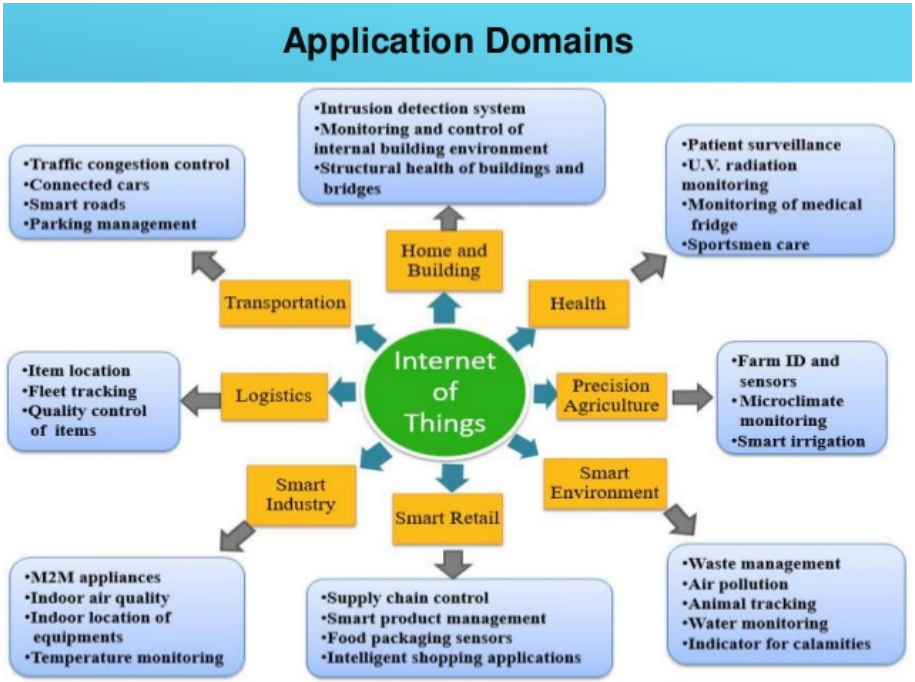
Case Study

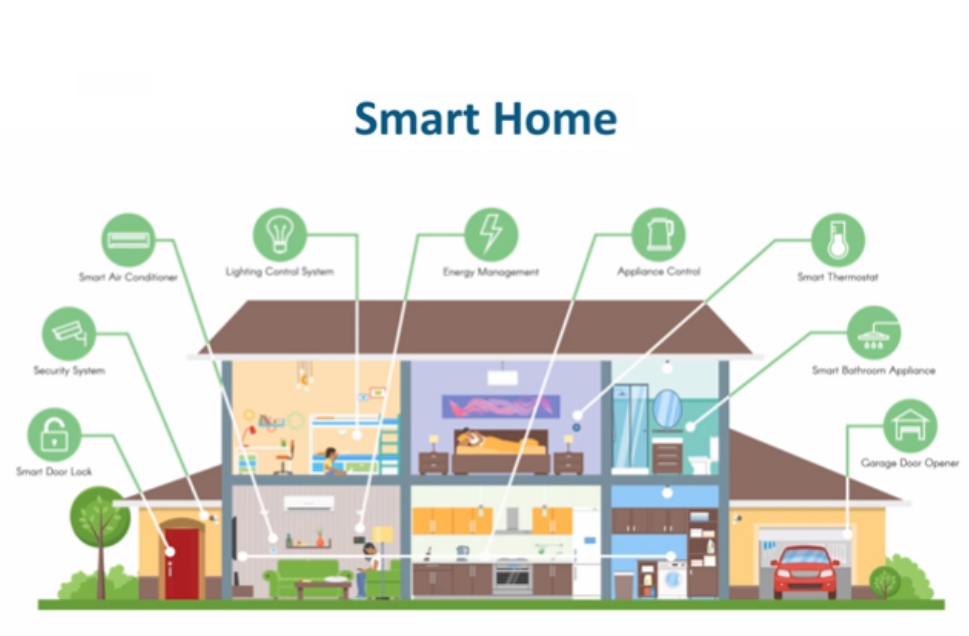
Internet of Things

Rahul Shandilya

IoT Case Study



Home Automation



Smart Lighting

Smart Lighting

- Smart lighting for homes helps in saving energy by adapting the lighting to the ambient conditions and switching on/off or dimming the lights when needed.

Smart Lighting

- Smart lighting for homes helps in saving energy by adapting the lighting to the ambient conditions and switching on/off or dimming the lights when needed.
- Key enabling technologies for smart lighting include solid state lighting (such as LED lights) and IP-enabled lights. For solid state lighting solutions both spectral and temporal characteristics can be configured to adapt illumination to various needs.

Smart Lighting

- Smart lighting for homes helps in saving energy by adapting the lighting to the ambient conditions and switching on/off or dimming the lights when needed.
- Key enabling technologies for smart lighting include solid state lighting (such as LED lights) and IP-enabled lights. For solid state lighting solutions both spectral and temporal characteristics can be configured to adapt illumination to various needs.
- Smart lighting solutions for home achieve energy savings by sensing the human movements and their environments and controlling the lights accordingly.

Smart Lighting

- Smart lighting for homes helps in saving energy by adapting the lighting to the ambient conditions and switching on/off or dimming the lights when needed.
- Key enabling technologies for smart lighting include solid state lighting (such as LED lights) and IP-enabled lights. For solid state lighting solutions both spectral and temporal characteristics can be configured to adapt illumination to various needs.
- Smart lighting solutions for home achieve energy savings by sensing the human movements and their environments and controlling the lights accordingly.
- Wireless-enabled and Internet connected lights can be controlled remotely from IoT applications such as a mobile or web application.

Smart Lighting

- Smart lighting for homes helps in saving energy by adapting the lighting to the ambient conditions and switching on/off or dimming the lights when needed.
- Key enabling technologies for smart lighting include solid state lighting (such as LED lights) and IP-enabled lights. For solid state lighting solutions both spectral and temporal characteristics can be configured to adapt illumination to various needs.
- Smart lighting solutions for home achieve energy savings by sensing the human movements and their environments and controlling the lights accordingly.
- Wireless-enabled and Internet connected lights can be controlled remotely from IoT applications such as a mobile or web application.
- Smart lights with sensors for occupancy, temperature, lux level, etc., can be configured to adapt the lighting (by changing the light intensity, color, etc.) based on the ambient conditions sensed, in order to provide a good ambiance.

- In controllable LED lighting system is presented that is embedded with ambient intelligence gathered from a distributed smart wireless sensor network to optimize and control the lighting system to be more efficient and user-oriented.

- In controllable LED lighting system is presented that is embedded with ambient intelligence gathered from a distributed smart wireless sensor network to optimize and control the lighting system to be more efficient and user-oriented.
- A solid state lighting model is implemented on a wireless sensor network that provides services for sensing illumination changes and dynamically adjusting luminary brightness according to user preferences.

- In controllable LED lighting system is presented that is embedded with ambient intelligence gathered from a distributed smart wireless sensor network to optimize and control the lighting system to be more efficient and user-oriented.
- A solid state lighting model is implemented on a wireless sensor network that provides services for sensing illumination changes and dynamically adjusting luminary brightness according to user preferences.

- In controllable LED lighting system is presented that is embedded with ambient intelligence gathered from a distributed smart wireless sensor network to optimize and control the lighting system to be more efficient and user-oriented.
- A solid state lighting model is implemented on a wireless sensor network that provides services for sensing illumination changes and dynamically adjusting luminary brightness according to user preferences.

Smart Appliances

Modern homes have a number of appliances such as TVs, refrigerators, music systems, washer/dryers, etc. Managing and controlling these appliances can be cumbersome, with each appliance having its own controls or remote controls.

- In controllable LED lighting system is presented that is embedded with ambient intelligence gathered from a distributed smart wireless sensor network to optimize and control the lighting system to be more efficient and user-oriented.
- A solid state lighting model is implemented on a wireless sensor network that provides services for sensing illumination changes and dynamically adjusting luminary brightness according to user preferences.

Smart Appliances

Modern homes have a number of appliances such as TVs, refrigerators, music systems, washer/dryers, etc. Managing and controlling these appliances can be cumbersome, with each appliance having its own controls or remote controls.

- Smart appliances make the management easier and also provide status information to the users remotely.

- In controllable LED lighting system is presented that is embedded with ambient intelligence gathered from a distributed smart wireless sensor network to optimize and control the lighting system to be more efficient and user-oriented.
- A solid state lighting model is implemented on a wireless sensor network that provides services for sensing illumination changes and dynamically adjusting luminary brightness according to user preferences.

Smart Appliances

Modern homes have a number of appliances such as TVs, refrigerators, music systems, washer/dryers, etc. Managing and controlling these appliances can be cumbersome, with each appliance having its own controls or remote controls.

- Smart appliances make the management easier and also provide status information to the users remotely.
- For example, smart washer/dryers that can be controlled remotely and notify when the washing/drying cycle is complete. Smart thermostats allow controlling the temperature remotely and can learn the user preferences.

- Smart refrigerators can keep track of the items stored (using RFID tags) and send updates to the users when an item is low on stock. Smart TVs allows users to search and stream videos and movies from the Internet on a local storage drive, search TV channel schedules and fetch news, weather updates and other content from the Internet.

- Smart refrigerators can keep track of the items stored (using RFID tags) and send updates to the users when an item is low on stock. Smart TVs allows users to search and stream videos and movies from the Internet on a local storage drive, search TV channel schedules and fetch news, weather updates and other content from the Internet.
- OpenRemote is an open source automation platform for homes and buildings.OpenRemote is platform agnostic and works with standard hardware.

- Smart refrigerators can keep track of the items stored (using RFID tags) and send updates to the users when an item is low on stock. Smart TVs allows users to search and stream videos and movies from the Internet on a local storage drive, search TV channel schedules and fetch news, weather updates and other content from the Internet.
- OpenRemote is an open source automation platform for homes and buildings.OpenRemote is platform agnostic and works with standard hardware.
- With OpenRemote, users can control various appliances using mobile or web applications.

- Smart refrigerators can keep track of the items stored (using RFID tags) and send updates to the users when an item is low on stock. Smart TVs allows users to search and stream videos and movies from the Internet on a local storage drive, search TV channel schedules and fetch news, weather updates and other content from the Internet.
- OpenRemote is an open source automation platform for homes and buildings.OpenRemote is platform agnostic and works with standard hardware.
- With OpenRemote, users can control various appliances using mobile or web applications.
- OpenRemote comprises of three components - a *Controller* that manages scheduling and runtime integration between devices, a *Designer* that allows you to create both configurations for the controller and create user interface designs and *Control Panels* that allow you to interact with devices and control them.

Intrusion Detection

- Home intrusion detection systems use security cameras and sensors (such as PIR sensors and door sensors) to detect intrusions and raise alerts.

Intrusion Detection

- Home intrusion detection systems use security cameras and sensors (such as PIR sensors and door sensors) to detect intrusions and raise alerts.
- Alerts can be in the form of an SMS or an email sent to the user. Advanced systems can even send detailed alerts such as an image grab or a short video clip sent as an email attachment.

Intrusion Detection

- Home intrusion detection systems use security cameras and sensors (such as PIR sensors and door sensors) to detect intrusions and raise alerts.
- Alerts can be in the form of an SMS or an email sent to the user. Advanced systems can even send detailed alerts such as an image grab or a short video clip sent as an email attachment.
- A cloud controlled intrusion detection system can be used, where the geo-location of each node of a home automation system is independently detected and stored in the cloud. In the event of intrusions, the cloud services alert the accurate neighbors (who are using the home automation system) or local police.

Intrusion Detection

- Home intrusion detection systems use security cameras and sensors (such as PIR sensors and door sensors) to detect intrusions and raise alerts.
- Alerts can be in the form of an SMS or an email sent to the user. Advanced systems can even send detailed alerts such as an image grab or a short video clip sent as an email attachment.
- A cloud controlled intrusion detection system can be used, where the geo-location of each node of a home automation system is independently detected and stored in the cloud. In the event of intrusions, the cloud services alert the accurate neighbors (who are using the home automation system) or local police.
- Intrusion detection system based on UPnP technology can be designed. The system uses image processing to recognize the intrusion and extract the intrusion subject and generate Universal-Plug-and-Play (UPnP-based) instant messaging for alerts.

Smoke/Gas Detectors

- Smoke detectors are installed in homes and buildings to detect smoke that is typically an early sign of fire.

Smoke/Gas Detectors

- Smoke detectors are installed in homes and buildings to detect smoke that is typically an early sign of fire.
- Smoke detectors use optical detection, ionization or air sampling techniques to detect smoke.

Smoke/Gas Detectors

- Smoke detectors are installed in homes and buildings to detect smoke that is typically an early sign of fire.
- Smoke detectors use optical detection, ionization or air sampling techniques to detect smoke.
- Alerts raised by smoke detectors can be in the form of signals to a fire alarm system, Gas detectors can detect the presence of harmful gases such as carbon monoxide (CO), liquid petroleum gas (LPG), etc.

Smoke/Gas Detectors

- Smoke detectors are installed in homes and buildings to detect smoke that is typically an early sign of fire.
- Smoke detectors use optical detection, ionization or air sampling techniques to detect smoke.
- Alerts raised by smoke detectors can be in the form of signals to a fire alarm system, Gas detectors can detect the presence of harmful gases such as carbon monoxide (CO), liquid petroleum gas (LPG), etc.
- A smart smoke/gas detector can raise alerts in human voice describing where the problem is, send or an SMS or email to the user or the local fire safety department and provide visual feedback on its status (healthy, battery-low, etc.).

Smart Cities

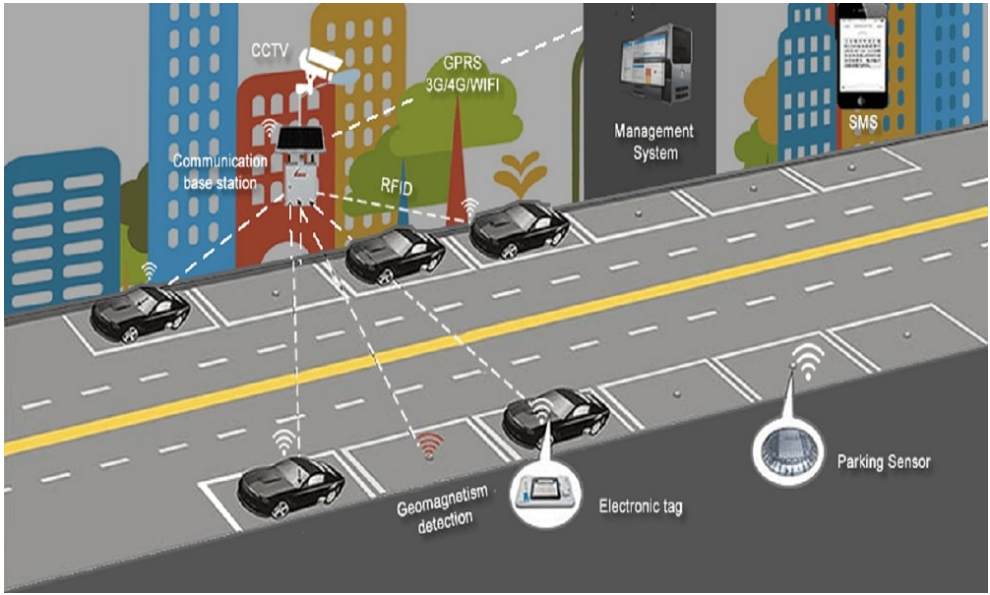
Smart Parking

- Smart parking make the search for parking space easier and convenient for Smart parking are powered by IoT systems that detect the number of empty parking slots and send the information over the Internet to smart parking application back-ends, These applications can be accessed by the drivers from smart-phones, tablets and in-car navigation systems

Smart Parking

- Smart parking make the search for parking space easier and convenient for Smart parking are powered by IoT systems that detect the number of empty parking slots and send the information over the Internet to smart parking application back-ends, These applications can be accessed by the drivers from smart-phones, tablets and in-car navigation systems
- In smart parking, sensors are used for each parking slot, to detect whether the slot is empty or occupied. This information is aggregated by a local controller and then sent over the Internet to the database.

Smart Parking



Smart Lighting

- Smart lighting systems for roads, parks and buildings can help in saving energy. Lighting is responsible for 19% of global electricity use and around 6% of global greenhouse gas emissions.

Smart Lighting

- Smart lighting systems for roads, parks and buildings can help in saving energy. Lighting is responsible for 19% of global electricity use and around 6% of global greenhouse gas emissions.
- Smart lighting allows lighting to be dynamically controlled and also adaptive to the ambient conditions.

Smart Lighting

- Smart lighting systems for roads, parks and buildings can help in saving energy. Lighting is responsible for 19% of global electricity use and around 6% of global greenhouse gas emissions.
- Smart lighting allows lighting to be dynamically controlled and also adaptive to the ambient conditions.
- Smart lights connected to the Internet can be controlled remotely to configure lighting schedules and lighting intensity.

Smart Lighting

- Smart lighting systems for roads, parks and buildings can help in saving energy. Lighting is responsible for 19% of global electricity use and around 6% of global greenhouse gas emissions.
- Smart lighting allows lighting to be dynamically controlled and also adaptive to the ambient conditions.
- Smart lights connected to the Internet can be controlled remotely to configure lighting schedules and lighting intensity.
- Custom lighting configurations can be set for different situations such as a foggy day, a festival, etc.

Smart Lighting

- Smart lighting systems for roads, parks and buildings can help in saving energy. Lighting is responsible for 19% of global electricity use and around 6% of global greenhouse gas emissions.
- Smart lighting allows lighting to be dynamically controlled and also adaptive to the ambient conditions.
- Smart lights connected to the Internet can be controlled remotely to configure lighting schedules and lighting intensity.
- Custom lighting configurations can be set for different situations such as a foggy day, a festival, etc.
- Smart lights equipped with sensors can communicate with other lights and exchange information on the sensed ambient conditions to adapt the lighting.

Smart Roads

- Smart roads equipped with sensors can provide information on driving conditions, travel time estimates and alerts in case of poor driving conditions, traffic congestions and accidents, Such information can help in making the roads safer and help in reducing traffic jams.

Smart Roads

- Smart roads equipped with sensors can provide information on driving conditions, travel time estimates and alerts in case of poor driving conditions, traffic congestions and accidents, Such information can help in making the roads safer and help in reducing traffic jams.
- Information sensed from the roads can be communicated via Internet to cloud-based applications and social media and disseminated to the drivers who subscribe to such applications.

Smart Roads

- Smart roads equipped with sensors can provide information on driving conditions, travel time estimates and alerts in case of poor driving conditions, traffic congestions and accidents, Such information can help in making the roads safer and help in reducing traffic jams.
- Information sensed from the roads can be communicated via Internet to cloud-based applications and social media and disseminated to the drivers who subscribe to such applications.
- The system can provide the drivers and passengers with a consistent view of the road situation a few hundred meters ahead of them or a few dozen miles away, so that they can react to potential dangers early enough.

Smart Roads

- Smart roads equipped with sensors can provide information on driving conditions, travel time estimates and alerts in case of poor driving conditions, traffic congestions and accidents, Such information can help in making the roads safer and help in reducing traffic jams.
- Information sensed from the roads can be communicated via Internet to cloud-based applications and social media and disseminated to the drivers who subscribe to such applications.
- The system can provide the drivers and passengers with a consistent view of the road situation a few hundred meters ahead of them or a few dozen miles away, so that they can react to potential dangers early enough.

Smart Roads

- Smart roads equipped with sensors can provide information on driving conditions, travel time estimates and alerts in case of poor driving conditions, traffic congestions and accidents, Such information can help in making the roads safer and help in reducing traffic jams.
- Information sensed from the roads can be communicated via Internet to cloud-based applications and social media and disseminated to the drivers who subscribe to such applications.
- The system can provide the drivers and passengers with a consistent view of the road situation a few hundred meters ahead of them or a few dozen miles away, so that they can react to potential dangers early enough.

Structural Health Monitoring

- Structural Health Monitoring consist a network of sensors to monitor the vibration levels in the structures such as bridges and buildings.

Smart Roads

- Smart roads equipped with sensors can provide information on driving conditions, travel time estimates and alerts in case of poor driving conditions, traffic congestions and accidents, Such information can help in making the roads safer and help in reducing traffic jams.
- Information sensed from the roads can be communicated via Internet to cloud-based applications and social media and disseminated to the drivers who subscribe to such applications.
- The system can provide the drivers and passengers with a consistent view of the road situation a few hundred meters ahead of them or a few dozen miles away, so that they can react to potential dangers early enough.

Structural Health Monitoring

- Structural Health Monitoring consist a network of sensors to monitor the vibration levels in the structures such as bridges and buildings.
- The data collected from these sensors is analyzed to assess the health of the structures. By analyzing the data it is possible to detect cracks and mechanical breakdowns, locate the damages to a structure and also calculate the remaining life of the structure.

- Using such systems, advance warnings can be given in the case of imminent failure of the structure.

- Using such systems, advance warnings can be given in the case of imminent failure of the structure.
- Since structural health monitoring systems use large number of wireless sensor nodes which are powered by traditional batteries, researchers are exploring energy harvesting technologies to harvest ambient energy, such as mechanical vibration, sunlight and wind.

- Using such systems, advance warnings can be given in the case of imminent failure of the structure.
- Since structural health monitoring systems use large number of wireless sensor nodes which are powered by traditional batteries, researchers are exploring energy harvesting technologies to harvest ambient energy, such as mechanical vibration, sunlight and wind.

- Using such systems, advance warnings can be given in the case of imminent failure of the structure.
- Since structural health monitoring systems use large number of wireless sensor nodes which are powered by traditional batteries, researchers are exploring energy harvesting technologies to harvest ambient energy, such as mechanical vibration, sunlight and wind.

Surveillance

- Surveillance of infrastructure, public transport and events in cities is required to ensure safety and security.

- Using such systems, advance warnings can be given in the case of imminent failure of the structure.
- Since structural health monitoring systems use large number of wireless sensor nodes which are powered by traditional batteries, researchers are exploring energy harvesting technologies to harvest ambient energy, such as mechanical vibration, sunlight and wind.

Surveillance

- Surveillance of infrastructure, public transport and events in cities is required to ensure safety and security.
- City wide surveillance infrastructure comprising of large number of distributed and Internet connected video surveillance cameras can be created.

- Using such systems, advance warnings can be given in the case of imminent failure of the structure.
- Since structural health monitoring systems use large number of wireless sensor nodes which are powered by traditional batteries, researchers are exploring energy harvesting technologies to harvest ambient energy, such as mechanical vibration, sunlight and wind.

Surveillance

- Surveillance of infrastructure, public transport and events in cities is required to ensure safety and security.
- City wide surveillance infrastructure comprising of large number of distributed and Internet connected video surveillance cameras can be created.
- The video feeds from surveillance cameras can be aggregated in cloud-based scalable storage solutions. Cloud-based video analytics applications can be developed to search for patterns or specific events from the video feeds.

Emergency Response

- ToT systems can be used for monitoring the critical infrastructure in cities such as buildings, gas and water pipelines, public transport and power substations.

Emergency Response

- ToT systems can be used for monitoring the critical infrastructure in cities such as buildings, gas and water pipelines, public transport and power substations.
- IoT systems for fire detection, gas and water leakage detection can help in generating alerts and minimizing their effects on the critical infrastructure.

Emergency Response

- ToT systems can be used for monitoring the critical infrastructure in cities such as buildings, gas and water pipelines, public transport and power substations.
- IoT systems for fire detection, gas and water leakage detection can help in generating alerts and minimizing their effects on the critical infrastructure.
- Using cloud-based architectures, multi-modal information such as sensor data, audio, video feeds can be analyzed in near real-time to detect adverse events.

Emergency Response

- ToT systems can be used for monitoring the critical infrastructure in cities such as buildings, gas and water pipelines, public transport and power substations.
- IoT systems for fire detection, gas and water leakage detection can help in generating alerts and minimizing their effects on the critical infrastructure.
- Using cloud-based architectures, multi-modal information such as sensor data, audio, video feeds can be analyzed in near real-time to detect adverse events.
- Response to alerts generated by such systems can be in the form of alerts sent to the public, re-routing of traffic, evacuations of the affected areas, etc

Emergency Response

- ToT systems can be used for monitoring the critical infrastructure in cities such as buildings, gas and water pipelines, public transport and power substations.
- IoT systems for fire detection, gas and water leakage detection can help in generating alerts and minimizing their effects on the critical infrastructure.
- Using cloud-based architectures, multi-modal information such as sensor data, audio, video feeds can be analyzed in near real-time to detect adverse events.
- Response to alerts generated by such systems can be in the form of alerts sent to the public, re-routing of traffic, evacuations of the affected areas, etc
- Smart traffic system adapts by dynamically adjusting traffic lights, changing related driving policies, recommending behavior change to drivers, and applying essential security controls.

Emergency Response

- ToT systems can be used for monitoring the critical infrastructure in cities such as buildings, gas and water pipelines, public transport and power substations.
- IoT systems for fire detection, gas and water leakage detection can help in generating alerts and minimizing their effects on the critical infrastructure.
- Using cloud-based architectures, multi-modal information such as sensor data, audio, video feeds can be analyzed in near real-time to detect adverse events.
- Response to alerts generated by such systems can be in the form of alerts sent to the public, re-routing of traffic, evacuations of the affected areas, etc
- Smart traffic system adapts by dynamically adjusting traffic lights, changing related driving policies, recommending behavior change to drivers, and applying essential security controls.
- Such systems can reduce the latency of emergency services for vehicles such as ambulances and police cars while minimizing disruption of regular traffic.

IoT for environment

Noise Pollution Monitoring

Due to growing urban development, noise levels in cities have increased and even become alarmingly high in some cities, Noise pollution can cause health hazards for humans due to sleep disruption and stress.

Noise Pollution Monitoring

Due to growing urban development, noise levels in cities have increased and even become alarmingly high in some cities, Noise pollution can cause health hazards for humans due to sleep disruption and stress.

- Noise pollution monitoring can help in generating noise maps for cities, Urban noise maps can help the policy makers in urban planning and making policies to control noise levels near residential areas, schools and parks.

Noise Pollution Monitoring

Due to growing urban development, noise levels in cities have increased and even become alarmingly high in some cities, Noise pollution can cause health hazards for humans due to sleep disruption and stress.

- Noise pollution monitoring can help in generating noise maps for cities, Urban noise maps can help the policy makers in urban planning and making policies to control noise levels near residential areas, schools and parks.
- IoT based noise pollution monitoring systems use a number of noise monitoring stations that are deployed at different places in a city.

Noise Pollution Monitoring

Due to growing urban development, noise levels in cities have increased and even become alarmingly high in some cities, Noise pollution can cause health hazards for humans due to sleep disruption and stress.

- Noise pollution monitoring can help in generating noise maps for cities, Urban noise maps can help the policy makers in urban planning and making policies to control noise levels near residential areas, schools and parks.
- IoT based noise pollution monitoring systems use a number of noise monitoring stations that are deployed at different places in a city.
- The data on noise levels from the stations is collected on servers or in the cloud. The collected data is then aggregated to generate noise maps.

Noise Pollution Monitoring

Due to growing urban development, noise levels in cities have increased and even become alarmingly high in some cities, Noise pollution can cause health hazards for humans due to sleep disruption and stress.

- Noise pollution monitoring can help in generating noise maps for cities, Urban noise maps can help the policy makers in urban planning and making policies to control noise levels near residential areas, schools and parks.
- IoT based noise pollution monitoring systems use a number of noise monitoring stations that are deployed at different places in a city.
- The data on noise levels from the stations is collected on servers or in the cloud. The collected data is then aggregated to generate noise maps.
- smart phone application can be designed that allows the users to continuously measure noise levels and send to a central server where all generated information is aggregated and mapped to a meaningful noise visualization map.

Forest Fire Detection

Forest fires can cause damage to natural resources, property and human life. There can be different causes of forest fires including lightening, human negligence, volcanic eruptions and sparks from rock falls.

Forest Fire Detection

Forest fires can cause damage to natural resources, property and human life. There can be different causes of forest fires including lightening, human negligence, volcanic eruptions and sparks from rock falls.

- Early detection of forest fires can help in minimizing the damage. IoT based forest fire detection systems use a number of monitoring nodes deployed at different locations in a forest.

Forest Fire Detection

Forest fires can cause damage to natural resources, property and human life. There can be different causes of forest fires including lightening, human negligence, volcanic eruptions and sparks from rock falls.

- Early detection of forest fires can help in minimizing the damage. IoT based forest fire detection systems use a number of monitoring nodes deployed at different locations in a forest.
- Each monitoring node collects measurements on ambient conditions including temperature, humidity, light levels, etc.

Forest Fire Detection

Forest fires can cause damage to natural resources, property and human life. There can be different causes of forest fires including lightening, human negligence, volcanic eruptions and sparks from rock falls.

- Early detection of forest fires can help in minimizing the damage. IoT based forest fire detection systems use a number of monitoring nodes deployed at different locations in a forest.
- Each monitoring node collects measurements on ambient conditions including temperature, humidity, light levels, etc.
- A forest fire detection system based on wireless sensor networks can be designed. These sensors send information to the cloud.

Forest Fire Detection

Forest fires can cause damage to natural resources, property and human life. There can be different causes of forest fires including lightening, human negligence, volcanic eruptions and sparks from rock falls.

- Early detection of forest fires can help in minimizing the damage. IoT based forest fire detection systems use a number of monitoring nodes deployed at different locations in a forest.
- Each monitoring node collects measurements on ambient conditions including temperature, humidity, light levels, etc.
- A forest fire detection system based on wireless sensor networks can be designed. These sensors send information to the cloud.
- AI or Machine Learning algorithm can take multi-criteria decision based on these data. The ANN fuses sensing data corresponding to multiple attributes of a forest fire (such as temperature, humidity, infrared and visible light) to detect forest fires.

River Floods Detection

River floods can cause extensive damage to the natural and human resources and human life. River floods occur due to continuous rainfall which cause the river levels to rise and flow rates to increase rapidly.

River Floods Detection

River floods can cause extensive damage to the natural and human resources and human life. River floods occur due to continuous rainfall which cause the river levels to rise and flow rates to increase rapidly.

- Early warnings of floods can be given by monitoring the water level and flow rate.

River Floods Detection

River floods can cause extensive damage to the natural and human resources and human life. River floods occur due to continuous rainfall which cause the river levels to rise and flow rates to increase rapidly.

- Early warnings of floods can be given by monitoring the water level and flow rate.
- IoT based river flood monitoring system use a number of sensor nodes that monitor the water level (using ultrasonic sensors) and flow rate (using the flow velocity sensors).

River Floods Detection

River floods can cause extensive damage to the natural and human resources and human life. River floods occur due to continuous rainfall which cause the river levels to rise and flow rates to increase rapidly.

- Early warnings of floods can be given by monitoring the water level and flow rate.
- IoT based river flood monitoring system use a number of sensor nodes that monitor the water level (using ultrasonic sensors) and flow rate (using the flow velocity sensors).
- Data from a number of such sensor nodes is aggregated in a server or in the cloud.

River Floods Detection

River floods can cause extensive damage to the natural and human resources and human life. River floods occur due to continuous rainfall which cause the river levels to rise and flow rates to increase rapidly.

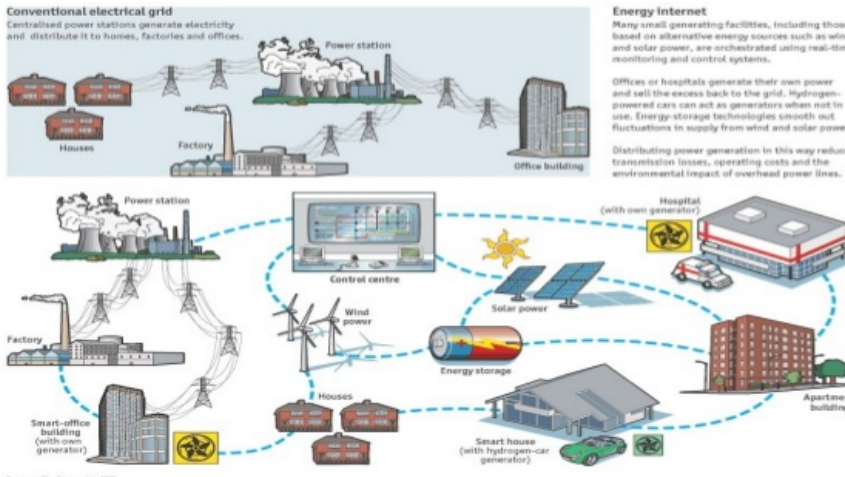
- Early warnings of floods can be given by monitoring the water level and flow rate.
- IoT based river flood monitoring system use a number of sensor nodes that monitor the water level (using ultrasonic sensors) and flow rate (using the flow velocity sensors).
- Data from a number of such sensor nodes is aggregated in a server or in the cloud.
- Monitoring applications raise alerts when rapid increase in water level and flow rate is detected.

River Floods Detection

River floods can cause extensive damage to the natural and human resources and human life. River floods occur due to continuous rainfall which cause the river levels to rise and flow rates to increase rapidly.

- Early warnings of floods can be given by monitoring the water level and flow rate.
- IoT based river flood monitoring system use a number of sensor nodes that monitor the water level (using ultrasonic sensors) and flow rate (using the flow velocity sensors).
- Data from a number of such sensor nodes is aggregated in a server or in the cloud.
- Monitoring applications raise alerts when rapid increase in water level and flow rate is detected.
- The system can includes a water level monitoring module, network video recorder module, and data processing module that provides flood information in the form of raw data, predicted data, and video feed.

Smart Energy Grid



Energy

Smart Grids

Smart Grid is a data communications network integrated with the electrical grid that collects and analyzes data captured in near-real-time about power transmission, distribution, and consumption.

Energy

Smart Grids

Smart Grid is a data communications network integrated with the electrical grid that collects and analyzes data captured in near-real-time about power transmission, distribution, and consumption.

- Smart Grid technology provides predictive information and recommendations to utilities, their suppliers, and their customers on how best to manage power.

Energy

Smart Grids

Smart Grid is a data communications network integrated with the electrical grid that collects and analyzes data captured in near-real-time about power transmission, distribution, and consumption.

- Smart Grid technology provides predictive information and recommendations to utilities, their suppliers, and their customers on how best to manage power.
- Smart Grids collect data regarding electricity generation (centralized or distributed), consumption (instantaneous or predictive), storage (or conversion of energy into other forms), distribution and equipment health data.

Energy

Smart Grids

Smart Grid is a data communications network integrated with the electrical grid that collects and analyzes data captured in near-real-time about power transmission, distribution, and consumption.

- Smart Grid technology provides predictive information and recommendations to utilities, their suppliers, and their customers on how best to manage power.
- Smart Grids collect data regarding electricity generation (centralized or distributed), consumption (instantaneous or predictive), storage (or conversion of energy into other forms), distribution and equipment health data.
- Smart grids use high-speed, fully integrated, two-way communication technologies for real-time information and power exchange.

Energy

Smart Grids

Smart Grid is a data communications network integrated with the electrical grid that collects and analyzes data captured in near-real-time about power transmission, distribution, and consumption.

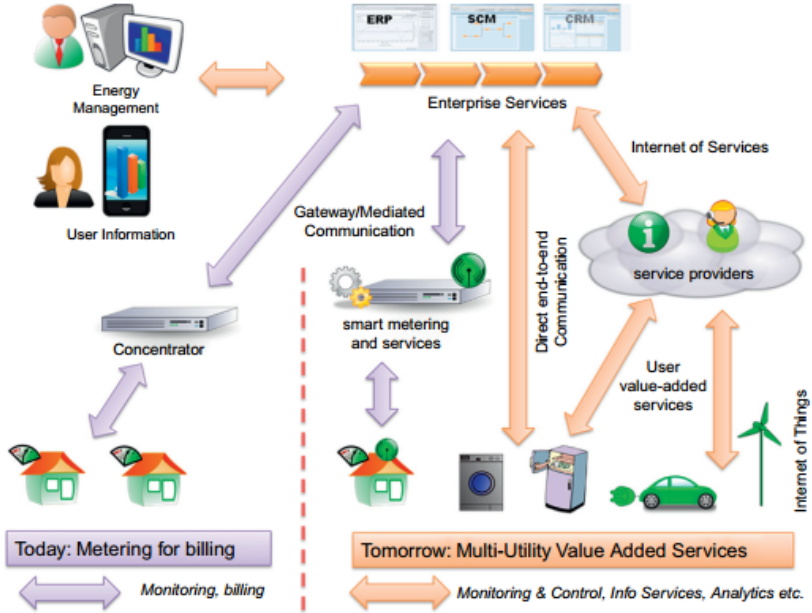
- Smart Grid technology provides predictive information and recommendations to utilities, their suppliers, and their customers on how best to manage power.
- Smart Grids collect data regarding electricity generation (centralized or distributed), consumption (instantaneous or predictive), storage (or conversion of energy into other forms), distribution and equipment health data.
- Smart grids use high-speed, fully integrated, two-way communication technologies for real-time information and power exchange.
- By analyzing the data on power generation, transmission and consumption smart girds can improve efficiency throughout the electric system.

- Cloud-based monitoring of smart grids data can improve energy usage levels via energy feedback to users coupled with real-time pricing information.

- Cloud-based monitoring of smart grids data can improve energy usage levels via energy feedback to users coupled with real-time pricing information.
- Real-time demand response and management strategies can be used for lowering peak demand and overall load via appliance control and energy storage mechanisms.

- Cloud-based monitoring of smart grids data can improve energy usage levels via energy feedback to users coupled with real-time pricing information.
- Real-time demand response and management strategies can be used for lowering peak demand and overall load via appliance control and energy storage mechanisms.
- Condition monitoring data collected from power generation and transmission systems can help in detecting faults and predicting outages.

Smart Meter


ERP
SCM
CRM
Energy Management
Enterprise Services
User Information
Internet of Services
Gateway/Mediated Communication
Direct end-to-end Communication
service providers
smart metering and services
Concentrator
User value-added services
Internet of Things
Today: Metering for billing
Monitoring, billing
Tomorrow: Multi-Utility Value Added Services
Monitoring & Control, Info Services, Analytics etc.

Renewable Energy Systems

- Due to the variability in the output from renewable energy sources (such as solar and wind), integrating them into the grid can cause grid stability and reliability problems. Variable output produces local voltage swings that can impact power quality.

Renewable Energy Systems

- Due to the variability in the output from renewable energy sources (such as solar and wind), integrating them into the grid can cause grid stability and reliability problems. Variable output produces local voltage swings that can impact power quality.
- Existing grids were designed to handle power flows from centralized generation sources to the loads through transmission and distribution lines. When distributed renewable energy sources are integrated into the grid, they create power bi-directional power flows for which the grids were not originally designed.

Renewable Energy Systems

- Due to the variability in the output from renewable energy sources (such as solar and wind), integrating them into the grid can cause grid stability and reliability problems. Variable output produces local voltage swings that can impact power quality.
- Existing grids were designed to handle power flows from centralized generation sources to the loads through transmission and distribution lines. When distributed renewable energy sources are integrated into the grid, they create power bi-directional power flows for which the grids were not originally designed.
- IoT based systems integrated with the transformers at the point of interconnection measure the electrical variables and how much power is fed into the grid.

Renewable Energy Systems

- Due to the variability in the output from renewable energy sources (such as solar and wind), integrating them into the grid can cause grid stability and reliability problems. Variable output produces local voltage swings that can impact power quality.
- Existing grids were designed to handle power flows from centralized generation sources to the loads through transmission and distribution lines. When distributed renewable energy sources are integrated into the grid, they create power bi-directional power flows for which the grids were not originally designed.
- IoT based systems integrated with the transformers at the point of interconnection measure the electrical variables and how much power is fed into the grid.
- To ensure the grid stability, one solution is to simply cut off the overproduction.

Renewable Energy Systems

- Due to the variability in the output from renewable energy sources (such as solar and wind), integrating them into the grid can cause grid stability and reliability problems. Variable output produces local voltage swings that can impact power quality.
- Existing grids were designed to handle power flows from centralized generation sources to the loads through transmission and distribution lines. When distributed renewable energy sources are integrated into the grid, they create power bi-directional power flows for which the grids were not originally designed.
- IoT based systems integrated with the transformers at the point of interconnection measure the electrical variables and how much power is fed into the grid.
- To ensure the grid stability, one solution is to simply cut off the overproduction.
- For wind energy systems, closed-loop controls can be used to regulate the voltage at point of interconnection which coordinate wind turbine outputs and provides reactive power support

Prognostics

Energy systems have a large number of critical components that must function correctly so that the systems can perform their operations correctly. These system must be monitored carefully as wear and tear in such critical components or sudden change in operating conditions of the machines can result in failures.

Prognostics

Energy systems have a large number of critical components that must function correctly so that the systems can perform their operations correctly. These system must be monitored carefully as wear and tear in such critical components or sudden change in operating conditions of the machines can result in failures.

- In systems such as power grids, real-time information is collected using specialized electrical sensors called Phasor Measurement Units (PMU) at the substations. The information received from PMUs must be monitored in real-time for estimating the state of the system and for predicting failures.

Prognostics

Energy systems have a large number of critical components that must function correctly so that the systems can perform their operations correctly. These system must be monitored carefully as wear and tear in such critical components or sudden change in operating conditions of the machines can result in failures.

- In systems such as power grids, real-time information is collected using specialized electrical sensors called Phasor Measurement Units (PMU) at the substations. The information received from PMUs must be monitored in real-time for estimating the state of the system and for predicting failures.
- Energy systems have thousands of sensors that gather real-time maintenance data continuously for condition monitoring and failure prediction purposes.

Prognostics

Energy systems have a large number of critical components that must function correctly so that the systems can perform their operations correctly. These system must be monitored carefully as wear and tear in such critical components or sudden change in operating conditions of the machines can result in failures.

- In systems such as power grids, real-time information is collected using specialized electrical sensors called Phasor Measurement Units (PMU) at the substations. The information received from PMUs must be monitored in real-time for estimating the state of the system and for predicting failures.
- Energy systems have thousands of sensors that gather real-time maintenance data continuously for condition monitoring and failure prediction purposes.
- IoT based prognostic real-time health management systems can predict performance of machines or energy systems by analyzing the extent of deviation of a system from its normal operating profiles.

Prognostics

Energy systems have a large number of critical components that must function correctly so that the systems can perform their operations correctly. These system must be monitored carefully as wear and tear in such critical components or sudden change in operating conditions of the machines can result in failures.

- In systems such as power grids, real-time information is collected using specialized electrical sensors called Phasor Measurement Units (PMU) at the substations. The information received from PMUs must be monitored in real-time for estimating the state of the system and for predicting failures.
- Energy systems have thousands of sensors that gather real-time maintenance data continuously for condition monitoring and failure prediction purposes.
- IoT based prognostic real-time health management systems can predict performance of machines or energy systems by analyzing the extent of deviation of a system from its normal operating profiles.
- Analyzing massive amounts of maintenance data collected from sensors in energy systems and equipment can provide predictions for the impending failures (potentially in real-time) so that their reliability and availability can be improved. Prognostic health management systems have been developed for different energy systems.