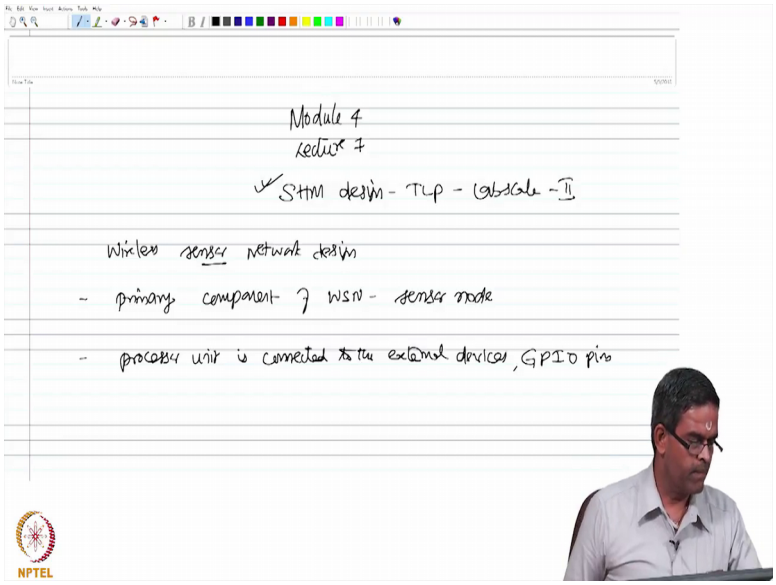
**Structural Health Monitoring (SHM)**
**Prof. Srinivasan Chandrasekaran**
**Department of Ocean Engineering**
**Indian Institute of Technology, Madras**

**Lecture – 77**
**Part - 1: Structural Health Monitoring (SHM) of lab scale model of TLP - II**

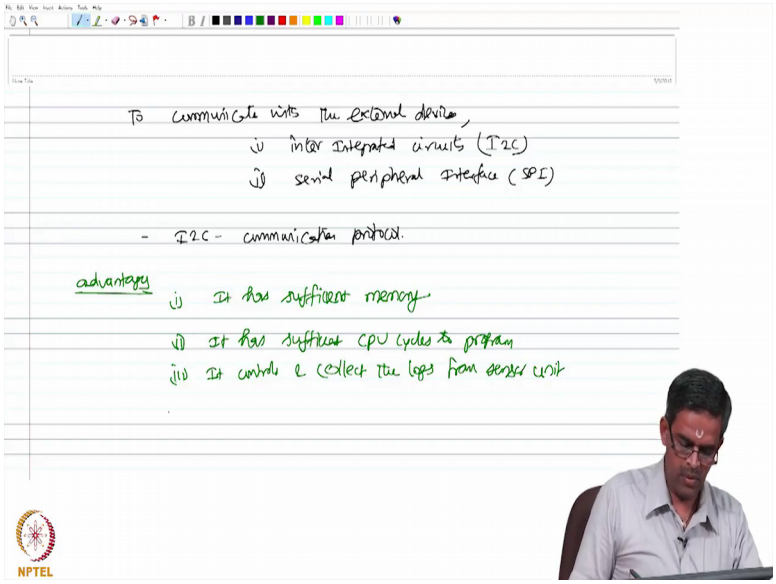
(Refer Slide Time: 00:21)




Welcome to the 7th lecture in module 4, where we are going to discuss about the structural health monitoring design, applied to tension leg platforms in lab scale, lecture 2. This is a continuation of the previous lecture number 6. So, let us continue to discuss what we had left in the last lecture.

We were talking about the wireless sensor, networking design. As I said in the last lecture the primary component of wireless sensor networking is the sensor node. The processor unit is connected to the external devices using general purpose input output pins with the external devices which are connected through the GPIO pins.

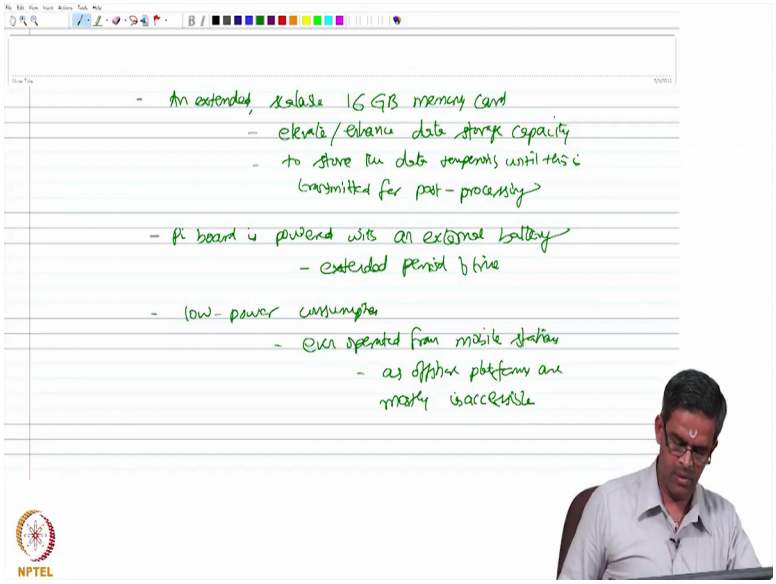
(Refer Slide Time: 01:36)




There are two options inter integrated circuits, which is I2C can be used or one can also use serial peripheral interface which is SPI. Any one of these protocols are generally used for such wireless communication in the present study we have used I2C communication channel or I should say communication protocol.

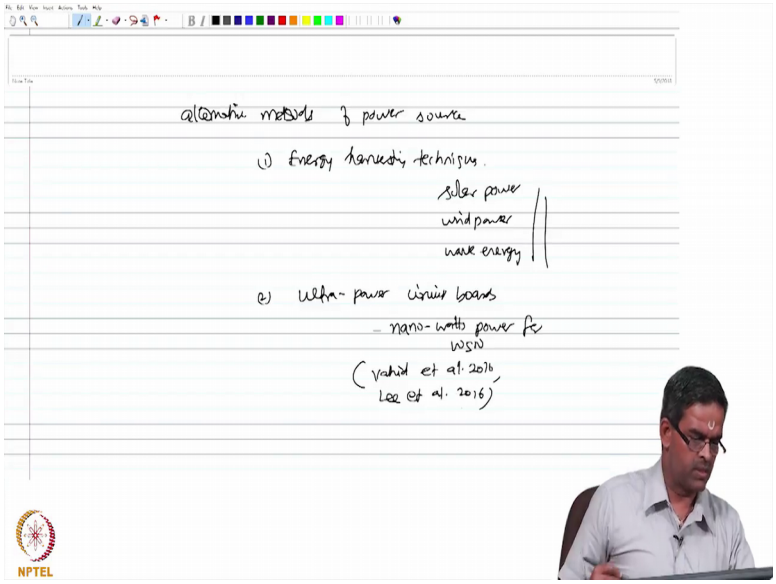
There are many advantage of using this, I am looking at the importants one. One is it has got a sufficient memory, it has sufficient to program, third from sensor units. So, this device is recommended to be used with an extended scalable memory card which is connected to elevate or let us say enhance the data storage capacity. This is required to store the data temporarily until for post processing.

(Refer Slide Time: 03:08)




The PI board is powered with an external battery which has the extended period of time to conduct the experiment. Sensors used have low power consumption, so that they can be even operated from mobile stations because that is required as offshore platforms or mostly inaccessible.

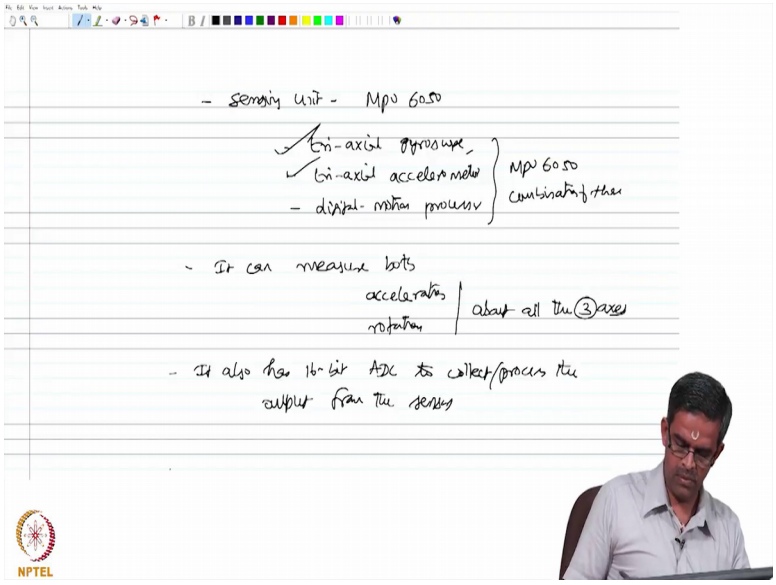
(Refer Slide Time: 04:58)




One can also use alternative methods of power, we also mentioned this in the previous lecture for the completion sake let us look into the details of alternative methods of power. One can use energy harvesting techniques like use of solar power, wind power,

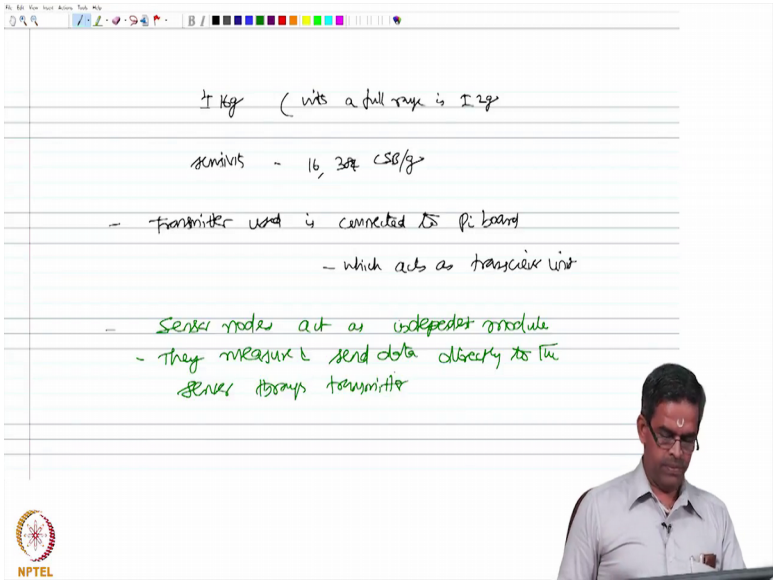
even wave energy for powering this SSM system. One can also alternatively use ultra power circuit boards which operate on nano watts for powering networking components. The details can be seen more at Vahid et al, 2016, Lee et al, 2016.

(Refer Slide Time: 06:12)




The sensing unit used in the present study is Mpu 6050 which is a combination of tri-axial gyroscope, accelerometer, motion processor. So, Mpu 6050 used in the present study is a combination of these. It can measure both, acceleration and rotation about all the 3 axes is a tri-axial component. It has 16 bit analog digital converter to collect and process the output from the sensors.

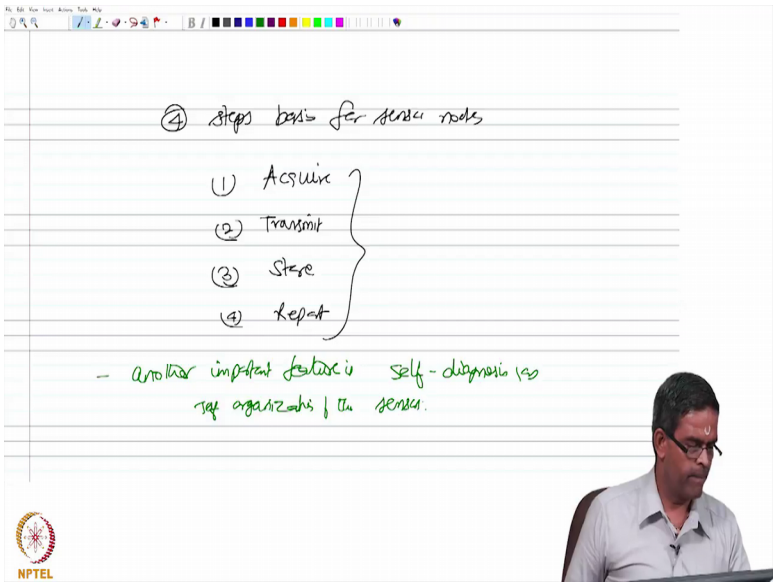
(Refer Slide Time: 07:36)




It can measure plus minus 16 g whereas, the full scale range is plus minus 2 g. The sensitivity is 16,384 LSB per g is connected to the Pi board which acts as a transceiver unit.

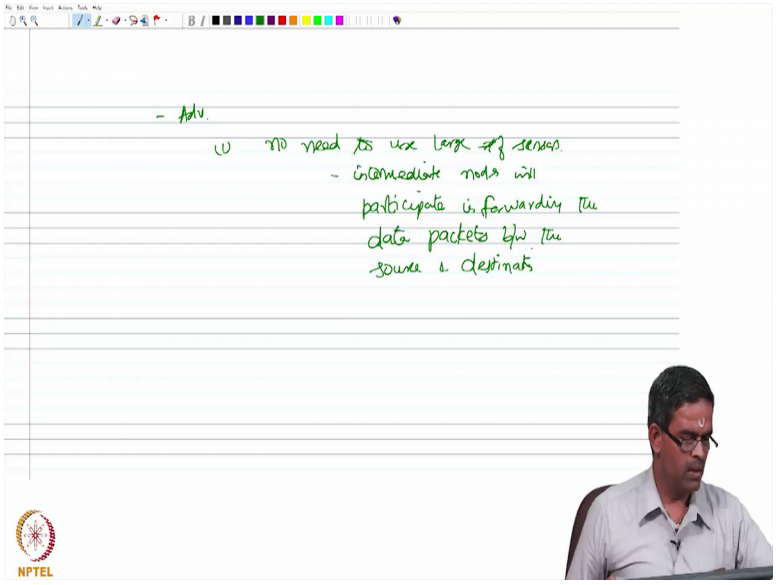
Now, most importantly in the wireless sensor networking sensor nodes act as independent module they measure and also send data directly to the server through transmitter.

(Refer Slide Time: 09:03)



Sensor nodes are implemented on 4 step basis, acquire transmit, store and report. The another important feature we have in this case is self diagnosis or I should say self organization of the sensors.

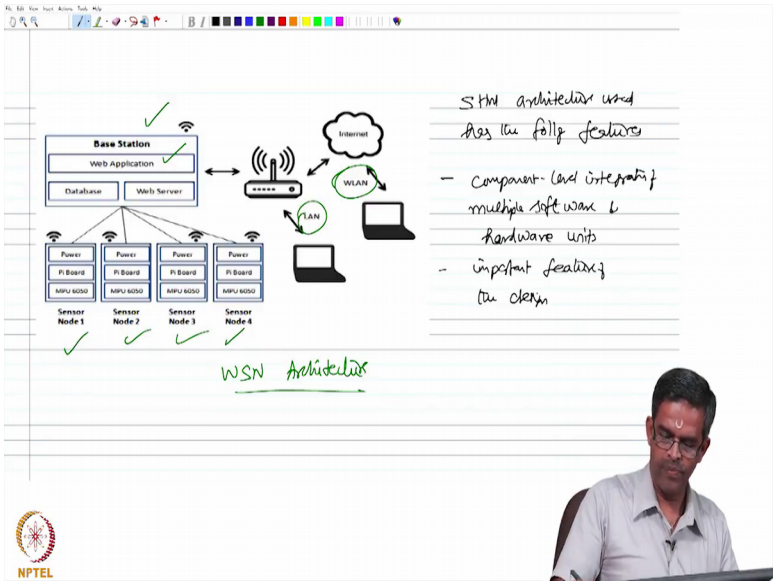
(Refer Slide Time: 10:02)




The advantages of this case could be no need to use large number of sensors because the intermediate nodes will participate in forwarding the data packets between the source and destination.

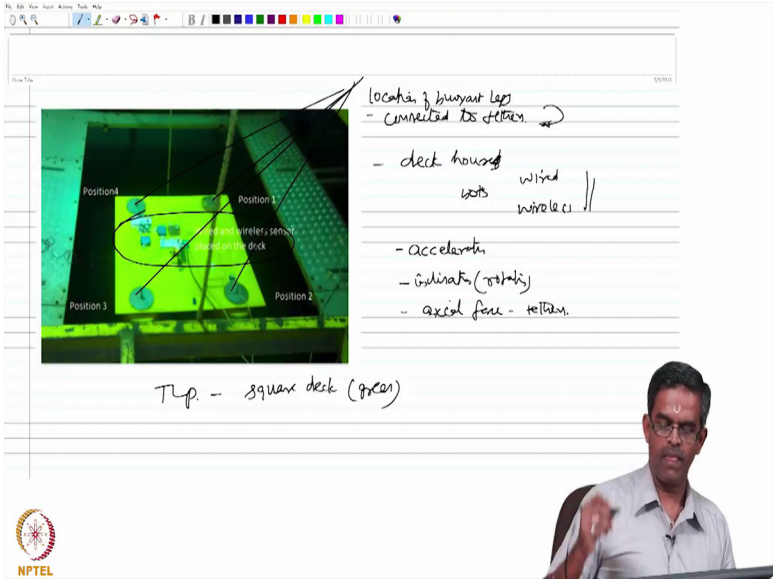
Let us look at the sensor architecture.

(Refer Slide Time: 10:37)



This is the wireless sensor networking architecture which is currently being designed and used for the TLP in experimental lab scale. There is a base station which has got a web application server, the sensors are connected to the base station using GPIO pins as we discussed. They communicate through intranet and receive and process either through LAN or wide LAN systems in the architecture given to store and process the data as we get has the following features.

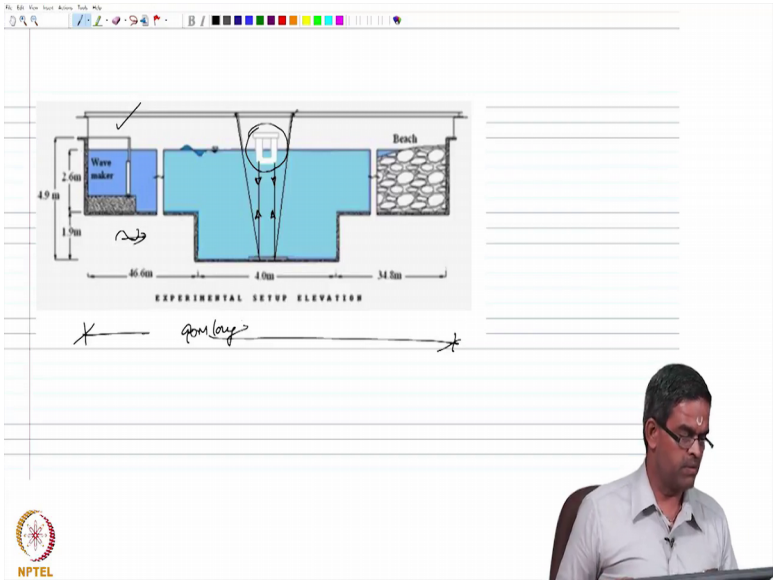
(Refer Slide Time: 12:01)




A component level integration of multiple software and hardware units which is an important feature of the design; the model what you see here is a tension like platform having a square deck which is painted in green in colour. All the 4 corners which I am marking here are the locations of buoyant legs which are further connected to the tethers which are marked as position 1 2 3 and 4 in a clockwise rotation or angle.

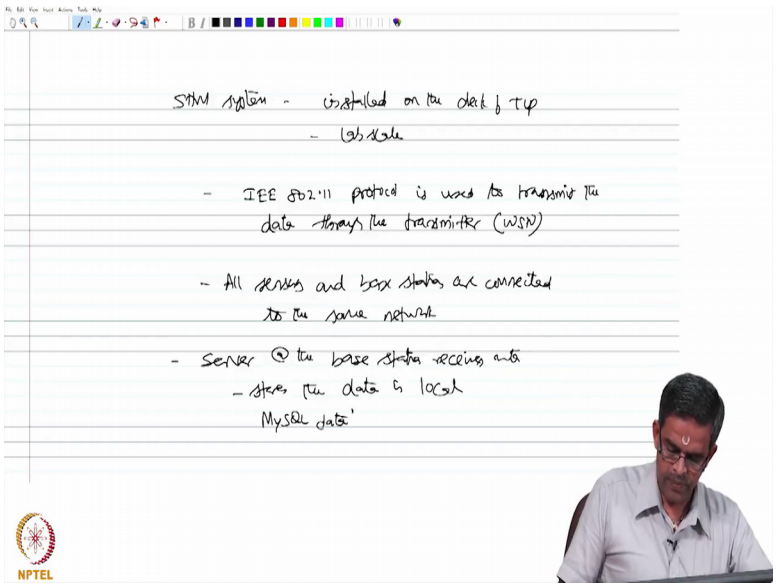
You can see here the deck houses both wired and wireless sensors, you see here. The wired sensors and wireless sensors are placed on the deck which has got capacity to measure acceleration, inclination, that what we call as rotation and of course, the axial force in the tethers.

(Refer Slide Time: 13:16)




The model is installed in the deep water wave flume as the teeters are subjected to axial tension, in about let us say in the deep water pit which is about 4.5 meters, from one end the wave is generated and other end. The wave is absorbed at the beach end it is about approximately 85-90 meters long. There is a tested which we discussed earlier as well, is installed on the deck of TLP on the lab scale.

(Refer Slide Time: 13:54)




Now, IEEE 802.11 protocol is used to transmit the data through the transmitter in case of wireless sensor networking. All sensors and base station or connected to the same

network. A server at the base station receives the data, stores the data in local my SQL database.