Applications of IOT

Mrs.D.K.Magdum

Home Automation

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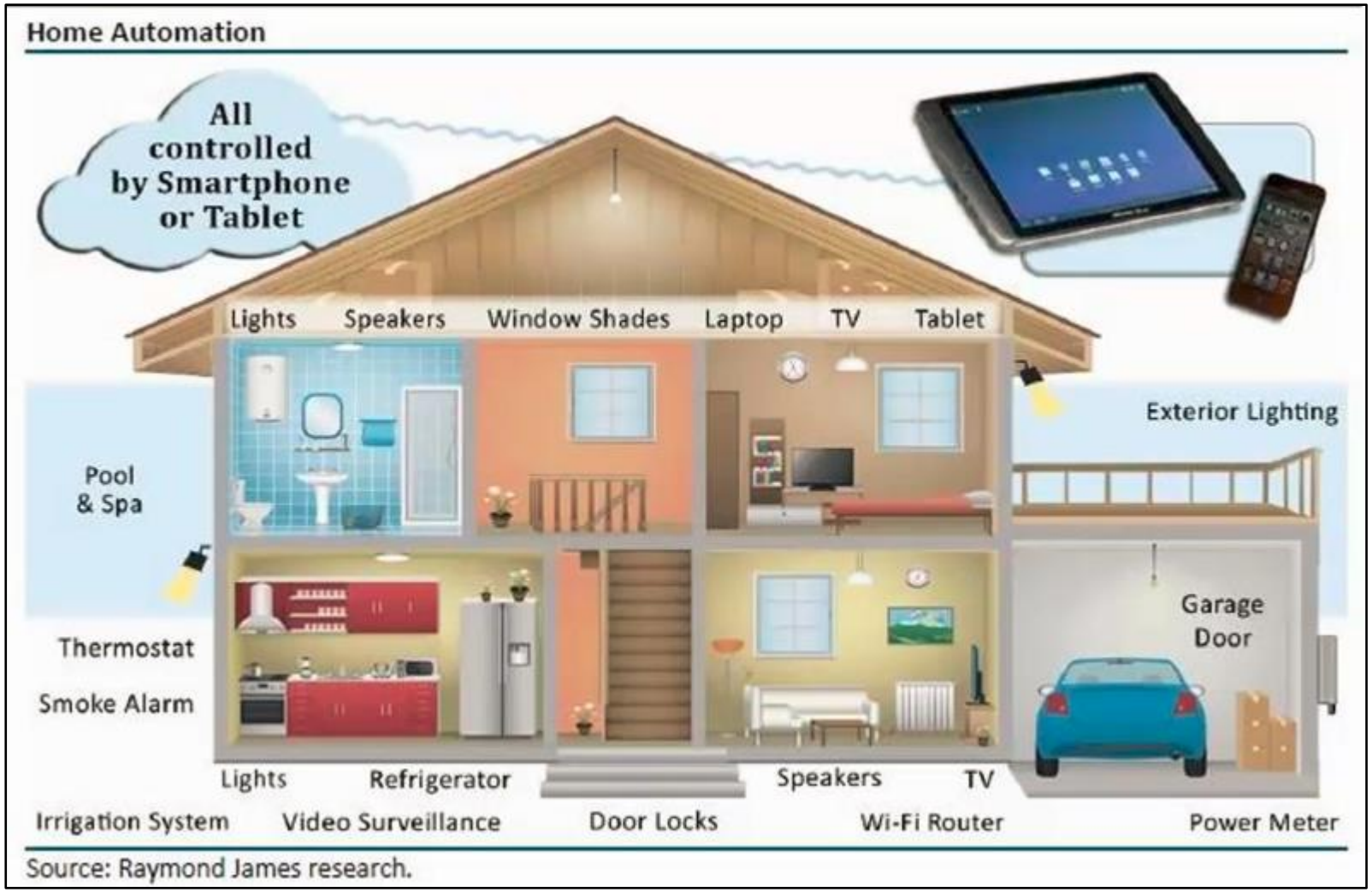


Smart Appliances

- Smart appliances make the management easier and also provide status information to the users remotely.
- Eg: Smart washer/ dryers can be controlled and notified when the washing/drying cycle is complete.
  - **Smart washers and dryers** are different from merely digital appliances. They can send notifications to your phone when a cycle finishes, download new wash and dry cycles, diagnose problems, and adjust settings with the control of a smartphone or voice command
- Smart thermostats allow controlling the temperature remotely.
  - A **thermostat** is a component which senses the temperature of a physical system and performs actions so that the system's temperature is maintained near a desired setpoint.
  - A **smart thermostat**, also known as a connected or communicating **thermostat**, allows you to create automatic and programmable temperature settings based on daily schedules, weather conditions, and heating and cooling needs.

Smart Thermostat

Smart Washer and dryer

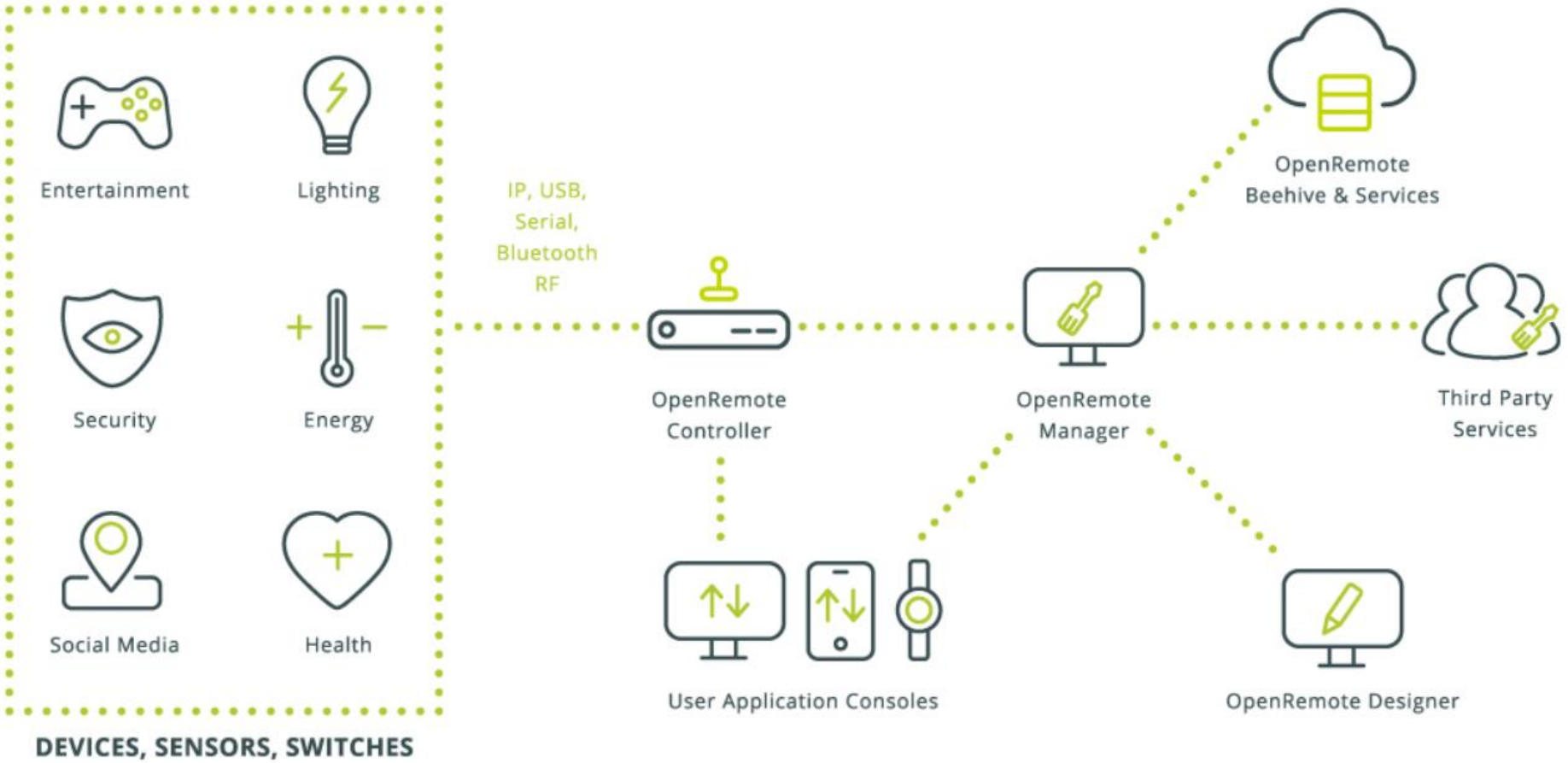
Smart TV

Smart Appliances (cont)

- 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 Refrigerator.pptx
- Smart TV 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 contents from the internet.
- Open Remote is an open-source automation platform for homes and buildings, that works with standard hardware.

OpenRemote

SYSTEM ARCHITECTURE



OpenRemote(cont)

- With an open remote, users can control various appliances using mobile or web applications.
- Open Remote comprises three components
  - A controller that manages scheduling and runtime integration between the devices
  - A designer that allows you to create both configurations for the controller and create user interface designs
  - Control panels allow you to interact with devices and control them
- An IOT based appliance control system for smart homes uses a smart central controller to set up a wireless sensor and actuator network and control modules for appliances

continued

Smart city

- Whether it is crowd control, public safety, or adaptive lighting, OpenRemote can assist in monitoring and integrating different systems in public spaces and enhancing citizen participation. Giving experts, area managers and visitors insight and control over their environment.

Buildings

- Managing and integrating your building systems, from climate control and power management to lighting and security into one system, adding individual user control, as well as tailored dashboards for facility management and maintenance. Open Remote offers the flexibility to do all of that with one solution.

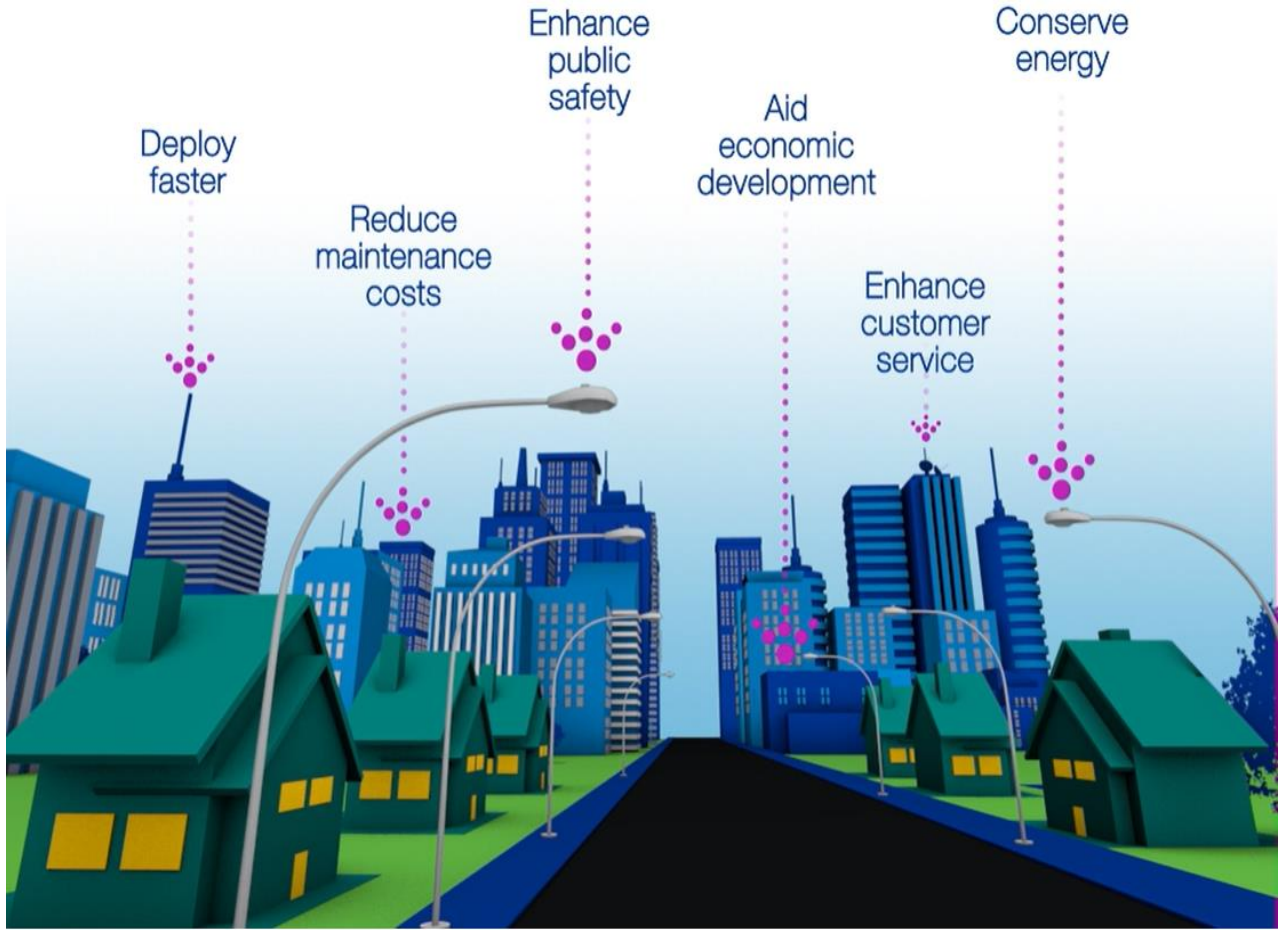
continued

Home Automation

- Manage your scenes comfortably in your living room, combine lighting ambiance and climate. Set the scene with the press of a single button. Open Remote enables you to connect virtually all types of devices within your network and create an intuitive universal remote on your tablet or smartphone. Or do without a UI and automate everything using Rules.

Health Care

- To assist people at home or support rehabilitation, OpenRemote offers control of your space even with just a blink of your eyes. Rules and messaging make independent living a reality. The solution can grow over time as the requirements change.


Deploy faster
Reduce maintenance costs
Enhance public safety
Aid economic development
Enhance customer service
Conserve energy

Smart Lighting

- Smart lighting for homes helps in saving energy by adapting the lighting to the ambient conditions and switching on/off or dimming lights when needed.
  - The system includes auto and manual modes. In auto mode, the system measures the light in a room and switches on the lights when it gets dark.
  - In manual mode, the system provides the option of manually and remotely switching on/off the light
- Key enabling technologies for smart lighting include solid-state lighting(LED lights) and IP-enabled lights.
- Smart lighting solutions for homes achieve energy savings by sensing the human movement and their environments and controlling the lights accordingly.
- Wireless enabled and internet-connected lights can be controlled remotely from IoT applications such as mobile or web applications.
- Smart lights with sensors for occupancy, temperature, and lux level can be configured to adapt the lighting(by changing the light intensity and color) based on ambient conditions sensed.

Smoke/ Gas Detector

- Smoke detectors are installed in homes and buildings to select smoke as an early sign of fire.
- Alerts raised by smoke detectors can be in the form of signals to a fire alarm system.
- Gas detector 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 and send or SMS or email to the user or the local fire safety department ad provide visual feedback on its status(healthy, battery low, etc.)

Intrusion Detection

- Intrusion: Any set of actions that attempt to compromise the confidentiality, integrity or availability of a computer resource.
- Intrusion detection is the process of identifying and responding to malicious activity targeted at resources.
- Intrusion detection System is a system designed to test /analyze network system traffic/events against a given set of parameters and alert/ capture data when these threshold are met.
- IDS uses collected information and predefined knowledge based system to reason about the possibility of an intrusion.
- Home Intrusion detection systems use security cameras and sensors(PIR sensor, door sensors) to detect Intrusions and raise alerts.
- Alerts can be in the form of an SMS or email to the user. Advanced system can also send detailed alerts such s image grab or short video clip sent as an email attachment.

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- A cloud controlled intrusion detection system uses location aware services, 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.
- Basically there are 3 components in IDS- senor, console and class
- Sensor: responsible for capturing packets and sending to the console class.
- Console: Responsible for analyzing packets captured by sensor class.
- It is the class responsible for displaying GUI and generating alerts

Home Automation Sensors

- Temperature sensors - DHT11/22, DS18B20, LM35, and MSP430 series from TI
- Lux sensors - measure the luminosity and can be used to trigger various functions ranging from cross-validating movements to turn the lights on if it becomes too dark.
- Water level sensors- HC-SR04 ultrasonic sensor and Float level sensors
- Air composition sensors - CO monitoring by MiCS-5525, MQ-8 to measure Hydrogen gas levels, MiCS-2714 to measure nitrogen oxide, MQ135 to sense hazardous gas levels
- Video cameras for surveillance - webcams and cameras
- Voice/Sound sensors
- Pressure sensors
- Humidity sensors
- Accelerometers
- Infrared sensors
- Vibrations sensors
- Ultrasonic sensors

Home Automation Protocols

- Bluetooth low energy or Bluetooth Smart: Wireless protocol with mesh capabilities, security, data encryption algorithms, and much more. Ideal for IoT-based products for smart homes.
- Zigbee: Low cost, mesh networked, and low power radio frequency-based protocol for IoT. Different Zigbee versions don’t talk to each other.
- Z-wave: Specializes in home automation with an emphasis on security
- Wifi
- 6lowpan
- UPB: Uses existing power lines installed in a home, reduces costs
- Thread: A royalty-free protocol for smart home automation, uses a 6lowpan
- ANT: An ultra-low-power protocol helping developers build low-powered sensors with mesh distribution capabilities.

Smart Cities

Smart Parking

- Smart parking makes the search for parking space easier and more convenient for drivers.
- Smart parking is 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 drivers from their smartphones, 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 of the server.
- Each parking slot has an ultrasonic sensor fixed above, which can detect the presence of a vehicle in the slot.
- Each sensor is read at regular intervals and the state of the parking slot(empty or occupied) is updated in the database.

Smart Lighting

Smart Light

- Light quality
- Monitors internal operating conditions and responds autonomously to fault conditions.
- Peer to peer communications capability to receive commands and sensor inputs, responding autonomously and transmitting status and event information.
- Able to be programmed to modify the response to sensor inputs.

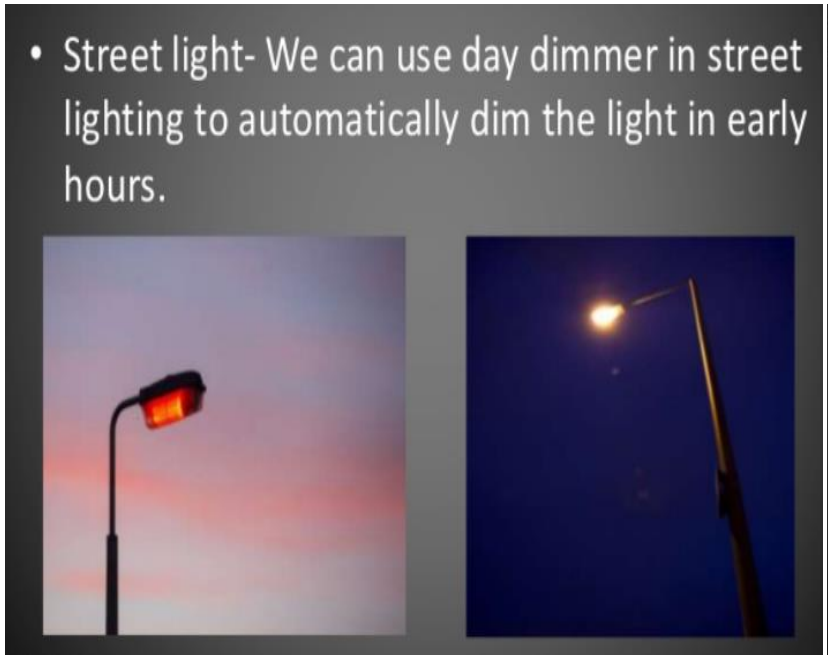
Smart lighting

A combination of smart lights and the software programs together is used to set up and configure an installation to behave as we want when an event occurs.

- Smart lighting systems for roads, parks, and buildings can help in saving energy.
- Smart lighting allows lighting to be dynamically controlled and also adaptive to ambient conditions.

continued

- 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 congestion, and accidents.
- The information sensed from the roads can be communicated via the internet through cloud-based applications and social media and informed to 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 so that they can react to potential dangers early enough.
- Smart Roads -smart roads.pdf

Structural Health Monitoring

- Structural Health Monitoring systems use 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.
- Since Structural Health Monitoring systems use large number of wireless sensor nodes which are powered by traditional batteries, so exploration of energy harvesting technologies to harvest ambient energy such as mechanical vibrations, sunlight and wind is in progress.

Emergency Response

- IOT 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 effect on the critical infrastructure.
- Used 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, evacuation of the affected areas.

Real-time applications of IOT

- Agriculture and Pest Control
- Environment
- Smart Home Applications
- Health Care
- Smart Cities
- Safe Driving
- Waste Management
- Tackling Industrial Issues

Continued

Supply Chain

- If you are using Amazon or Swiggy, you might be aware of the tracking system they use to track the delivery of your goods.
- Supply chains have been using IoT applications for quite some time. It has helped suppliers track goods in transit as well as get immediate customer feedback with the help of a rating system.
- IoT systems can also help the supplier or drivers to preserve the goods better during transit by communicating information about the temperature and pressure that the item is being preserved in.
- Hence, IoT can optimize workflow by improving supply chain transit.

Tackling Industrial Issues

- In the manufacturing department, IoT can be used in asset management and inventory management.
- Implanting IoT in the manufacturing sector can help in tracking the efficiency of the systems being used, detect any errors in the machinery, detect causes of lack of efficiency, etc.
- IoT in the industry can help in tackling unplanned downtime too.

Continued

Waste Management

- IoT applications can notify truck drivers about filled dustbins and set a route for them so that they do not have to waste time by exploring locations with empty dustbins.
- IoT devices can also help in developing Smart bins, that is, trash bins that can segregate waste into categories like plastic, metal, glass, or paper

Safe Driving

- A recent area where IoT is being used is in the construction of driverless cars. These cars use advanced sensors and gyroscopes, all of which are connected to cloud platforms and the internet.
- Using this platform, the driverless car is able to data from a variety of sources which tells them about the traffic conditions as well as potholes, sharp turns, speed breakers, and other useful information required for driving.
- Driverless cars can be a perfect addition to a Smart City to ensure smooth traffic conditions.

IOT in healthcare

- IOT in healthcare is heterogeneous computing, wirelessly communicating system of apps and devices that connects patients and health providers to diagnose, monitor, track and store vital statistics and medical information.
- Few examples of IoT in healthcare
- Headsets that measure brainwaves
- Clothes with sensing devices
- BP monitor and Glucose monitors
- Sensors embedded in medical equipment, dispensing systems, surgical robots, and device implants
- Wearables IOT devices that allow non-invasive and continuous monitoring of physiological parameters can help in health and fitness monitoring.
- Wearables devices – belts and wrist bands.

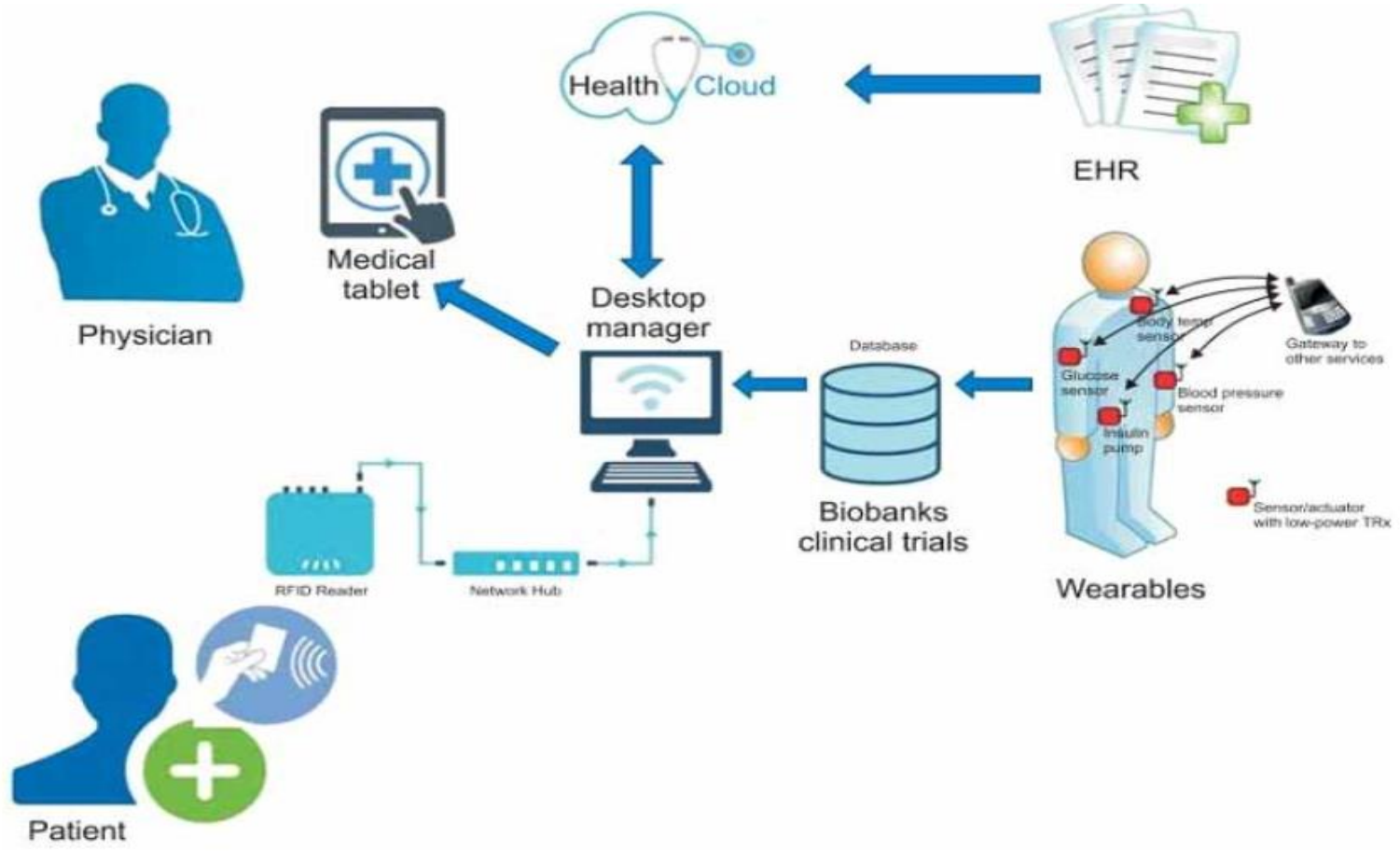
Health and fitness Monitoring

- The Wearables devices form a type of WSNs called body area networks in which the measurements from a number of Wearables devices are continuously sent to the master node(smartphone) which then sends the data to the server or a cloud-based back end for analysis.

IoT in healthcare helps in:

- Reducing emergency room wait time
- Tracking patients, staff, and inventory
- Enhancing drug management
- Ensuring availability of critical hardware

Application of IOT in healthcare



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- In the figure, we find an RFID card assigned to a patient, wearable technology, and Electronic Health Records (EHR) provide data collected and stored on database management systems and then transferred to a physician through a desktop manager on their device. They can use this data for multiple purposes, from research to creating treatment approaches.

Reference for IoT in healthcare

- https://www.finoit.com/blog/the-role-of-iot-in-healthcare-space/
- https://aglowiditsolutions.com/blog/iot-in-healthcare/

Thank You