

Infrastructure Health Monitoring using Zigbee Communication

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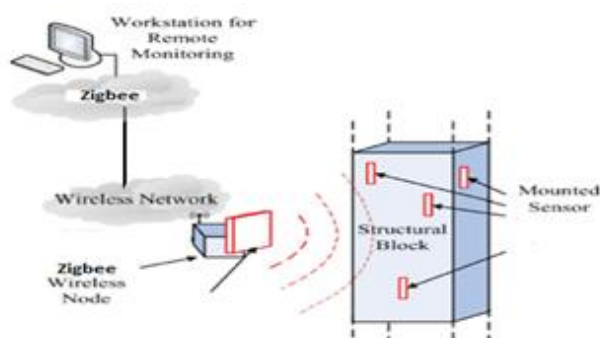
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Abstract -- Here we are implementing an earthquake monitoring system. An earthquake (also known as a tremor or temblor) is the result of a sudden release of energy in the Earth's crust that creates seismic waves. Earthquakes are recorded with a seismometer, also known as a seismograph. This project presents Microcontroller based An Earthquake Detection using Sensing Element to reduce its destructive losses.



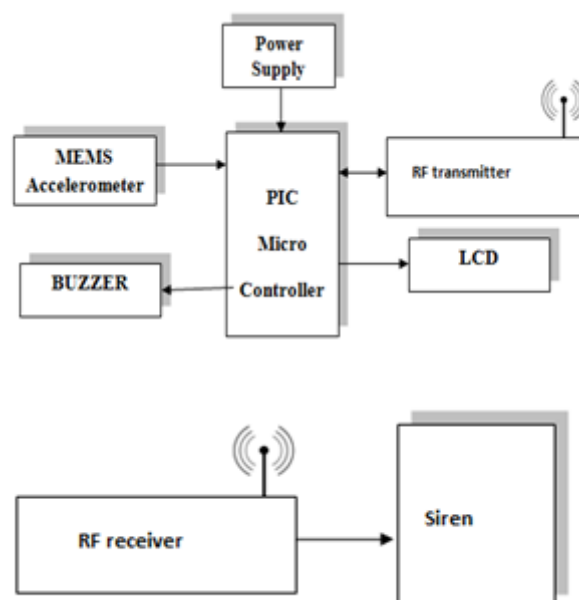
Introduction

Infrastructure health monitoring is an essential discipline in civil engineering as it provides vital information which can be used to evaluate the state of civil structures, such as bridges, buildings, and tunnels. For this purpose, measurements of dynamic responses of structures are highly important. Vibration-based infrastructure health monitoring is extensively used in this process to acquire the necessary vital information (e.g., natural frequencies and mode shapes) by measuring dynamic acceleration of structures.

Existing system

In existing system we have MEMS accelerometer to take vibrations in the building which gives to the microcontroller in turn sends to the monitoring section

through RF wireless technology. Here we have two sections. At the monitoring section siren alert is given to intimate.



Drawback: RF communication is implemented in a single place and also in a shorter distance.

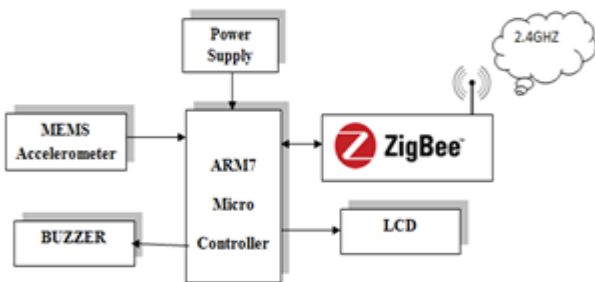
Proposed system

In this project we have MEMS accelerometer to sense the shaking of the building which in sends to the microcontroller which in turn sends to the monitoring section through Zigbee wireless technology. Here we have three sections, the two floor sections has PIC microcontroller, Zigbee device and MEMS accelerometer. The monitoring section has PC and a Zigbee wireless device, which will collect the data

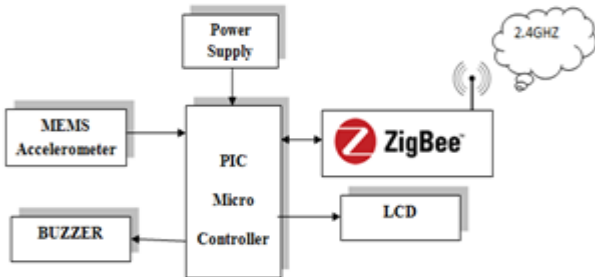
from the floor sections and analyze the stability of the building.

BLOCK DIAGRAM

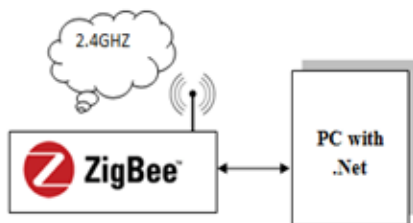
Floor 1:



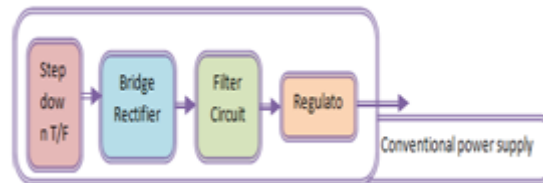
Floor 2:



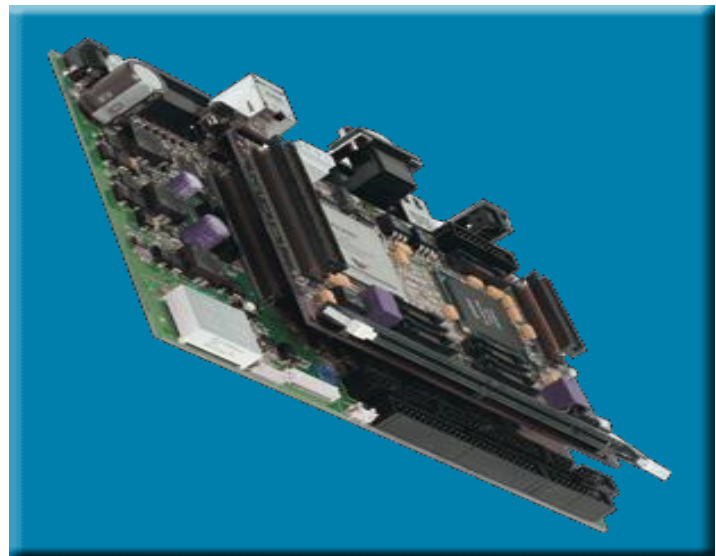
Monitoring Section



This project uses regulated 3.3V, 500mA power supply. Unregulated 12V DC is used for relay. 7805 three terminal voltage regulator is used for voltage regulation. Bridge type full wave rectifier is used to rectify the ac out put of secondary of 230/12V step down transformer.



ARM PROCESSOR



ARM7TDMI Processor Core

- Current low-end ARM core for applications like digital mobile phones
- TDMI
 - T: Thumb, 16-bit compressed instruction set
 - D: on-chip Debug support, enabling the processor to halt in response to a debug request
 - M: enhanced Multiplier, yield a full 64-bit result, high performance
 - I: Embedded ICE hardware
- Von Neumann architecture

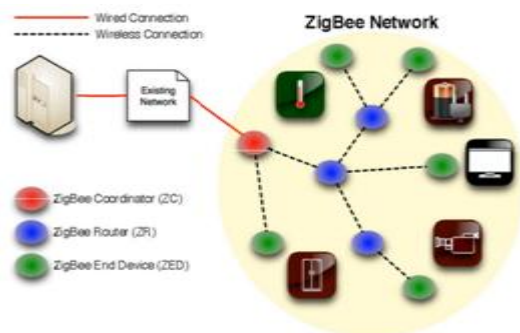
PIC

The PIC is one of the latest products from *Microchip*. It features all the components which modern microcontrollers normally have. For its low price, wide range of application, high quality and easy availability, it is an ideal solution in applications such as: the control of different processes in industry, machine control devices, measurement of different values etc. Some of its main features are listed below.

- **RISC architecture**
 - Only 35 instructions to learn
 - All single-cycle instructions except branches
- **Operating frequency 0-20 MHz**
- **Precision internal oscillator**
 - Factory calibrated
 - Software selectable frequency range of 8MHz to 31KHz
- **Power supply voltage 2.0-5.5V**
 - Consumption: 220uA (2.0V, 4MHz), 11uA (2.0 V, 32 KHz) 50nA (stand-by mode)

Zigbee

It is the wireless device for transmitting and receiving purpose or simply it called as Transceiver. Zigbee is based on the IEEE802.15.4 protocol. The range of the Zigbee is covered as 100m. It range is 10 times better than blue tooth device so it can be more preferable one in wireless device. The data rate is very low for transmission while using this device.



Zigbee is a PAN technology based on the IEEE 802.15.4 standard.

Unlike Bluetooth or wireless USB devices, ZigBee devices have the ability to form a mesh network between nodes. Meshing is a type of daisy chaining from one device to another. This technique allows the short range of an individual node to be expanded and multiplied, covering a much larger area.

Technical Specifications of Zigbee

- Frequency band 2.400 — 2.483 GHz
- Number of channels 16
- Data rate 250 kbps
- Supply voltage 1.8 – 3.6 V
- Flash memory 128 kB
- RAM 8 kB
- EEPROM 4 kB Operating
- Temperature -40 — +85 °C

MEMS

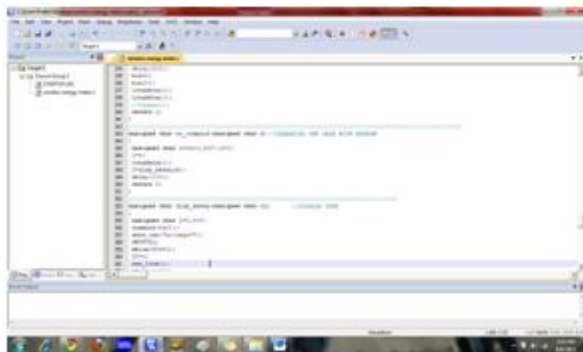
An accelerometer measures acceleration (change in speed) of anything that it's mounted on. Single axis accelerometers measure acceleration in only one direction. Dual-axis accelerometers are the most common measure acceleration in two directions, perpendicular to each other. Three-axis accelerometers measure acceleration in three directions.

Accelerometers are very handy for measuring the orientation of an object relative to the earth, because gravity causes all objects to accelerate towards the

earth. A two-axis accelerometer can be used to measure how level an object is.

Software tools

Keil compiler is a software used where the machine language code is written and compiled. After compilation, the machine source code is converted into hex code which is to be dumped into the microcontroller for further processing. Keil compiler also supports C language code.

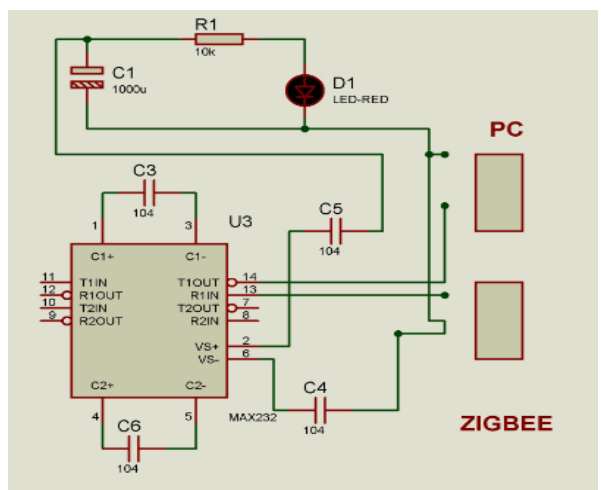
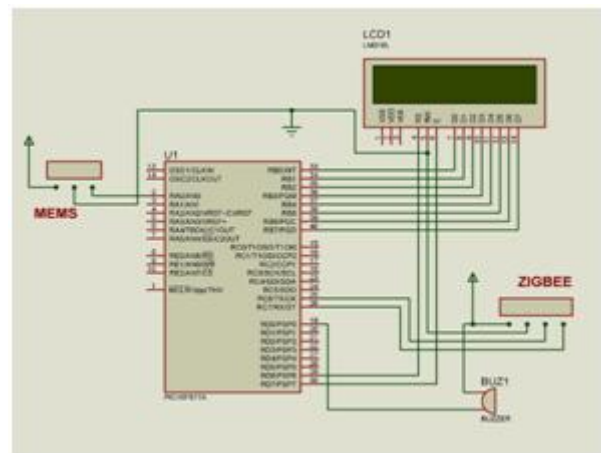
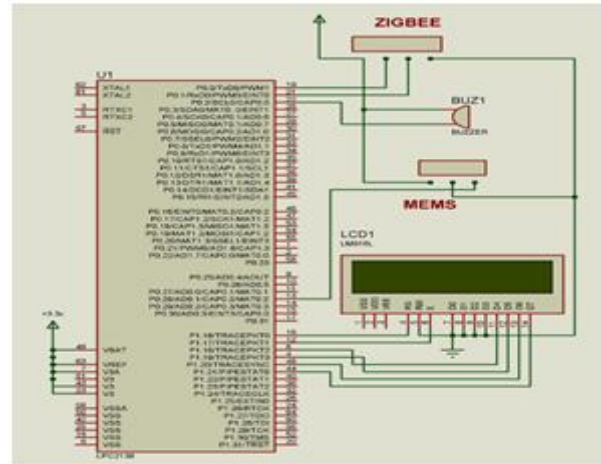


Flash Magic

Flash Magic is a tool which is used to program hex code in EEPROM of micro-controller. It is a freeware tool. It only supports the micro-controller of Philips and NXP. It can burn a hex code into that controller which supports ISP (in system programming) feature. Flash magic supports several chips like **ARM Cortex M0, M3, M4, ARM7 and 8051**.



Schematic diagram



Results



Advantages

- Low cost
- Easy to implement
- Safety
- Loss of life can be avoided

Applications

- Apartments
- Malls
- Commercial places

Conclusion

In this paper, a dynamic acceleration measurement system with an accelerometer integrated semi passive RFID tag was presented for remote monitoring of infrastructure.

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