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Module 3

Lecture 9:

SHM design : different structures

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I Components of STM system

Hardware components of STM system - 4 functional Modules

1. Sensor unit
2. Data acquisition Unit
3. Computational core
4. Wireless communication channel

} ⇒ STM system

Comments

(1) Commercially available hardware components will be used
- technical details will be examined for its versatility, availability & cost

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primary Objective of the STM design is that

"Arriving a layout of sensors costing lesser and functionally efficient"

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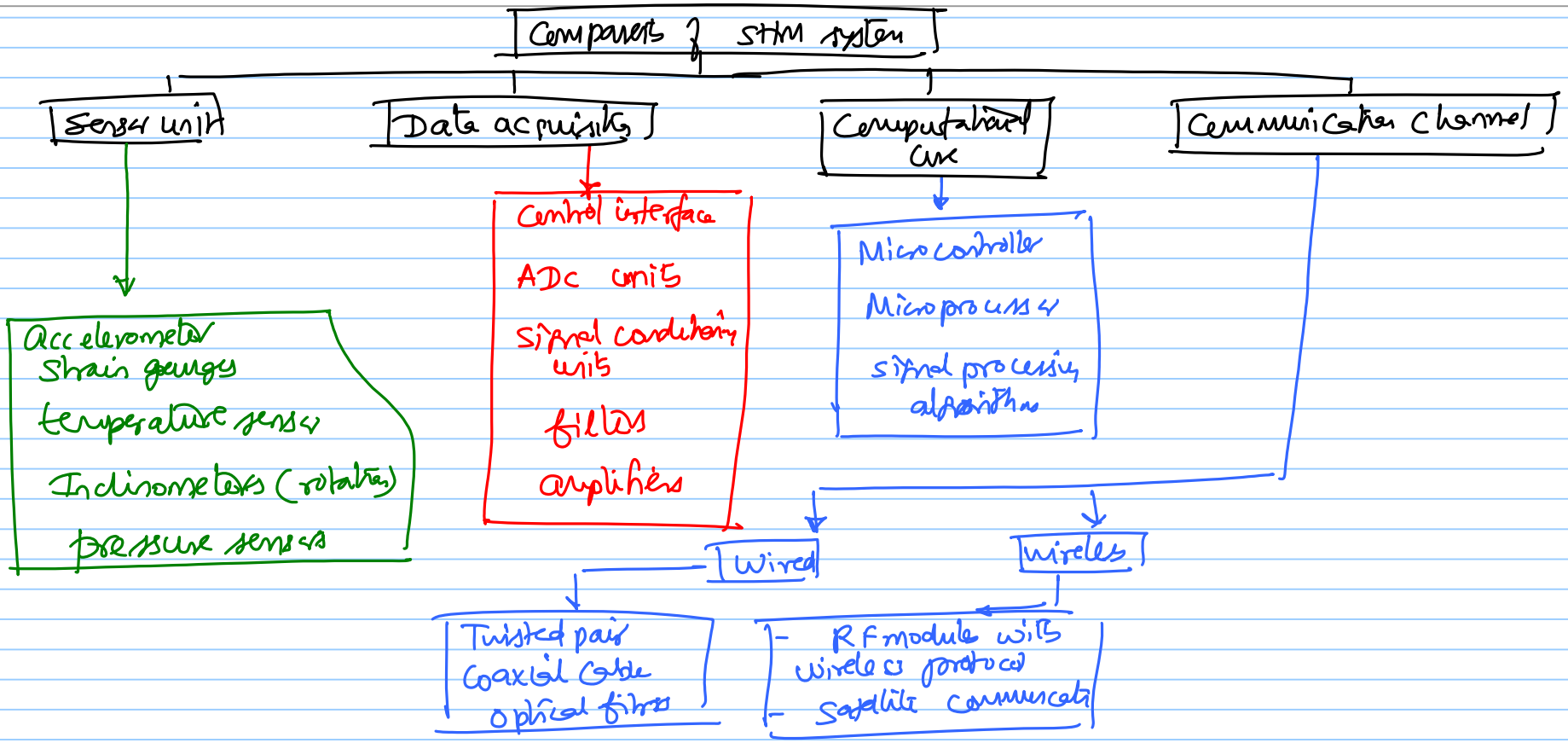

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(2) Sensing Unit

- fundamental blocks of SHM design
- sensor-based SHM system
  - measure (2) Quantity
    - (i) kinematic (acceleration, inclination, strain & displacement)
    - (ii) Environmental (temp, humidity, wind direction/speed etc)

- Wireless sensors are supposed to monitor both type of Quantity
- It also enforces level of monitoring
  - Different structure are massive
  - upto what level monitoring need to be done
  - extent, measurements are to be taken!

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Sensor technology – advancements are rapid

- sensors
- wireless – sensing unit
- smart – sensing units

Basic criteria

(1) Capability to capture both local & system-level response (extent)

(2) Capability to acquire data in both consistent & retrievable manner for long-term data processing & analysis

(3) Adaptability to operational conditions & environment

\\ sensors – are commercially available
– cost ↓ – production is massive

match: sensing, system capability

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(3) Data Acquisition Unit (DAQ)

- physically measures the response
- Hardware - to measure/receive the signal
  PC with a required software - to process the signals

  useful manner
  - graphical
  - tabular

  SMS/Text

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Basic parameters

- sampling rate
- resolution
- # of channels
- transducer type

commercial model – lab scale

SPIDER-8 DAQ

Catman Express software

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Wireless modules are chosen
- they match with DAQ capacity & that of wired ones.
- Sensing interface should be designed properly
  - It remain compatible with all types of sensors
  - appropriate sampling rate

Traditional SHM systems have
- Analog sensors
- ADC

@ DAQ end.

- MEMS sensor modules
  - also have in built ADC

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Additional factors

DAQ

(1) # of sensors

(2) Type/ variety of sensors

(3) Spacing b/w the sensors

(4) Specify b/w the sensor & DAQ

- data degradation possibility (packet loss)
- Noise (filters)

frequency-control low-pass filters

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③ Computational Core (not a blind Analyzer
Intelligent source of producing out.
meaningful output/desired format)

- Micro-controller unit
  - inbuilt algorithms to interrogate the measured data
- is a combination of
  - (i) Data Storage
  - (ii) processing unit (needs hippocampus to store the measured data & also process it in the desired format)

Min- 256 KB RAM memory (Lab scale)
- data is stored/processed only on a temporary basis
- Should be transmitted / as early as possible

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- processor consists of expandable memory of SD cards
  operating system
  USB flash drive
  interface for external devices

- It is also programmed to perform customized operations
  - desired data collection
  - storage
  - processing
  - Transmission

  || as demanded by SDN

(retrieval is an important data step)

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④ Communication Channels

(i) Wireless channel

Design parameters are the following

(i) data rate
(ii) open space range
(iii) encoding reliability
(iv) radio band etc

They are decided based on the required functionality

- reliability
- range

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Adverse possibilities

(i) data loss due to interference reflection

(ii) path loss.

addressed in the WSN design architecture

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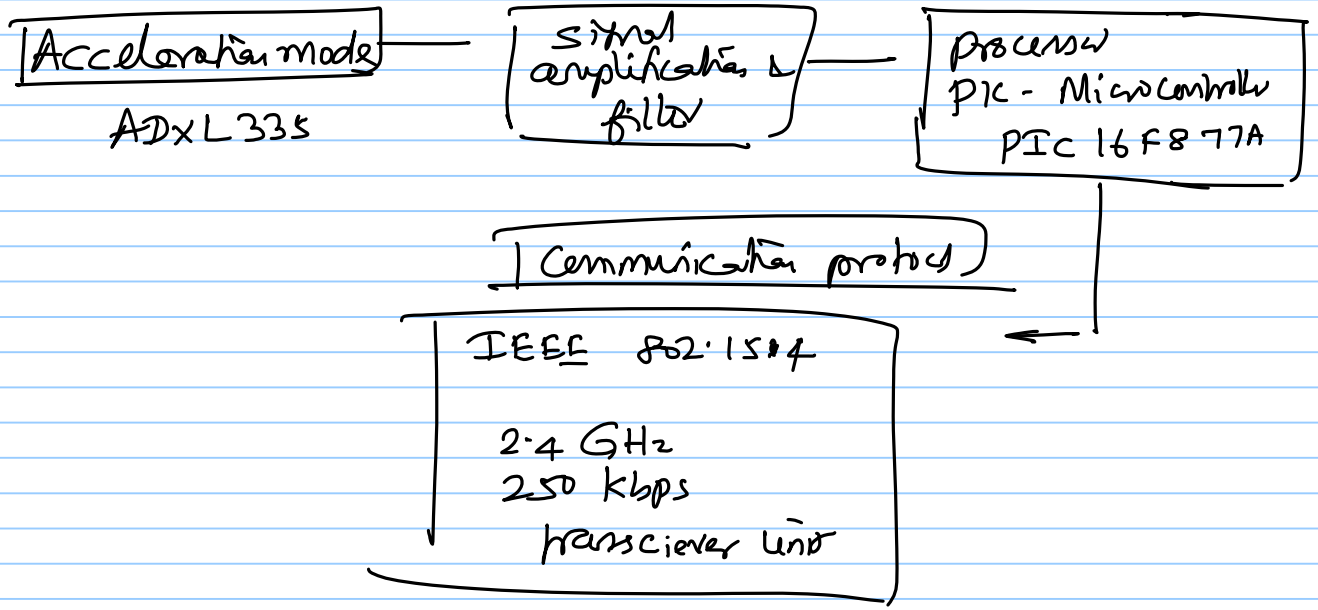
Wired communication channel



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Summary

modules of sthm design

- functionality of each module
- brief specifications Hardware/software each module
- Wired sensors - brief specifications

- Commercially available sensors, DAQ, communications & compute core
  - adaptability @ lower cost
  - reliability