Structural Health Monitoring (SHM)
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Lecture - 60
Part - 2: SHM design - Part 2

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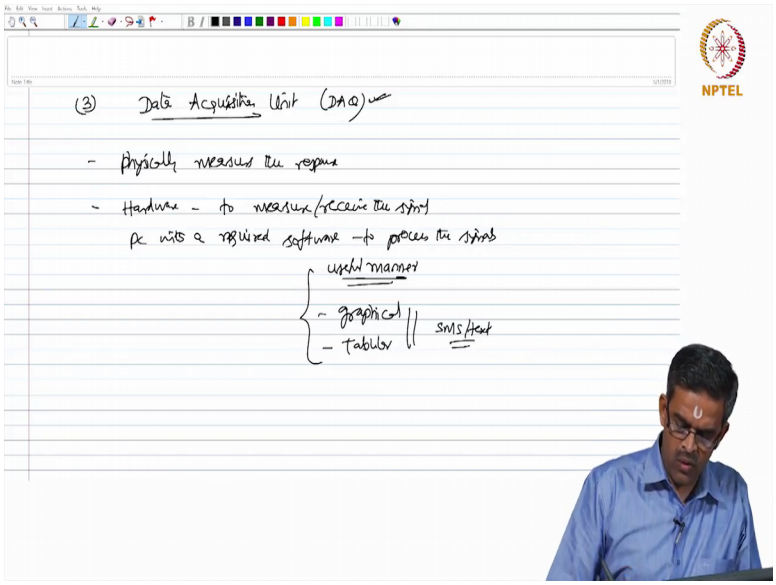

The next unit what we will talk about will be the Data Acquisition Unit, briefly known as DAQ. DAQ also actually physically measures the response. It has the hardware to measure the response or to receive at least this response. It also has pc with a required software to process the received signals, in an useful manner that is very very important. The signals as such are not useful we are got a convert them into an useful manner: maybe in a graphical form, maybe in a tabular form or at least a brief SMS text form.

So, all these job has got to be carried out by the data acquisition unit instantaneously once the signal is received.

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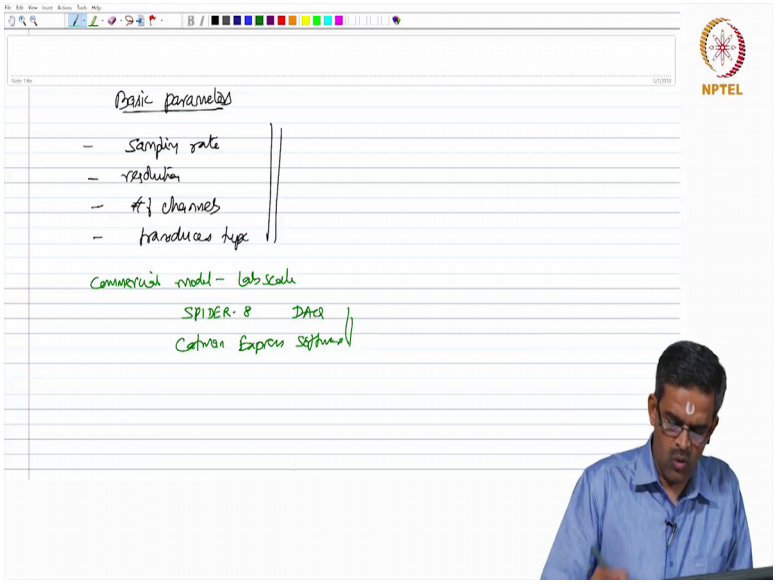

So, now the question comes what could be the basic parameters based on which the DAQ should be chosen for the design of SHM. One, it should be based on the sampling rate, it should also based on the resolution of the data you want to produce the number of channels you are connecting them in parallel, and the type of transducers you are using as sensors.

So, they are very very important because some of them will record analog signals and some of them may record digital signals. So, we need to handle them in the same frequency by using a converter which we call as an analog digital converter so that we have the same quality of message received from all kinds of transducer types to the data acquisition system in the upfront which is shown to the user or the monitor.

So, essentially in the present design we are trying to use a commercial model available in the lab scale. So, spider 8 is the DAQ data acquisition system used with the software supported as Catman Express which is going to process the data.

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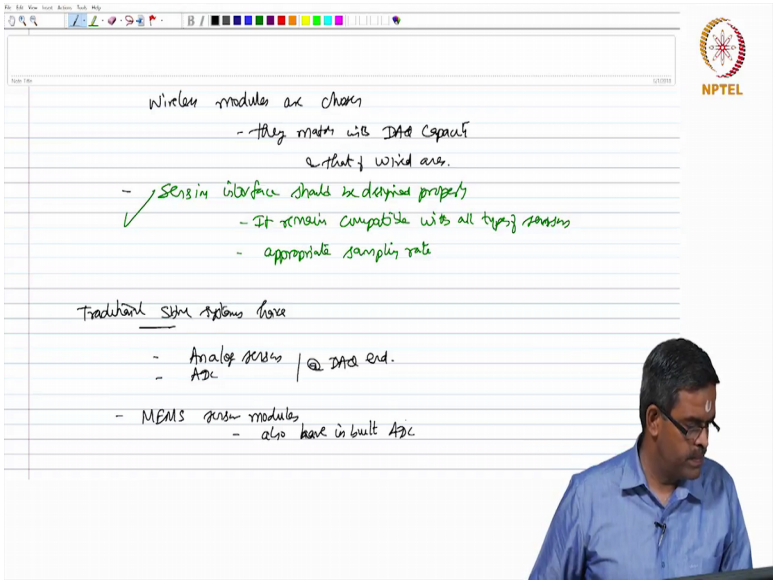

Now wireless modules are chosen, such that they match with the DAQ capacity and that of the wired once. It is very important that the sensing interface should be designed properly so that it remains compatible with all types of sensors. That is a challenge really but that is very very important step in the DAQ design, and for an appropriate sampling rate.

So now, let us see what are the traditional SHM system have, ok. Analog sensors with analog digital converter at the DAQ end. And most of the sensors are MEMS based because they occupy less space they are cheaper and they are more reliable. And these sensor modules also have very interestingly an inbuilt ADC; so, one of the factors which will also think about while designing DAQ.

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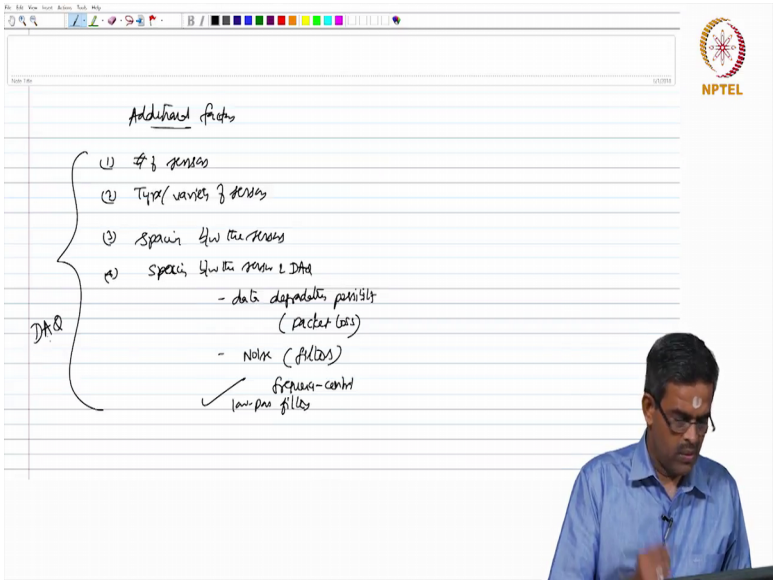

The additional factors could be: number of sensors to be used, type or variety of sensors to be used in the design, then spacing between the sensors- this controls the distance of wired sensors at least spacing between the sensors and DAQ. Because this going to control the data degradation possibility, what we call as packet loss in computational language; sometimes if the distance is too small or too large can also attract additional noise.

So, we need filters to control these noise by a specific frequency control filters, low pass filters etcetera. We need them to be all equip in the DAQ.

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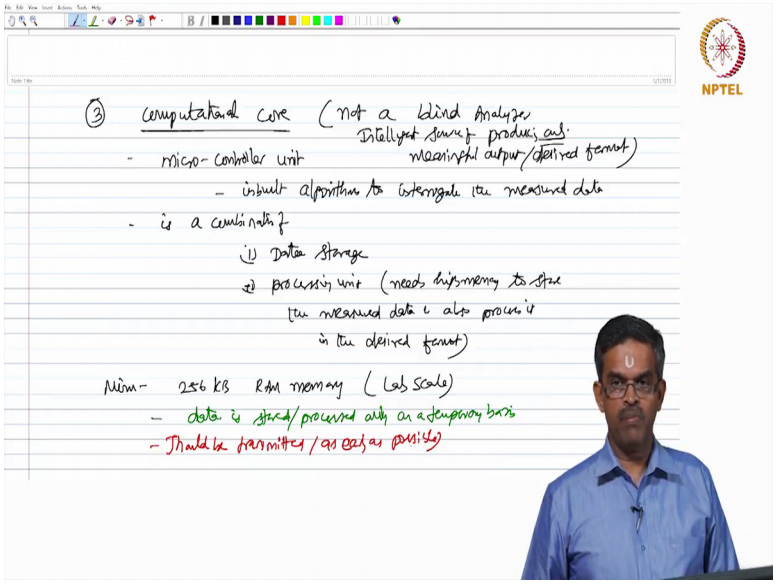

The third one is the computational core: it will be a microcontroller unit which has inbuilt algorithms to interrogate the measured data. So, nowadays please understand friends the computational core is not a blind analyzer, it is actually an intelligent source of producing only meaningful output in the desired format. That is very important, that is the requirement of the day.

Therefore our computational core should also address these issues when you design the SHM system for any structure in particular in this case a scaled model of an offshore platform. Therefore, computational core is a combination of data storage processing unit which of course needs very high memory to store the measured data and also process it, in the desired format.

So, the minimum requirement of the system could be 256 KB RAM memory. We are talking about the lab scale gentleman so do not get confused with the real time analysis. So that, the idea here is data is stored and processed only on a temporary basis. Then you may ask me a question what will happen to the data the data should be transmitted as early as possible. It is not going to act as a permanent data storage packet for the whole health monitoring system.

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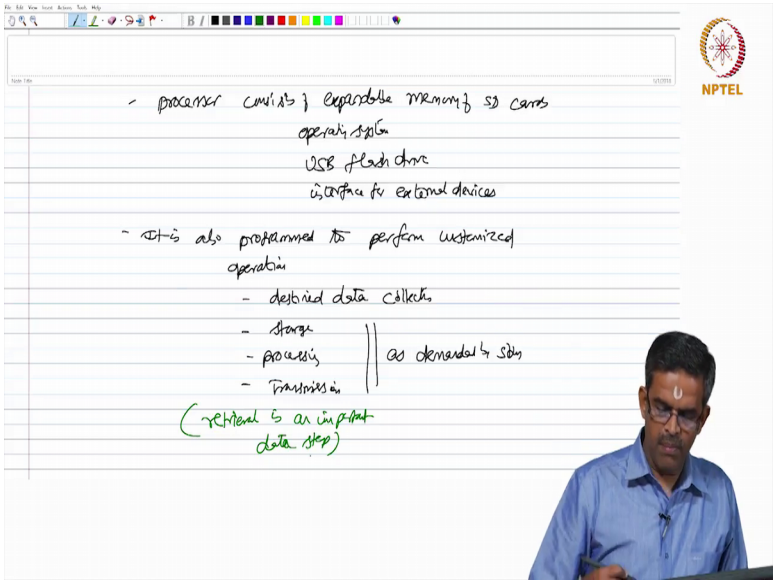

Now, the processor which is being used consists of expandable memory of SD cards, operating system, USB flash drives, interface for other external devices depending upon the number of pins required to access the processing unit. It is also programmed to perform customized operation like: destined data collection, storage, processing, and transmission as demanded by the SHM system.

So, here friends retrieval is also an important stage being performed, ok.

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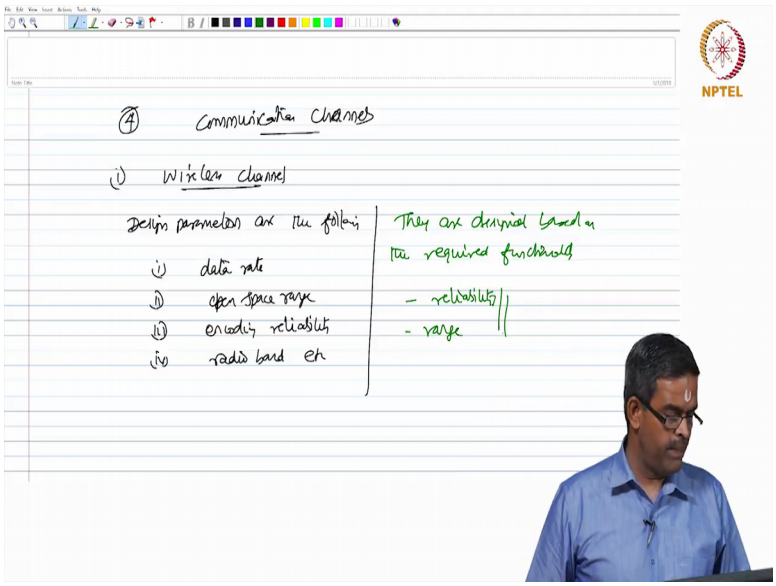

Again there are two channels here operating: one is wireless channel which we will discuss now. The design parameters which govern the design of wireless channel are the following: one, the data rate; two, open space range; three, encoding reliability; four, radio band etcetera.

So, the essential feature is they are designed based on the required functionality. The main parameters in choosing these sensors or the channel could be an range of communication.

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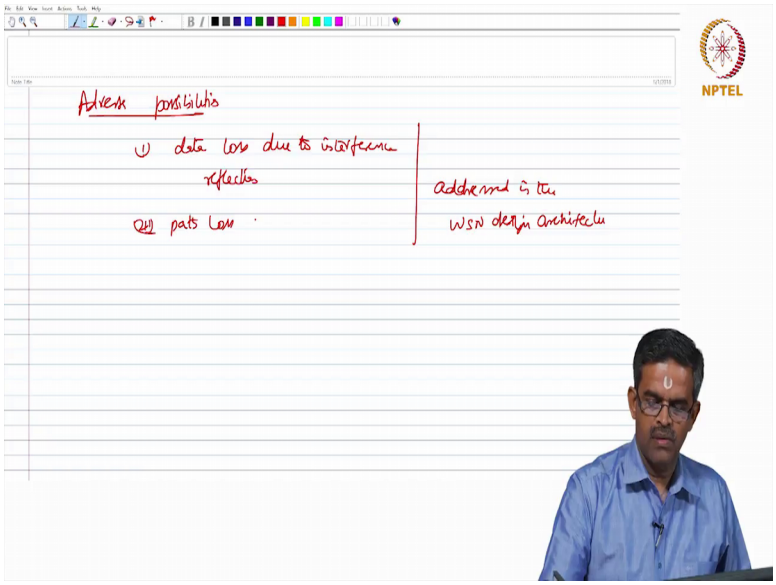

In case of wireless communication over a larger area there can be a possibility of data loss which are adverse possibilities could be data loss due to interference, reflections. It may also cause sometimes a path loss which need to be addressed in the wireless sensor network design architecture or wired communication system.

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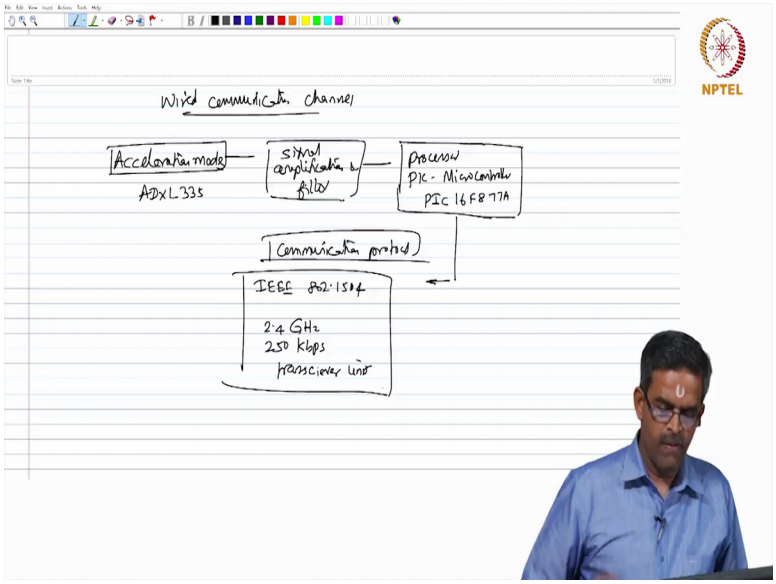

It has got an acceleration mode which essentially is ADXL 335 it has a signal amplification and filter unit which then takes it to the processor which essentially is PIC microcontroller which is in this case we are using PIC 16F877A. Then it may lead to the communication protocol which is essentially IEEE 802.15.4 a capacity specification of 2.4 Gigahertz 250 Kbps transceiver unit.

It is being used in the design an wired systems.

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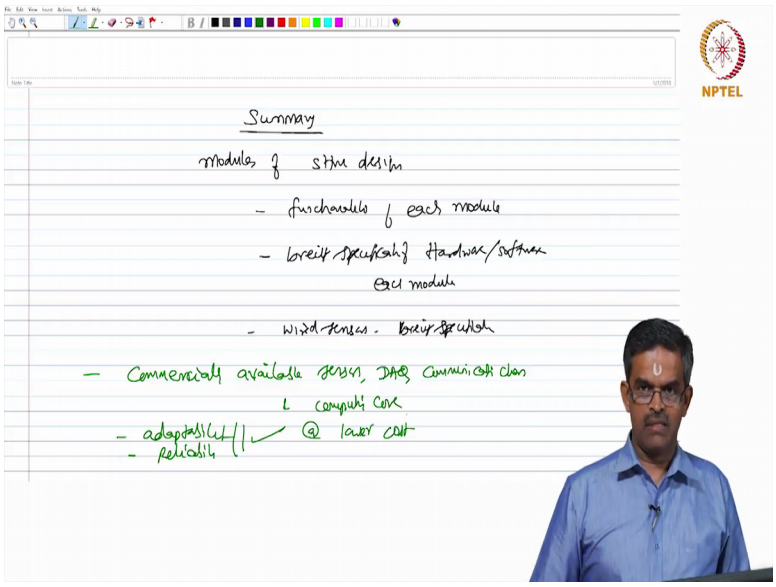

In this lecture we discussed about the modules of SHM design, various functionalities of each module, a brief specification of hardware and software which are used in each module. We also saw the requirements of wired sensors and a brief specification used in these modules. The essential goal was one should use commercially available sensors, acquisition system, communication channel, and computing code. So that adaptability, reliability, or ensure at lower cost. That is the idea.

We will continue to discuss this and its application consequences in an example problem of a scaled model of an offshore structure in the next lecture as well.

Thank you very much and bye.