

ITP272 SENSOR TECHNOLOGIES AND PROJECT

L01: Introduction

AGENDA

- ⦿ Module Overview
- ⦿ Smart World and Sensors

MODULE OVERVIEW

Module Aim

- ◉ To equip students with fundamentals of sensor technologies, interfacing techniques. Students will learn how to develop application leveraging the data acquired and collated from the sensors.

Hours and credits

- ◉ 120 Hours / 8 credit points

Mode of Teaching

- ◉ Lecture (15) Practical (105) Tutorial (0)

Mode of Assessment (Total 100%)

- ◉ Examination (Not Applicable)
- ◉ Test (30%)
- ◉ Participation (Lab, eLearning) (10%)
- ◉ Project (60%)

MODULE OVERVIEW

Module Objectives

- ⦿ Identify and select sensors based on the requirements of the system.
- ⦿ Describe basic electronic circuitry, signal conditioning and interfacing techniques.
- ⦿ Describe and use the various data communications methods for data transmission.
- ⦿ Design and develop applications on smart objects to acquire, store and process data read from sensors.

MODULE OVERVIEW

Module Content

- ⦿ Course Introduction
- ⦿ Sensor Fundamentals
- ⦿ Basic Electronics
- ⦿ Sensors and their Principles
- ⦿ Signal Conditioning Techniques and Interfacing
- ⦿ Data Communication
- ⦿ Smart objects and Wireless Sensor Networks

MODULE OVERVIEW

Module Delivery

- ⦿ Lecture (1 hour per week)
- ⦿ Practical cum Tutorial (7 hours per week)
- ⦿ Module Lesson Plan (Refer to Blackboard)

MODULE OVERVIEW

Module Leader and Tutors

- ◉ Refer to project Guide

MODULE OVERVIEW

Module Assessment

○ ICA1	
■ Written Test 1 & 2	30% (15 + 15%)
○ ICA2	
■ Practical, Tutorials, eLearning	10%
○ Project	
■ Documentation	
■ Presentation	
■ Technical Review	60%
○ Total	<hr/> 100%

MODULE OVERVIEW



Expectation

Previous
Semester

C# (Windows Form)
C# (ASP .NET)



C# (Raspberry Pi)

Tutorial

PROJECT

WRITTEN
TESTS

MODULE OVERVIEW

PROJECT



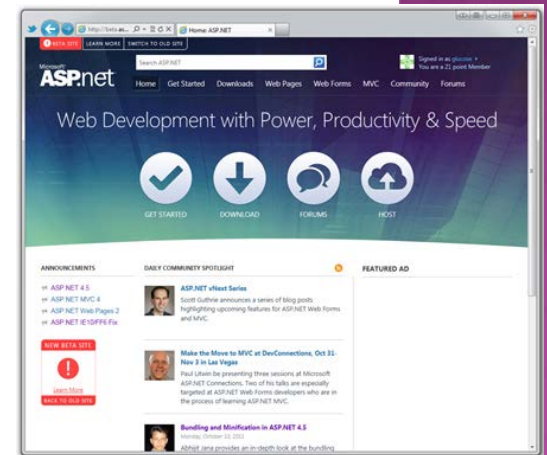
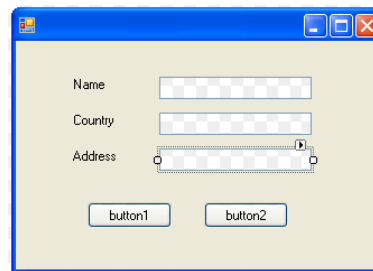
C# (Raspberry Pi 3)

C# (Windows Form)

C# (ASP .NET)



Sensor data



MODULE OVERVIEW

Project Guide

- ◉ More detailed information can be found in the Project Guide. Please read through the project guide

Text References

- ◉ Sensor Technology Handbook, Jon S. Wilson
- ◉ Handbook of Modern Sensors: Physics, Designs, and Applications, Jacob Fraden

SMART WORLD AND SENSORS

What is a Smart world

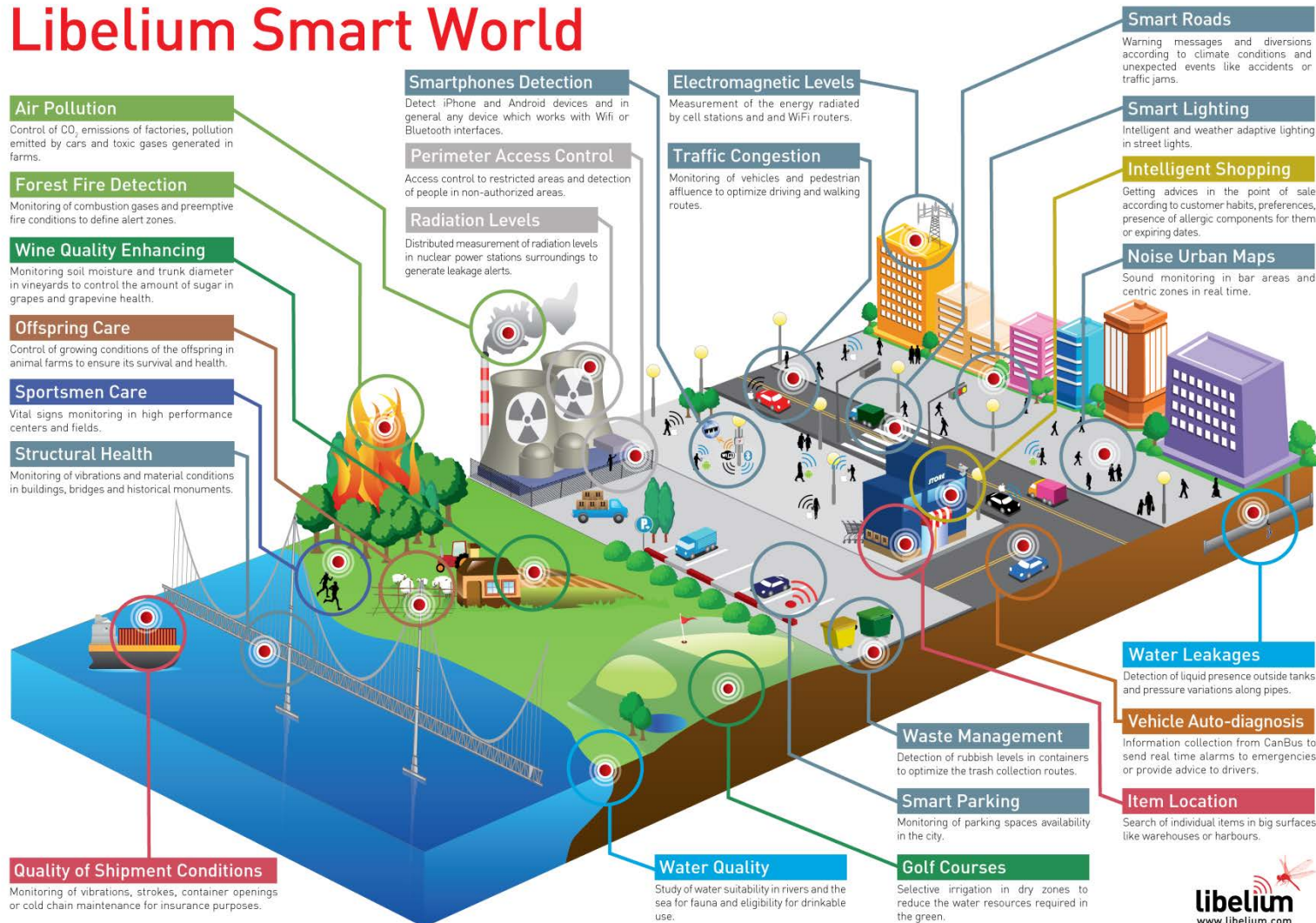
- ◉ Things happening around us are being monitored and reported fast and automated
- ◉ Devices can react to these feedbacks to optimize operations
- ◉ Tedious and manual work becomes automated
- ◉ Security is enhanced, energy is conserved and disasters can be avoided

What can contribute to Smart world

- ◉ Forest Fire detection
- ◉ Traffic congestion control
- ◉ Radiation monitoring

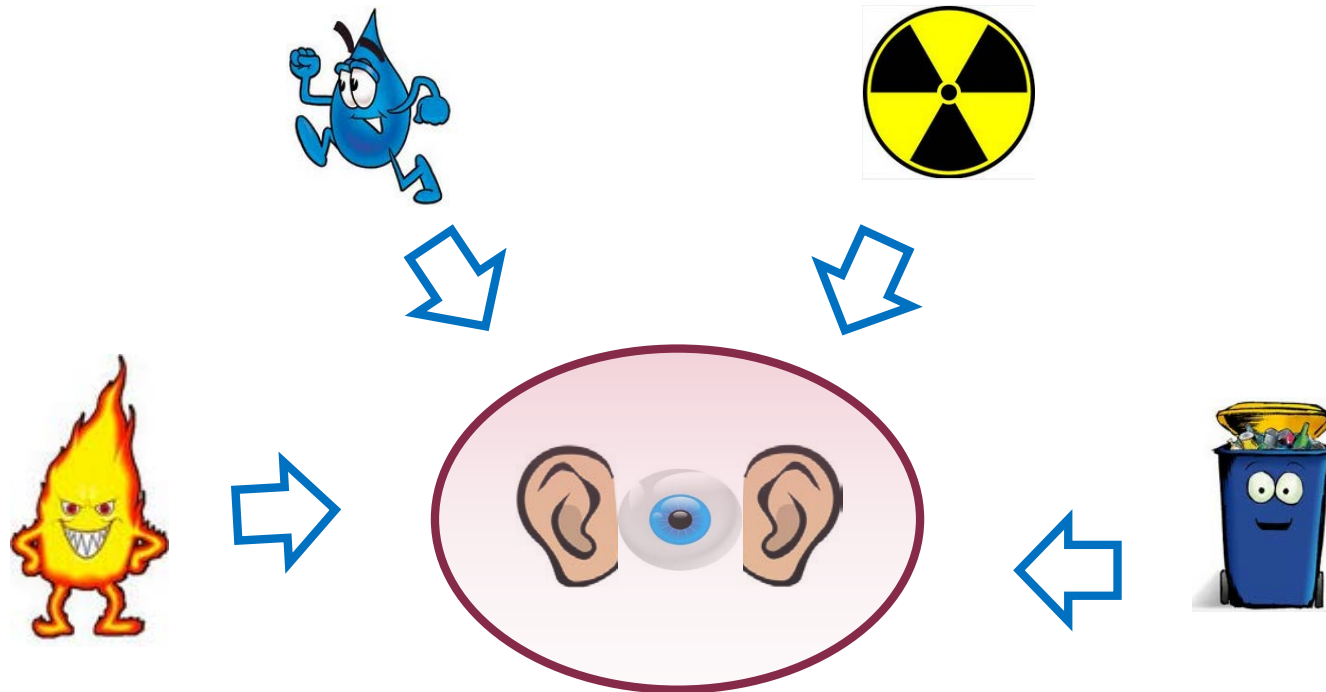
SMART WORLD AND SENSORS

Libelium Smart World



SMART WORLD AND SENSORS

Basis of “Smart”?



Sensors !!!

DIGITAL AND ANALOG

Digital Bits (Binary)

- ⦿ 2 states (bit)
 - On
 - Off

Computer try to use numbers to represent everything

- ⦿ 2 states are insufficient
- ⦿ So combine more bits to form more states
- ⦿ The more bits used, the bigger number you can have
- ⦿ There is why in computer world, it is full of 1's and 0's

DIGITAL AND ANALOG

Hence you always see in movies, computer processing are associated with this image



DIGITAL AND ANALOG

Things in the human world are mostly analog in nature

- ◉ For distance range of 255cm, it is continuous 0 – 255 cm
 - You would not be able to know how many possible states there are
 - 255 different states?
 - 0 cm, 1 cm, 2cm, ... , 255cm
 - Then how about 1.1 cm? 1.125cm?
 - Infinite states

Computer try to model things in the world using finite states.
The more states there are, the closer it is to the real thing

DIGITAL AND ANALOG

To model a distance range of 255 cm

- ◉ If you use 1 bit to model this distance
 - 0 => 0 cm
 - 1 => 255 cm
 - So if the actual distance is 100.5 cm, it is reported as 0 cm which is used to represent 0 cm
 - Error is 100.5 cm
- ◉ If you use 2 bits to model this distance
 - 00 (0) => 0 cm
 - 01 (1) => 85 cm
 - 10 (2) => 170 cm
 - 11 (3) => 255 cm
 - So if the actual distance is 150.5 cm, it is reported as 1 which is used to represent 85 cm
 - Error is 65.5 cm

DIGITAL AND ANALOG

To model a distance range of 255 cm

◉ If you use 8 bit to model this distance

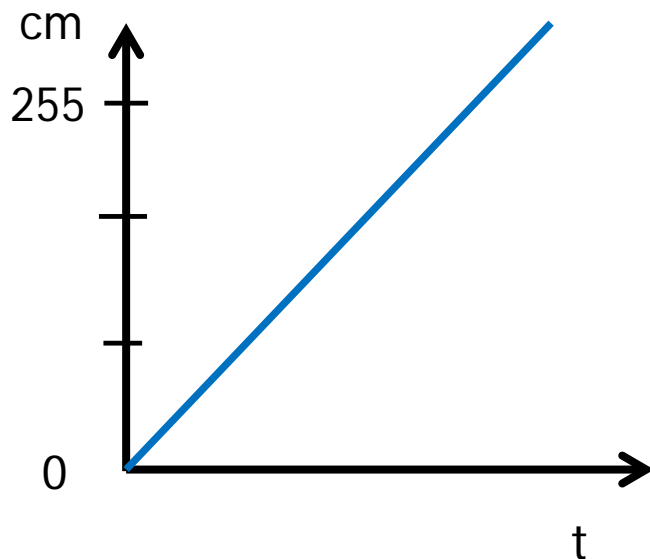
- 00000000 (0) => 0 cm
- 00000001 (1) => 1 cm
- ...
- 10010110 (150) => 150 cm
-
- 11111111 (255) => 255 cm
- So if the actual distance is 150.5 cm, it is reported 150 which is used to represent 150 cm
- Error is 0.5 cm

So for computer, if more digital bits are used to model the output, it becomes more accurate !

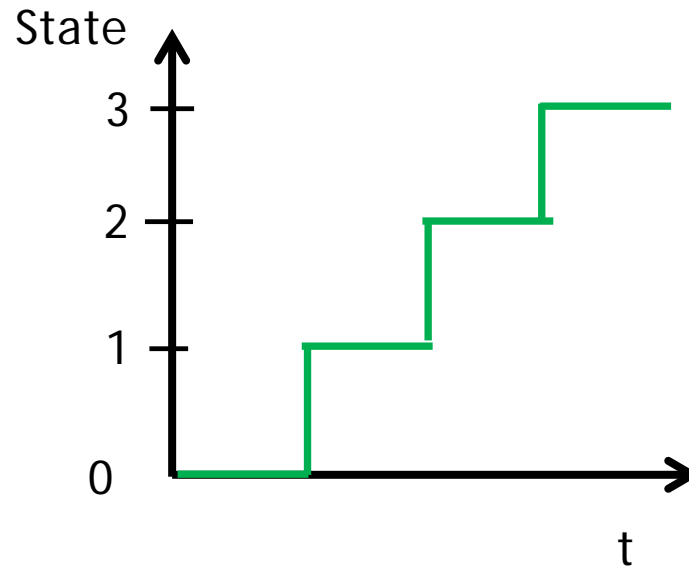
DIGITAL AND ANALOG

Using 2 bits to model full range of 255cm

Analog



Digital



DIGITAL AND ANALOG

Micro-controller must be able to process analog input from sensors



Digital Input



DIGITAL AND ANALOG

Not all sensor produce analog signals to computer.

Some sensors only has 2 state output like a switch

- ◉ On state
- ◉ Off State

These sensor produces signals that is seen as a digital Input to the computer. Thus computer can take in input from sensors main in 2 forms

- ◉ Digital Input
- ◉ Analog Input