Strategy to implement Internet of things in thermal power plants A take on NTPC Dadri

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Abstract:

Thermal power plants are major source of electricity generation till date in our country and there are dedicated resources to handle the malfunction and faults which occurs at the site. Now a day with the advent of mobile technology,big data,wireless sensors, RFID & smart technologies and their interconnectivity with ability to share data have given the concept of Internet of Things (IoT).. The concept behind IoT is derived from data collected from LAN / Internet connected devices that can be used to develop new services, enhance productivity and efficiency improvement, real time decision making and solving critical problems. Now the problems can be solved in a much easier way. Currently the machines at local (hardwares) send the values to the server (DDCMIS/ maxDNA system –) and then those run time values will be further sent it to operator (in LVS) and if the condition is alarming and alarm starts display over LVS screen. Then an operator will try to reset the alarm and if it is not getting reset physical inspection is required to rectify the alarm so, the maintenance person has to travel to the hardware/machine. So it incurs some time to rectify the problem. With the advent of IoT the problem can be rectified early. The maintenance engineer will be equipped with the hand held devices like laptops, tablets, or some time mobile phones etc and an application is installed on them. The hardware sensor will continuously check the device in the range with the help Radar and NFC sensors and as soon as the device comes into the vicinity of the sensors an Alarm is sent to the device so that the problem can be rectified immediately. Recently at NTPC Dadri one application of IoT was distributed from which we can fetch data of AAQMS, CEMS, and EQMS on a real time basis. Apart from this RFID based boom barrier application has been installed to monitor traffic network in township. The present paper will give a driving philosophy to implement IoT in energy conservation or energy management in thermal power plant as well as early fault diagnosis in supply demand imbalances to manage grid efficiently also.

What is IoT – In easy words we can say IoT is an architecture which consists of web enabled devices that collect, send and act on data they acquire from their surrounding environments using embedded sensors, processors and communication hardwares.These smart devices are connected with cloud server via gateway devices and provide real time information to cloud/server which possess the detailed records about each and every device connected to it. The data transmitted through gateway is stored and processed surely within the cloud infrastructure using big data analytics engine. End users (like operation engineers working at OWS) can interact with the cloud using smart phones. These devices, can talk to other related device which is also called machine-to-machine (M2M) communication, and act on the information they get from one another.

How it is done (Enablers) - A number of enablers which help in implementation of IoT are cheap sensors, cheap bandwidth, mobile telephony, Wi-Fi , cloud computing, big Data, IPv6 , NFC and RFID. Then there are physical things like occupancy sensor, motion sensors, door locks or light bulbs The way smart sensors, transmitters and services and new technologies are advancing power sector is poised for the second digital revolution. Many leading companies like ABB, ALSTOM, Ericssion, Schneider Electric etc are working on IoT based system and their integration with power utilities for customized solutions. These developments will help in solving critical problems and early fault diagnosis.

IoT in Power Plant - Energy regulators are increasingly penalizing organizations that use inefficient assets or devices with a low power factor. CERC has raised the bar for compliance with energy standards and reduction in carbon footprints. Smart energy management systems (EMS), combined with the Internet of Things (IoT), provide the ideal solution for these pressing challenges by supporting radical changes in the way energy consumption is monitored and managed. EMS installed in NTPC Dadri can be used in implementation of IoT. Even DeiTY (Deptt of Elec. commn and IT) has given thrust on IoT in preview of SMART city . Recently URJA app launched by PFC is also an example in this regard.

IoT makes a **digital twin of power plant**. It uses two things majorly. First is **SCADA** – It allows the centralized monitoring and control of far-off generation and transmission systems and **AMI: AMI (Advanced metering infrastructure)** is a two-way communication system of smart devices on both the utility and customer sides of the meter. Component of smart Grid .Using analytics it generate scorecard and algorithms that allow individual devices to make better decision about operational parameter . Joint algorithm can be created for combined set of operation .EMS act as a central facilitator .Sensors also connected to internet through LAN to leverage information and smart decisions . IoT helps in Equipment efficiency, Root cause analysis, Predictive maintenance, Correction and Carbon emission reduction

Example :

Let us use IoT for cooling in a control room. Based upon the floor space area, the cooling or heating capacity needs to be determined; this should be greater than the expected maximum requirement for a given area and set of environmental conditions. This might require installation of multiple chillers with separate piping plans

Below are two scenarios where analytics enables smart insights for intelligent decision-making. Controlling operational parameters of chillers Commercial chillers operate by circulating chilled water into the rooms' water pipes. In each room, a number of blowers blow air over the chilled water pipes, in turn cooling the air and leading to air conditioning of the room. (The same mechanism is followed by central heaters; the only difference being that the water is heated instead of chilled.) This is a two-stage process of energy expenditure. First, energy is consumed in cooling the water that is then circulated through pipes that run in the rooms. In the second stage, energy is consumed by the blowers that blow air over the water chilled pipes. The ability to maintain a static temperature in a location depends upon a host of factors. These include the occupancy, weather conditions, chiller parameters, the temperature of chilled water, the blowers in the room, and other factors such as heat-producing items in the room. The IoT brings together information from all these controllable and uncontrollable factors for all sections in the building. The EMS then makes real-time decisions about the number of blowers to be switched on to maintain the required temperature in each room and achieve ergonomic comfort. However, the EMS needs smart algorithms to leverage the data and make intelligent real-time decisions. A set of scorecards also needs to be developed. One set of scorecards needs to consider the environmental conditions of the building and inform the EMS about the amount of energy required to chill the water to the required temperature. The EMS then computes the operational parameters at which the chiller should operate and sends this information to the chiller, enabling it to operate efficiently. The second set of scorecards needs to consider environmental conditions, occupancy patterns, information about the room, the number of blowers available, and past energy consumption patterns. Using this information, the scorecards can predict the amount of energy required to maintain a specific temperature in the room. Separate scorecards will be required for each room and each chiller. Figure 2 illustrates this process

Optimizing lighting The EMS monitors the Air Handling Unit parameters to maintain optimal air circulation for dynamic occupancy. This helps ensure that occupants can comfortably breathe and work in their respective rooms. With such a system in place, lighting can also be automatically turned on when the first person enters the room and automatically turned off in case the last person to exit the room forgets to do so. When granular occupancy information is available, the EMS effectively governs the required lighting for individuals who are entering or exiting. Similarly, the EMS can interact with workstations to determine if they can be turned off or not. The workstations send information to EMS over the LAN that no active thread is running and the EMS then validates that the user has, in fact, exited the building. It then sends instructions to the workstation to turn itself off.

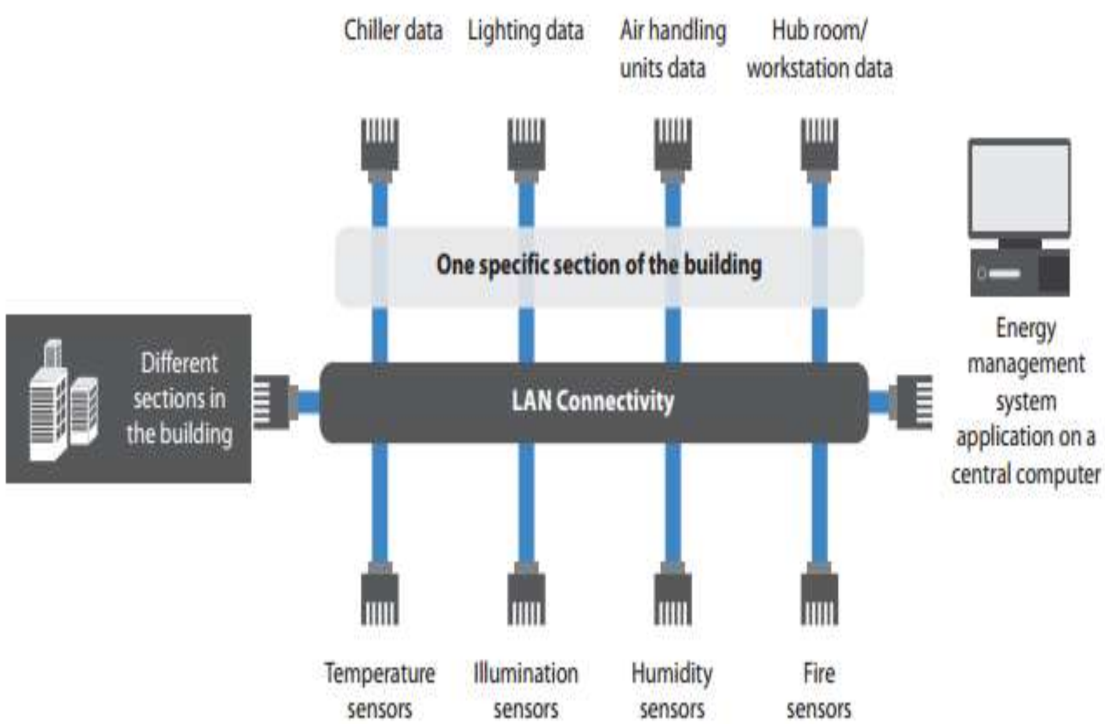
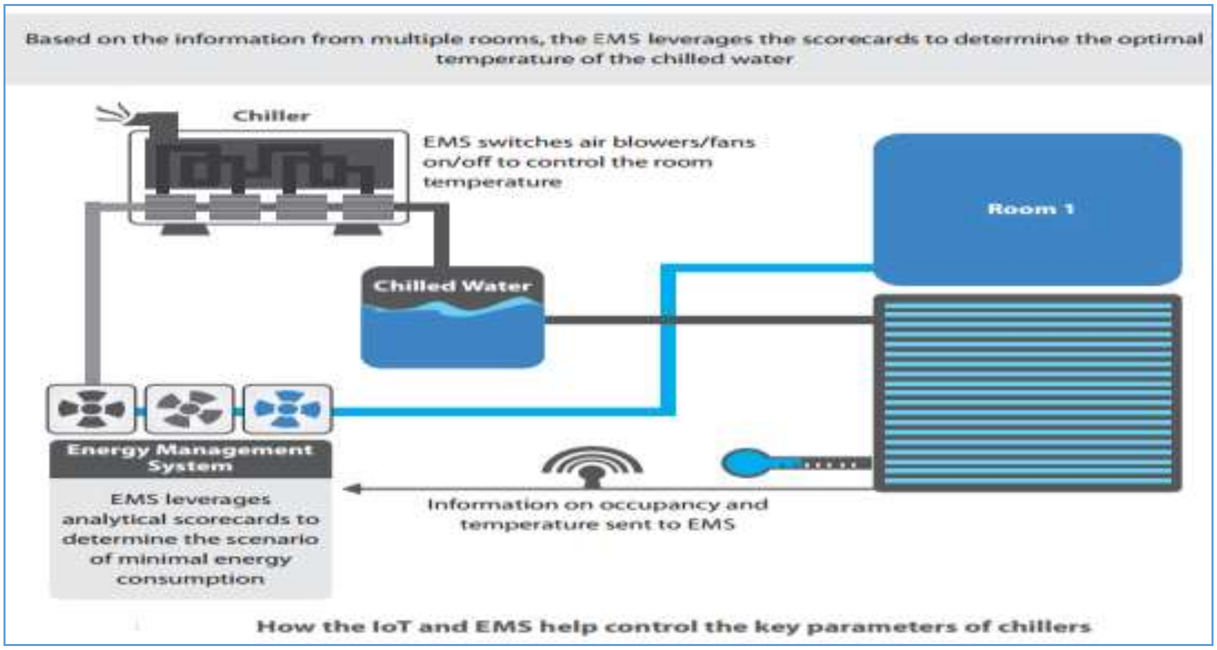
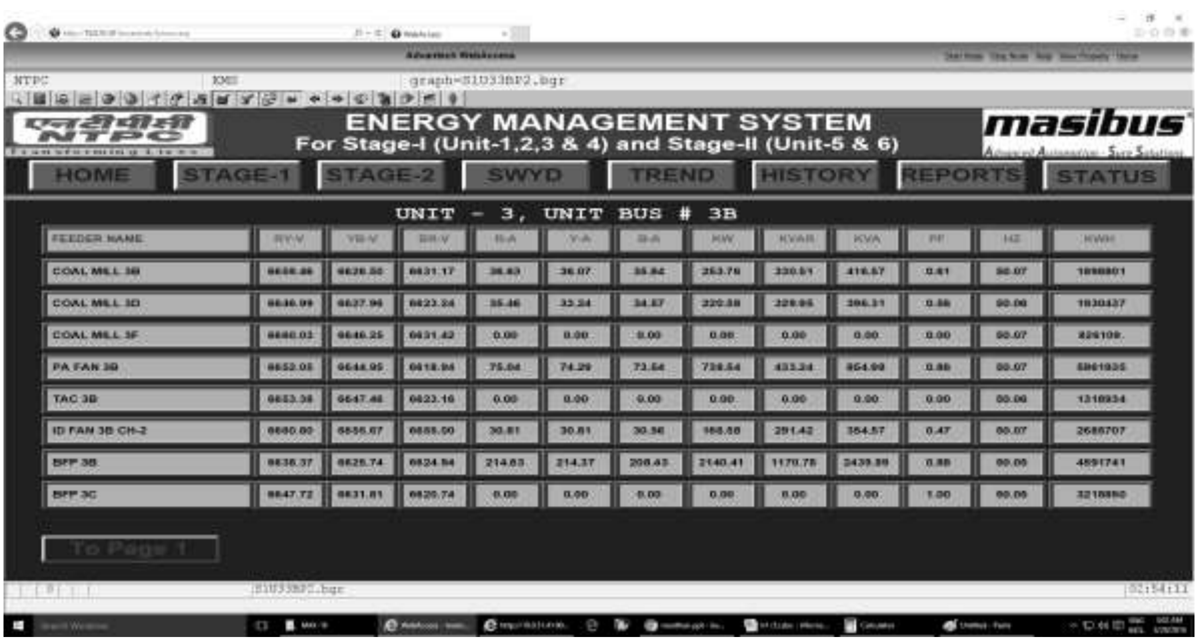


Figure 1: IoT based energy management system in buildings



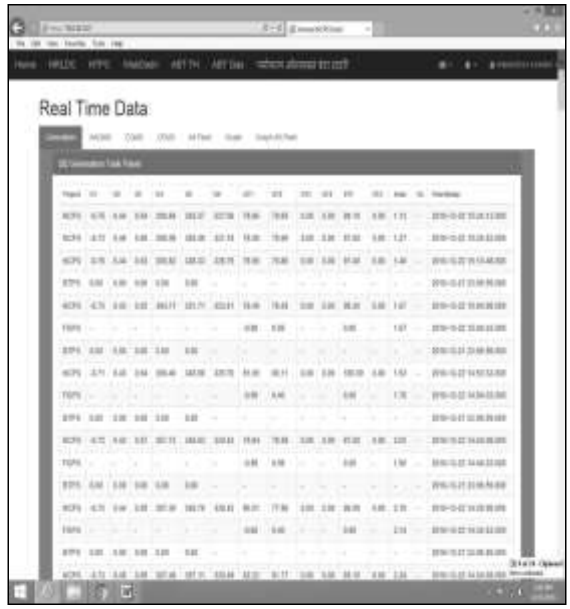
How the IoT and EMS help control the key parameters of chillers



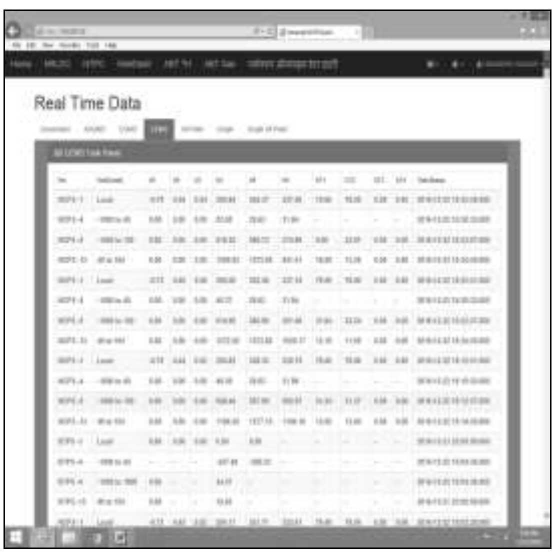
The EMS can also help control the devices when even direct communication between devices fails to serve the required purpose. In such cases, the system optimizes the operational parameters and broadcasts them to the respective devices over the LAN. On receiving the new instructions from the EMS, the devices change their operational parameters accordingly.

Application of IoT at NTPC Dadri presently: Recently at Dadri station IoT application was implemented to monitor emissions and generation data. The application ip address is 10.0.50.132. At this page we can login and see the real time data and emissions data at our smartphone or PC. Various snapshots are as followed :

Login page 10.0.50.132



Generation Data



CEMS Data

EMS/AAQMS data

EMS data is also going to be added into this database so that even from our smart phone only we can see and tell the behavior of amperage pattern of HT and LT drives. It will be easier to say that which BFP/ID/PA is taking high current and subsequent decisions can be taken care of like replacement of cartridges etc..

Formulation of architecture for application of IoT in Thermal power plants (Taking an example of ID Fan)

How to be done - Following are the stpes how to implement IoT in power plant.

1. To keep Radar sensors of NFC at each equipment is not a noble idea. It may be expensive. So high amperage driving equipment and critical machines are to be used for IoT. As for eg. For eg. BFP, Fans, CW pumps etc.

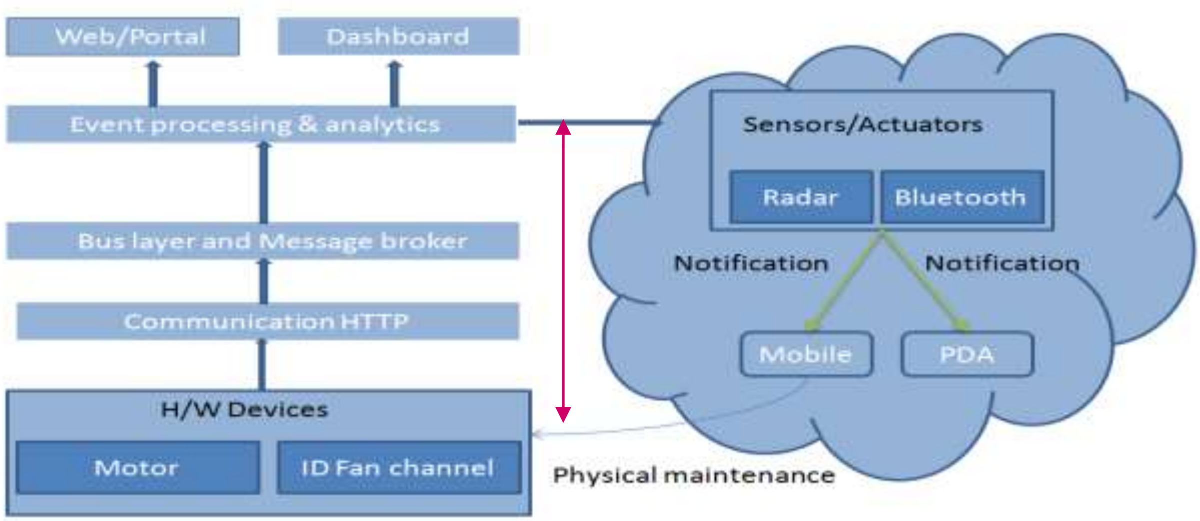
2. These sensors are driven by radar or Bluetooth or NFC based so there will be no need of any physical sensors.

3. If there is any deviation occurs like rise of bearing temperature , stopping off VFD blowers, vibration reading spikes etc alarm signal will go to communication HTTP and from there it goes to bus layer and message broker and then to event processing & analytics.

4. From event processing & analytics IoT sensors will give notification to Mobile, smart phone , PDA (personal digital assistant). PDA- It is also a hand held device where we can send text or mails.

5. From event processing & analytics alarm is also gone to dashboard / LVS depending upon the set value of alarm.

It's a type of pre alarm activation. Suppose there is tripping of fan at vibration level of 11m/s and there is spike of 7.5 mm/s and alarm value is set at 9 mm/s ; then at present situation (without IoT) alarm will not be sensed by operator. But If IoT is enabled then a TEXT of deviation will be automatically send to maintenance engineer. And pre failure problem diagnosis can be done. Diagram of architecture will be like as :



Conclusion

According to draft policy on IoT -2015, GOI is also planning to implement IoT based system n domain specific applications like smart city, smart water, smart environment, smart health, smart waste management, smart agriculture, smart safety , smart supply chain & logistics,smart manufacturing/ Industrial IoT. IoT doesn't function without cloud based applications to interpret and transmit the data coming from all the sensors & devices. The cloud is what enables the app to go to work for anything,anytime,anywhere. These developments will take time but is taking shape very fast. For power sector companies it means greater flexibility to accommodate new energy sources , better management of assets and operations,greater reliability, enhanced security, better customer service and enablement of new business models and services.

NTPC being a pioneer with a value of innovation and speed should take a step to become a mistake proof operation handling company.

References:

1. Draft policy of Internet of things by GOI-2015
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