Extreme Condition Detection

Abstract:

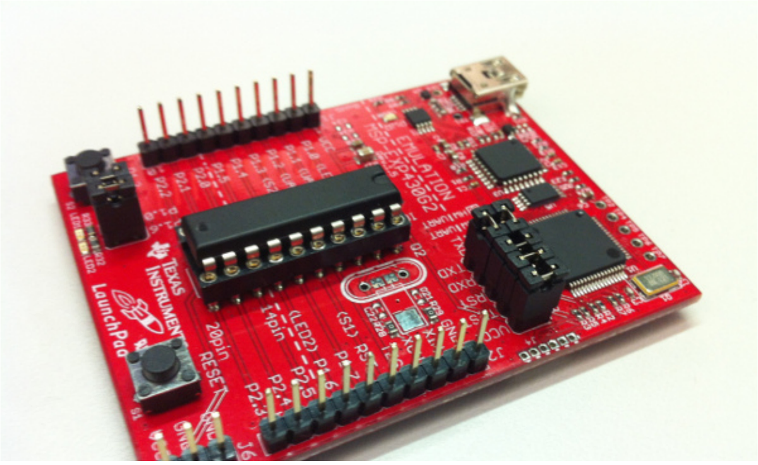
Extreme condition detection is a setup with a vibration sensor, an accelerometer, a pressure sensor, GSM and a micro controller that is used to detect extreme situations and send a word about it to the concerned person to take required action. This is a very simple and economic approach to get informed in advance about the upcoming extreme situations.

Introduction:

This setup consists of 5 major components. A micro controller, in this case MSP430(G2553), a GSM modem, differential pressure sensor, vibration sensor and an accelerometer. The principle of working is quite simple and logical. All the sensors will continuously check for the changes in its surrounding. When all of them reach their extreme values it means that the surrounding is in a very undesirable state. When the device recognizes that, a text message will be sent to the concerned person using a GSM modem. And depending on that message required precautions could be taken. This has been devised for a much lower scale for the project purpose. This is a multi use device that can be used in several areas like, to detect a natural calamity, or to check for a system's stability, in understanding worst case scenarios and many more.

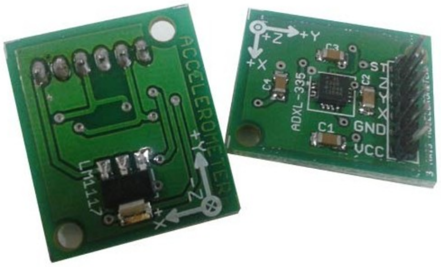
Anatomy of the Device:

1. MSP430 with G2553 controller.



2. Differential Pressure Sensor

3. Accelerometer



4. Vibration Sensor

4. GSM Modem

Working principle and other details:

The device is made self-efficient to understand the extreme condition of its surroundings using the sensors it is composed of. The components or the sensors of the device work as explained below.

1. ***Differential Pressure Sensor*** (To be filled when its working is understood properly)

2. ***Accelerometer:***

The ADXL335 is a small, thin, low power, complete 3-axis accelerometer with signal conditioned voltage outputs. The product measures acceleration with a minimum full-scale range of ±3 g. It can measure the static acceleration of gravity in tiltsensing applications, as well as dynamic acceleration resulting from motion, shock, or vibration. Here its application is quite different though the concept of its working is used quite similarly. Whenever there is a change in the position of the device, the sensor gives a different analog value which is pretty obvious. So, when there is a substantial amount of change, device gives an extreme end reading. And breaching this will trigger a signal to the micro controller.

3. ***Vibration sensor:***

Usually vibration sensors are made up of a piezoelectric material that uses the piezoelectric effect to sense the change in strain or force applied on it. Thus, whenever there is a change in strain or stress on the device it initiates a signal. But, however we need only extreme condition values. To get this the logic is simple. The controller continuously monitors the vibration sensor. If we have a sustained change or in the words if the device initiates the signal for quite a long time then it can be concluded that the effect is extreme one.

4. ***GSM Modem:***

A GSM modem is a specialized type of modem, which accepts a SIM card, and operates over a subscription to a mobile operator, just like a mobile phone. From the mobile operator perspective, a GSM modem looks just like a mobile phone. This can be a dedicated modem device with a serial, USB or Bluetooth connection, or it can be a mobile phone that provides GSM modem capabilities. This is the component that links the user and the device. This will send a message just like a mobile phone to the concerned person when it is asked to by the micro controller. This uses SIM900A, which is an ultra compact and reliable wireless module. The SIM900A is a complete Dual-band GSM/GPRS solution in a SMT module, which can be embedded in the customer applications allowing you to benefit from small dimensions, and cost-effective solutions.

5. ***The Micro-Controller:***

This is the heart and brain of the device that governs the working of all its components. This monitors the readings of all the sensors, actuates GSM to send message when it receives the extreme values form all the sensors. MSP430 with G2553 is the controller used in this model. The code for the working of the device is fed to the micro-controller. Whole of the working is controlled by the controller and hence the name.

So on the whole the device will detect the situation as extreme when all the three sensors reach their extreme values. Thus the device is made intelligent to understand and differentiate between normal circumstances and extreme conditions.

Few important things that you must know:

1. While using the accelerometer, the position you hold while calibrating must be maintained same while checking for the results. If changed you might send wrong signals to the controller or you might not send any even when the extreme condition is encountered.
2. The vibrating sensor has three pins. Red wire has to be connected to the VCC, Black to the GND and Blue to the Data pin. Here, analog values are not used as few might think. This does not give the magnitude of vibration. If left untouched, the digital value you can see will have a pattern say 10101001 or so. But when continuously tapped, it gives only 0s. This is used in the logic. If you get more than 20 or 30 0s continuously then it can be told that there is continuous vibration. This is how this sensor has been made use of in this application.
3. Make sure that the serial communication pins of emulator and the controller are put horizontally. If connected otherwise, you cannot upload any code into the controller.
4. Most important thing is the delay management in the code. While understanding the code print as much as you want in the serial monitor. But keep in mind that it introduces delay in the system. Your code will not work exactly the same way if you don’t print them. You must also give enough time to the sensors to respond. Printing unnecessary things in the serial monitor might cause undesirable effects, which are quite difficult to debug.

A little heads up on GSM Modem

GSM Modem has to be dealt with more caution. Otherwise it is pretty much a headache. Follow the steps to start with GSM.

1. To start with GSM, connect the GSM to your computer using a serial connector RS232. Download any terminal application to send commands to the module or receive from it.
2. After downloading, open the terminal window.
3. Then, switch on the supply to the power the module. This is an important step. Because, immediately after the module is powered it sends few responses to the terminal. In order to receive them your terminal window should be at the ready. If you power the module and then open the terminal you will not receive any response from the module since it has been already sent. And most of the times, for the commands you pass from then on you will receive an error message.
4. After you get well accustomed with the GSM via RS232, then try sending commands via microcontroller. Even here, power the module after uploading the code and opening the serial monitor.
5. The delay management between the commands while you are trying to send via controller is very important. You must give enough time for the module to accept the command and respond to it.
6. Always cross connect Rx and Tx pins of any module and the controller.

Where can I get help from???

Well, here are few links that might help you.

1. https://www.youtube.com/watch?v=E6Bsr0y9Qsw
2. https://www.youtube.com/watch?v=E6Bsr0y9Qsw
3. https://www.youtube.com/watch?v=zBA6glLSXWk
4. http://www.datasheet-pdf.com/datasheet-html/S/I/M/SIM900_ETC.pdf.html

Code: (without pressure sensor)

```
 int m=0;    Int cnt=0;
 void setup()
{
 pinMode(P1_5, INPUT);
 Serial.begin(9600);
}
 void loop()
{
 int v=digitalRead(P1_5);
 int x=analogRead(P1_3);
 int y=analogRead(P1_4);
 int z=analogRead(P1_0);
 delay(100);
  if (m==v)
   cnt++;
  else
   cnt=0;
  if (cnt>=20 && (x>=400 || y>=370 || z>=400))
  {
     Serial.println("AT+CMGF=1;/r");
    delay(1000);
    Serial.println("AT+CMGS=\"+919538040168\"\r");
    delay(1000);
    Serial.println("alert");
    delay(1000);
    Serial.println((char)26);
    delay(100);
  }
}
```

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