Charge which accumulates in solid materials in response to applied mechanical stress.
- Small AC voltage is created when the film moves back and forth.

Principle of Operation :Transverse Effect

- Force is applied on the neutral axis and charges are generated in direction perpendicular to the line of force.

Input Voltage: From the microcontroller.

COMPONENT LIST / PROJECT COST

Sr No	COMPONENTS	MODEL No	ACQUIRED	COST
1	Accelerometer	MEMSIC 2125	OCT 3rd	$34
2	Magnetometer	HDMC 5823	Reordered	$29
3	Piezo Vibration Sensor	MEAS	OCT 20th	$3
4	LCD	ADM1602K	NOV 28th	$12
5	Accelerometer	ADXL345	NOV 1st	$14

THANK YOU!

QUESTIONS?