

Module 4

Lecture 5

STM-design② for Bus - III ✓

Processing unit of STM scheme

GPIO - read the connected sensor unit

- acts as an interface b/w the embedded processor via I2C, SPI.

Sampling rate is an important parameter is s/s.

- selected such that the device is able to detect the changes associated with the max signal frequency
- reconstruct the signal if the sampling rate is twice the max frequency component
- The max signal frequency \leq Nyquist frequency
- avoid oversampling
- ensure signal reconstruction
- lab scale, sampling rate is 40kHz
- max freq is $\leq 10\text{kHz}$ ($\leq \leq f_N$)

power optimization

— Challengin factor is STM. (retention memory)

processor vit — ④ different power modes

i) run mode is which all functionality of the core processor are powered up

ii) standby mode, where processor can quickly woken up & interrupt, till that time the core clock is shutdown but power circuits will remain active

iii) Shut-down mode (switched off)

iv) dormant mode, in which the core is powered down but cache is on.

To reduce the power consumption, standby Mode is followed

Source of power supply

- mobile power banks for an extended period of time during the experiments

In real time monitoring,

alternate sources of power supply

- 1) solar charger
- 2) special wall waste use parts
- 3) alkaline/rechargeable batteries (AA) with voltage regulator

power consumption can also be reduced by decreasing the sample

Idle rate is reduced to a minimum

- power consumption is reduced

(Alippi et al, 2010), a reduction of about 80% of the # of samples is the data without affecting the accuracy of the data will result in power saving to the devices

Communication channel

STM-II design, wireless communication channel.

- wireless data acquisition saves time money !! lots real time tests ✓
- wireless data - market ✓

IEEE 802.11 protocol

includes wi-fi ranging upto 10km.
with 100m antenna operating under
ideal conditions

IEEE 802.15.2 protocol

- lower power consumption is comparable to IEEE 802.15.4 protocol.
- range is about 300m for wireless sensor
- high gain is antenna

STM-32L1

IEEE 802.11 protocol is used | enables data transfer from the sensor node to the base station

operating freq is 2.4 GHz

- with adapter is connected to the processor board which transmits the data from sensor node to the central server

This ensure the full advantage

1) There is no packet loss | data

because the TCP layer will handle this
in the data layer if not

2) It can also detect any failed packets

- and retransmit them automatically

3) There is no misordering the order of the data

because the packets will be sorted based
on the header information

Design ensures a reliable delivery of data using TCP.

But, is real-time important?

Transmitting the chosen frequency range with the available standard protocol is challenging issue

- Choice for communications

- Voice over IP

- Broadband access

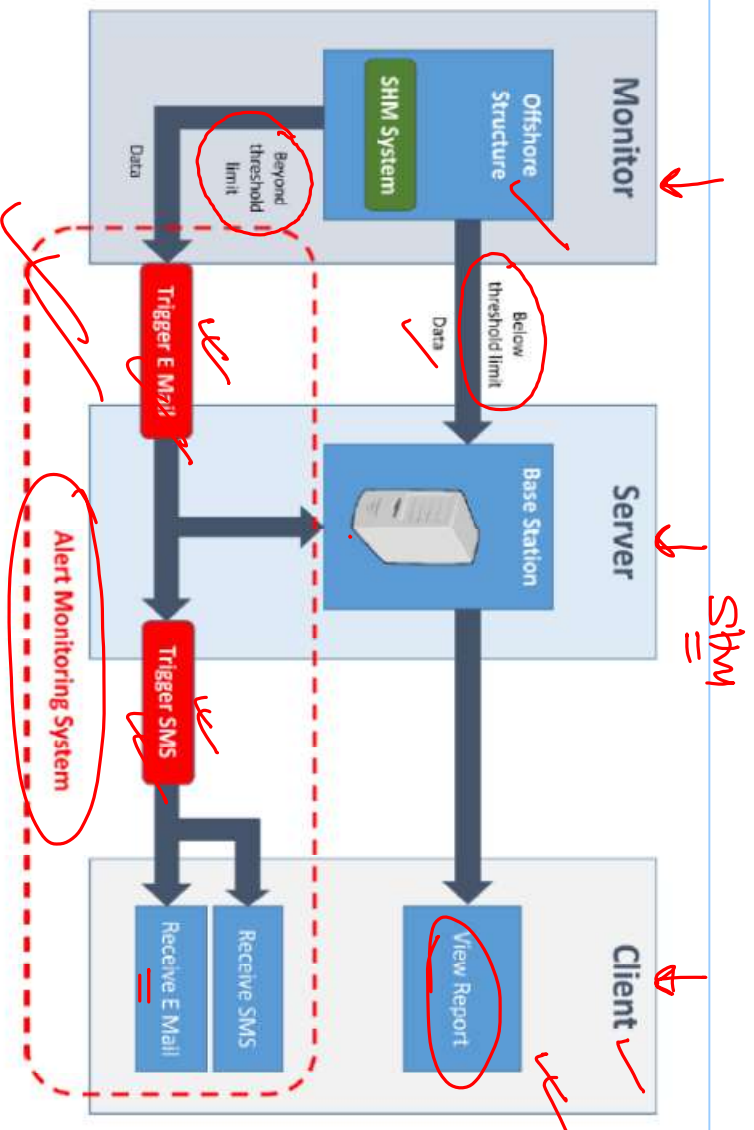
- Video communication

} different topology & network.

Improvements in satellite communication (VSATs)

Very Small Aperture Terminal

- can be used to enhance the communication efficiency
- because they can handle higher bandwidths
- other platforms



SHM depn-II (Lab Scale)
No media-aware configurations (sensors nodes & is number)

- Typical sensor node components of

transmit unit
 processing unit
 communication channel //

- When the structural system is idle, sensors are deployed to remain in sleep mode

- Even under a small displacement, that sensors will become active & start acquiring

- Locates of sensors.

- Chosen over the numerical analysis

- Sensor node & base station -
 single network

Alert Monitoring System

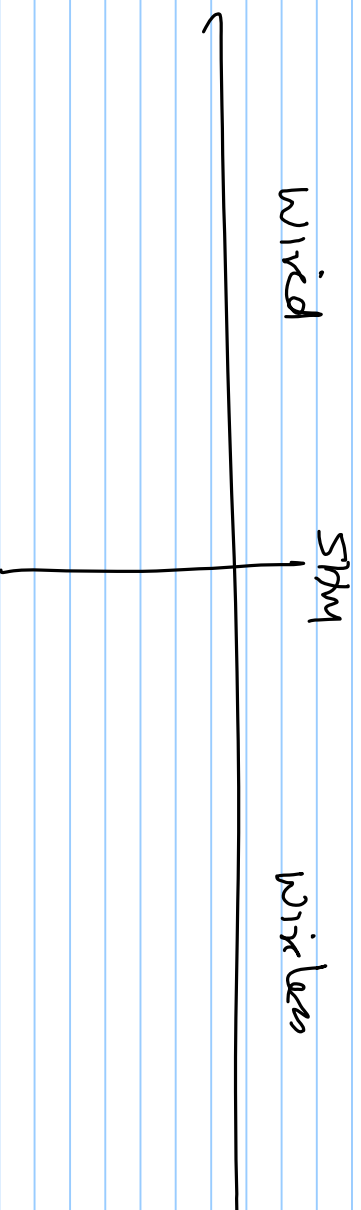
AMS

- generates reliable report when the acquired data exceeds the preset threshold value
- This communicates to Alert happens instantaneously.
- Threshold values are identified by bench marking the averaged previous records is non-critical condition (for the same situation)
- Exceedance to the threshold value - indicates danger & danger
 - danger location is known
 - danger exceedance is quantifiable
- appropriate actions for repair

On exceeding of threshold value,

- Processing unit will trigger an email alert
- Transmits the data to the back states
- Sensor is the back states will process this data and performs detailed analysis
- Subsequent an Alert Message will also be displayed in the user interface
- Alert message displayed on the monitor of the user reduces the workload on the Administrator
- SMS, triggers on the registered mobile no. (RMD) is an authenticated record of offense

- sensors used is STM-2 and to be calibrated for the lab environment
- wired accelerometers MPU 6050 chip
- Calibrates in the present experiment was done using a shake table experiment



Wired	Wireless SHM System	
	I	II
With 393B04 PCB module and spider 8 DAQ	with PIC microcontroller and ADXL335 - 802.15.4 Protocol (SHM System-1)	with Raspberry pi and MPU6050 - 802.11.x Protocol (SHM System-2)
Sensors are physically connected	sensors are <u>not</u> physically connected	sensors are <u>not</u> physically connected, but work as <u>independent</u> module
Installation is complex and <u>time consuming</u>	Easy and quicker to setup	
Data Acquisition Unit will collect data from sensor unit	Central Server will collect the data from <u>sensor</u> nodes through 802.15.4 Protocol and then makes it visible in public domain	Local database will collect the data at sensor nodes itself and then transmits it through 802.11.x Protocol to make it visible in public domain
Central server should be <u>connected</u> through wires to the sensor nodes	No wired <u>connection</u> is required. Central server should be placed in proximity to acquisition node	Central server can be placed anywhere, as the database will be uploaded directly to the web server
Data loss is lesser for lesser distance of layout	Probability of data loss is high in comparison with that of wired network.	Probability of data is very less as the data is stored to a local database on the <u>system itself</u>
There is no noise interference	Signal to noise ratio is seen to be significant	Noise interference is comparatively lesser

Summary STM design

4) $STM < \frac{T}{II}$ architecture is 1st order, few features are necessary to be considered when real-time monitor

1) In real-time monitor, frequency range of the RT can be different, frequency should be chosen based on operating frequency band of the RT

2) Layout of sensors

sensor network is 1st order / interface b/w hardware is unaltered

- real-time monitor, bandwidth issues
gateway issues

for long-term monitoring.

- sensors should be embedded
- main challenge is human interaction with environment [1].

IEEE 802.11, used in lab scale
— is not compatible with all kinds of

Ocean Environment

all-encompassing

Voice over IP

broadband data

video communication devices