

Structural Health Monitoring (SHM)
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Lecture - 73
SHM design- 2 for BSLRP-Part1

Friends welcome to the 5th Lecture in Module 4. We will continue with the design of Structural Health Monitoring System, where the option of system design 2 is being attempted and we are now applying this SHM design 2 for buoyant leg storage regasification platform on a lab scale. The third lecture in the series which talks about the design of SHM on a lab scale.

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Module 4
Lecture 5
SHM - design 2 for BSLRP - III ✓

processing unit of SHM scheme

- GPIO - read the connected sensor units
- acts as an interface b/w the embedded protocols like I2C, SPI.

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In the last lecture we talked about the power and the processing units of the health monitoring scheme. We said that the GPIO pins can read or can be useful to read the connected sensor units, and also acts as an interface between the embedded protocols like I 2 C, S P I etcetera.

Now, friends the sampling rate of sense is very important is an important parameter in monitoring process; sampling rate is selected such that the device is able to detect the changes associated with the maximum signal frequency.

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Sampling rate is an important parameter is shown.

- selected such that the device is able to detect the changes associated with the maximum signal frequency.
- reconstruct the signal if the sampling rate is twice the maximum frequency component.
- the maximum signal frequency \ll Nyquist frequency
 - avoid oversampling
 - ensure signal reconstruction
- lab scale, sampling rate is 40Hz, maximum freq is \ll 10Hz (\ll FS)



Now, one can reconstruct the signal, if the sampling rate twice the maximum frequency ok. So, it is very important that the maximum signal frequency shall be much lower than the Nyquist frequency.

So, that you can avoid over sampling and you can ensure signal reconstruction. So, in the present study in the lab scale the sampling rate is taken as forty hertz and the maximum frequency is expected to be below 10 hertz, which is much lower than the Nyquist frequency. The next issue comes is the power optimization.

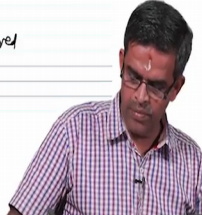

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power optimization

- challenge factor in system. (redefine parameters)

processor unit - ① different power modes

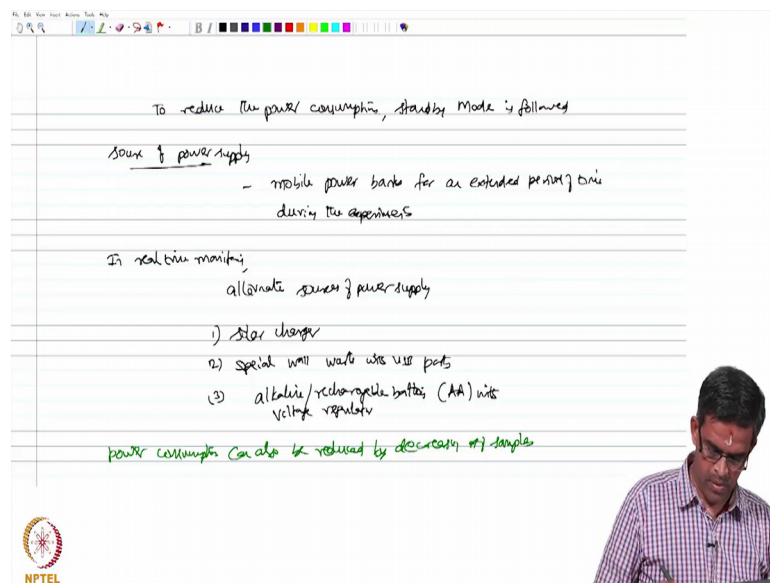
- full mode in which all functionality of the core processor are powered up
- standby mode, where processor can quickly woken up to alternate, but that time the core clocks are shutdown but power circuits will remain active
- shut-down mode (switched off)
- dormant mode, in which the core is powered down but cache is on



This is one of the challenging factors in structural health monitoring, when you really do a real time monitoring. In the lab scale it may not be that effective, but when you apply to a real time monitoring the power optimization is actually a big challenge. Now, if you look at the processor unit it has 4 different power modes one the run mode in which all functionality of the core processor or powered up. The second mode could be the standby mode where processor can quickly woken up and interrupt, till that time the core clocks are shut down, but interestingly the power circuits will remain active, that is the second mode.

Now, the third mode is completely shut down mode, the power is switched off and the fourth mode is called as dormant mode, in which the core is powered down, but the cache memory is on.

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Now, to reduce the power consumption on the processing unit, standby mode is followed generally. Now, the source of supply for power in the lab scale for the present system design is taken from the mobile power banks for an extended period of time during the experiments ok.

So, this is possible in lab scale, but in real scale is a challenge. So, what people generally do is the following in real time monitoring one can use alternate sources of power supply, namely one can use a solar charger, one can use a special wall warts with USB ports, one can also use alkaline batteries or rechargeable batteries, which are essentially

double a batteries, which are used of course, with a voltage regulator. You can also reduce the power consumption, but decreasing the number of samples.

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Data rate is reduced to a minimum
- power consumption is reduced
(Allipi et al, 2010), a reduction of about 80% of the no. of samples
in the data without affecting the accuracy of the data
will result in power savings to the sensors

Now, in that case data rate is reduced to a minimum thereby power consumption is reduced, look at the recommendation made by Allipi et al in 2010 the researchers say that a reduction of about 80 percent of the number of samples, in the data without affecting the accuracy of the data will result in power savings to the sensors.

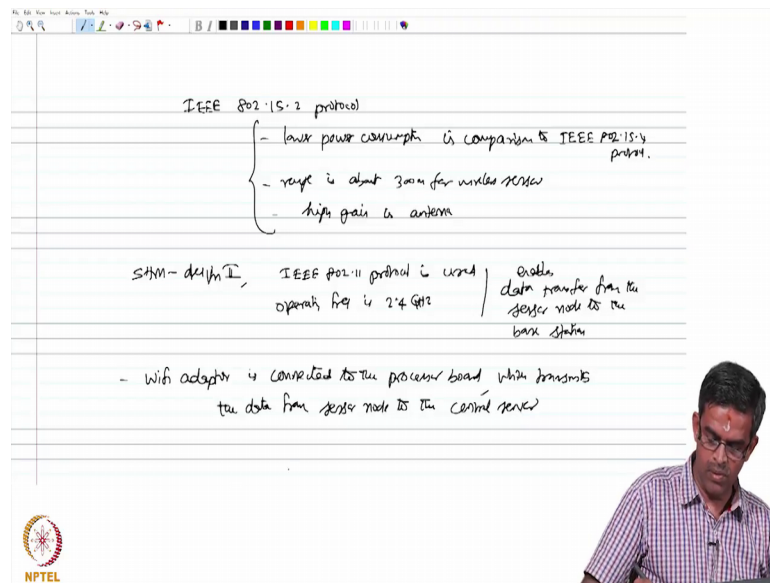
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Communication Channel
STM-II data, wireless communication channel.
- wireless data acquirers saves time many || bits resolution 10/100 ✓
- wireless data market ✓
IEEE 802.11 protocol
includes Wi-Fi range up to 10km.
Most Yagi antennas operate under ideal conditions

Then we talk about the communication channel in the design in the present SHM 2 design, we are using a wireless communication channel.

Now, we know that wireless data acquisition, saves, time, money, in both real time and (Refer Time: 12:13) lab scale. There are many wireless DAQ available in the market, some of them are I triple E 802.11 Protocol including, wifi ranging up to 10 kilometers with Yagi antennas operating under ideal condition.

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One can also use I triple E 802.15.2 protocol, which has a lower power consumption in comparison to I triple E A 0 2.15.4 protocol. The range is about 300 meters for the wireless sensors to be connected and there is a high gain in antenna signal. So, these are the positive points you can look for this particular protocol. Now in SHM design 2, which we were discussing currently I triple E 802.11 protocol is used the operating frequency is 2.4 gigahertz, this enables the data transfer from the sensor nodes to the base station.

Now in the design wifi adapter is connected to the board, which transmits the data from sensor node to the central server.

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This ensures the following advantages:

- 1) There is no packet loss of data because the TCP layer will handle this issue in the data layer itself.
- 2) It can also detect any failed packets and retransmit them automatically.
- 3) There is no mismatch in the order of the data because the packets will be sorted based on the header information.

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This ensures the following advantages; one there is no packet loss of data during transmission this is because the TCP layer will handle this issue in the data layer itself. Further it can also detect any failed packets and retransmits them automatically.

However, there is no mismatch of the data because the packets will be sorted based on the header information.

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Design ensures a reliable delivery of data using TCP.

But, in real-time applications, transmitting the chosen frequency range with the available standard protocol is challenging.

- Choice for communications:

- Voice over IP
- Broadband audio
- Video communications

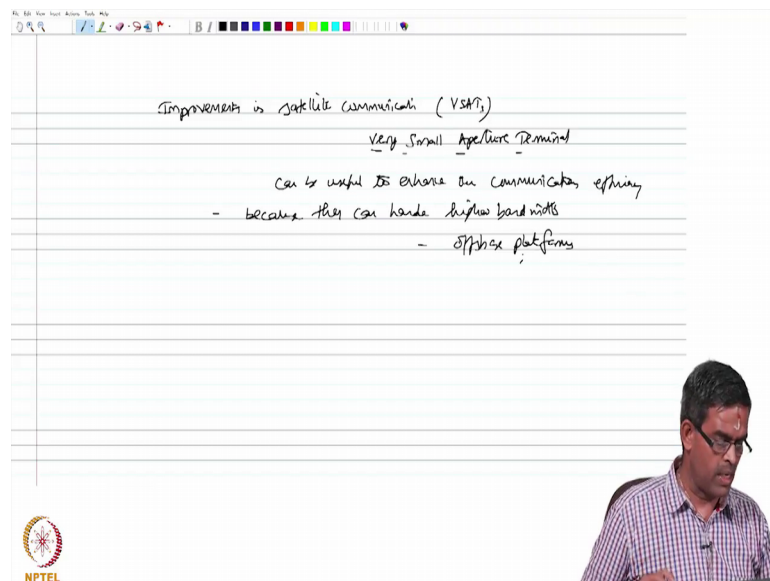
different analysis done.

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So, now the design ensures a reliable delivery of data using TCP, but in real time monitoring transmitting the chosen frequency range with the available standard protocol is a challenging issue.

So, in that cases the common choice for communication should be voice over IP, broadband data, and video communication services with different topology of sensors.

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The image shows a digital whiteboard interface with a toolbar at the top. The whiteboard contains the following handwritten text:

Improvements in satellite communication (VSATs)
Very Small Aperture Terminal
Can be useful to enhance the communication efficiency
- because they can handle higher bandwidth
- offshore platforms

In the bottom right corner, there is a small inset video of a man with glasses and a checkered shirt, who appears to be the presenter. The NPTEL logo is visible in the bottom left corner of the whiteboard area.

Further, improvements in satellite communication like VSATS nothing but very small aperture terminal. That is VSAT can be useful to enhance the communication efficiency, because they can handle higher bandwidth which is required for offshore platforms because a frequency bandwidth in this case is very broad.